TEACHING METHODS FOR SHARING THE CREATION OF ELECTROACOUSTIC MUSIC WITH INEXPERIENCED PEOPLE

Miki Matsumoto[1], Takumi Mashita, Soma Arai[1],
Hidefumi Ohmura[2], Hiroyuki Yaguchi[1] and Takuro Shibayama[1,3]
[1]Tokyo Denki University
Ishizaka, Hatoyama, Hiki, Saitama 350-0394, Japan
[2]Tokyo University of Science
2641 Yamazaki, Noda, Chiba 278-0022, Japan
[3]Tokyo Collage of Music
1-9-1 Kamimeguro, Meguro, Tokyo 153-0051, Japan

ABSTRACT

Our lab holds a workshop using computers to create electroacoustic music (EAM) for a variety of inexperienced people. Since EAM is positioned as an extension of contemporary music, which has a large philosophical component, it has not gained as many creators and listeners as popular music. The reason for this may be that, compared to music meant for entertainment, both the structure in music theory and the concepts in expressive practice create the impression among many people that EAM is difficult to understand. However, we observed that numerous people enjoy creating EAM in workshops. This may be because EAM is created not by following the rules of ordinary music theory, but by producing a montage of sound materials formed from fragments of recorded sounds along a computer timeline, allowing the listener to hear a near-perfect acoustic representation in real time through intuitive manipulation. Through our creative method, we taught participants to capture their impressions of fragmented acoustic materials using metaphorical adjective pairs such as 'high–low' and 'hard–soft' and to maintain the intensity of the contrast between them. This study is based on an analysis of the works created in university courses that share the same teaching techniques as our workshops. The analytical procedure of the present study was as follows: (1) We selected an 'excellent' completed piece of music. (2) We individually extracted the acoustic materials that made up the piece. (3) We used pairwise comparison to examine the participants' impressions of all acoustic materials used in the given piece. (4) We carried out an analysis to determine whether the original piece maintained a high degree of contrast in the impression of the acoustic materials, thereby validating our instructional technique, which we empirically derived from past workshops.

KEYWORDS

Computer Music, Electroacoustic Music, Educational Method, Pedagogy

1. INTRODUCTION

'Contemporary music' originates in the breakdown of tonality that emerged from the end of the 19th century to the beginning of the 20th century, the subsequent practice of creating atonal music in the early 1900s, and the creation of noise music by the Italian Futurists of the 1910s. Electroacoustic music (EAM) was first produced in France in the late 1940s; it is also known as *musique concrète*, established by Pierre Schaeffer (1910–1995) in France and as *Electronische Musik*, established by Herbert Eimert (1897–1972) and Karlheinz Stockhausen (1928–2007) in Germany. While 'electronic music' involves the use of generators to synthesise sounds and compose music, 'concrete music' is characterised by the fact that it is produced not by 'musical sounds' played on musical instruments but by 'unpitched sounds' recorded on media (such as records and magnetic tapes) and their montage (Brindle, 1987). Nowadays, with the development of digital sound processing technology and the low cost of computers, the boundary between 'concrete music' and 'electronic music' has become blurred, and music created with both technologies is collectively called 'electroacoustic music' or EAM. Currently, EAM continues to be spread through education and culture in specialised institutions and in universities with information and arts departments.

2. THE POSSIBILITY OF EAM BEING ENJOYED BY EVERYONE

2.1 The Possibilities Offered by the Experience of Creating EAM

EAM, like other contemporary music, seems 'esoteric' to most people; for this reason, it has not gained many listeners or creators. Ordinary music may consist of a totality of acts, such as singing or dancing to a beat, either in a 'chorus' or an 'ensemble'. Such musical acts can be viewed auspiciously as a kind of 'musicking' that encompasses the totality of the act (Small, 1998). The creative workshops that we conduct involve producing 'concrete music' as part of EAM. In other words, the music generated in the workshops does not have the rhythm, melody, or harmony of normal music. This creative approach is based on (1) the use of objects in daily life that are not musical instruments brought in by the participants; (2) recording sounds by hitting or rubbing the objects together or against other objects; (3) creating acoustic materials by further fragmenting and processing the recorded sounds; and (4) composing a montage of the acoustic materials (Shibayama et al, 2021). Another reason why EAM has not attracted many listeners and creators is that it is positioned as an extension of contemporary music, which many people often perceive as difficult. Contemporary music belongs to the latter category in the division between entertainment and philosophical music, which began in the early 1900s and was closely linked to Adorno's later emphasis on contemporary music as avant-garde to cultivate a critical spirit toward the consumerist society that emerged with the rise of popular music (Adorno, 1962).

Shibayama reported his experience from practice that EAM tends to seem 'difficult' to many people, while its creation can be enjoyable for many inexperienced individuals (Shibayama et al 2018, 2020). Thus, we considered it necessary to understand the structure of EAM from the perspective of cognitive science, and we explicitly addressed the validity of our creative teaching method. We believe this clarification will help to expand the realm of the mind such that more people can enjoy EAM.

2.2 Understanding the Structure of EAM

To achieve the abovementioned aims, we must first understand the structure of EAM from the standpoint of cognitive science. Concrete music is characterised by the fact that it is composed of a montage of non-musical recorded acoustic material, so it is considered difficult to position its creation as an extension of traditional compositional techniques. Non-musical recorded sound is 'unpitched'; this is distinguished in music theory from 'musical sound', which has musical elements (such as pitch) played by usical instruments. In ordinary music, the structure of transitive articulations is based on music theory, consisting of 'musical tones', whereas in 'concrete music', the acoustic material does not have a clear pitch in the first place, so the structure cannot be analysed according to conventional music theory. Schaeffer (1966) compiled this theoretical system of concrete music into a systematic theory in 1966. However, his creative theory is limited to the morphological classification of acoustic materials and conceptualization based on Saussure's linguistics, and is not based on the acquisition of quantitative data during listening by the listeners.

Roy (2004) detailed methods and examples of analysis of EAM by Nattiez, TenHoopen, and Delalande, among others. Nevertheless, their analyses are rooted in the work of each established composer and his/her respective discourse; hence, their analyses cannot be considered studies for purposes such as how the broader public perceives a given work. On the other hand, the tool designed by Couprie to visualize the structure of electroacoustic music is considered one of the most practical approaches at present (Couprie, 2016).

However, the application of these research on the composition of EAM through cognitive experimental testing remains unexplored.

2.3 Goals of this Study

We aimed to establish a practical theory for sharing the creation of EAM—which many people perceive as difficult—with multiple individuals. The basis for this is the three possibilities offered by the creation of EAM for educational purposes:

(a) EAM is fundamentally different from conventional musical composition rooted in music theory, allowing for repeated trial and error while listening to a creation directly on the spot.

(b) Since the goal of completion is not grounded in the concepts of right or wrong in relation to music theory norms, everyone has a chance to experience the creation involved, regardless of lever of expertise.

(c) The creator can experience the process of discovering and solving his/her own problems.

We aimed to (1) share the process of feeling joy in creating music, which is difficult for many people to achieve; (2) explicitly address the reasons for the 'fun' felt by the participants using quantitative data; (3) to establish these data as an educational model; and (4) to propose and share the model's usefulness with society. In other words, we identified factors that transform 'previously unenjoyable experiences' into 'enjoyable experiences' for numerous inexperienced people and we propose expanding the notion of enjoyment. Shibayama (2018) proposed the process as the Figure 1, which refers a state that only A can be accepted as enjoyable music, on the other hands, the centre refers a state that A and B are able to be accepted as enjoyable music with the expansion of the mind. Creative attitude directs the right end that exploring the out of A, B and C as an universal realm of human mind. Such a mental orientations can explore D, E and F that are not shown in the figure. As a small step toward fulfilling this purpose, we analysed music composed by inexperienced individuals and verified whether our creative instruction was appropriate.

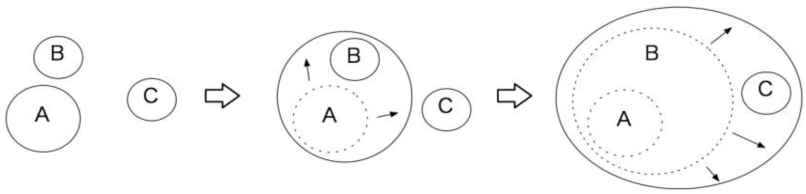

Figure 1. Expansion of the mental realm and enjoyable music (Shibayama, 2018)

3. VERIFICATION OF THE HYPOTHESIS

We attempted to determine the validity of ours and others' workshops, as well as university methods for teaching creative music composition. The instructions consisted of the following steps: (a) attaching figurative language labels to fragments of acoustic material; (b) maintaining a high contrast in the figurative language labels; and (c) completing the resulting work in such a way that movement could be felt. We hypothesised that 'from the works completed as a result of creative instruction, a high degree of contrast in metaphorical language labels may be maintained in the arrangement over time of fragments of acoustic material used in pieces that were rated as "moving" by the instructors' and verified the hypothesis.

3.1 Methods of Teaching Composition Practice as a Prerequisite for the Hypothesis

To verify the hypothesis, we decided to test its validity in teaching sound design in 'Introduction to Formative Design', a course for first-year students enrolled in the Department of Information Systems Design at the Faculty of Science and Engineering at Tokyo Denki University in Japan. We targeted the completed works of this class for analysis because (1) it was difficult to hold the workshop due to COVID-19; and (2) this class was designed in accordance with the teaching methods used in previous workshops, so it was appropriate as a target for analysis.

The flow of the practice was as follows:

(a) the distribution of sound materials for use in creation;

(b) instruction on montage techniques using Digital Audio Workstation (DAW) software;
(c) instruction in sound editing in DAW software;
(d) montage instruction based on linguistic figurative impressions of, and contrasts with, the acoustic material used.

In class, the teacher demonstrated the operation to the learners, and they were given one week to complete a 10-second piece of music as homework. In the off-campus workshop, we started by recording the sound materials to be used, but in ‘Introduction to Formative Design’, because the time for creation was limited, we distributed seven pre-prepared sound materials, which all students used to create their own music. As a creative point to keep in mind regarding the above (b), the sound material could not be used as it was. Instead, very short fragments of .1 to .5 seconds had to be cut from the given sound materials, and these fragments had to be woven into a montage. The reason for this was that the given acoustic materials lasted from one second to a few seconds; therefore, if the original acoustic materials had been montaged as they were, there was a chance that musical ‘movement’ might not be fully created. In addition, d) in this flow is the pillar of this study, the teaching method that encourages participants to be aware of the metaphorical impressions of the fragmented acoustic materials. As a result, they imagined their impressions of each acoustic material by relying on the five figurative attributes of *height*, *length*, *hardness*, *coldness*, and *smoothness*, and they were told to create a montage by considering the contrasts of their impressions.

3.2 Selection of the Target Piece and Analysis of the Acoustic Sound Fragments

Among the pieces produced by the students during the training, we selected one piece that we deeply evaluated and dismantled for each of the acoustic fragments that made up the piece. We based our selection on the effectiveness of the teaching method, i.e. the aurally evident characteristics of the piece exhibiting movement. Because the piece consisted of seven sounds and one reverse-playback processed sound (a total of eight sound fragments), we labelled these eight fragments of acoustic material as A–H according to their temporal order of appearance. F is the acoustic material played backwards from E. We obtained the results (see Table 1) by counting the acoustic materials used in the music.

Figure 2. Results of the analysis of sound fragments composing a piece of music

Table 1. Acoustic materials, labelled A–H, that appear in the music and the number of times they appear

Sound fragments	A	B	C	D	E	F	G	H
Number of appearances	8	6	2	2	4	4	3	2

3.3 Preparing the Experiment to Capture Participants’ Impressions

To examine the participants’ impressions of the sound fragments, we conducted our preliminary experiment in June 2021; we administered a questionnaire using the semantic differential (SD) method on a 5-point scale and obtained online responses from the participants.

To perform the experiment, we needed to quantify the participants' relative impressions of the sound fragments; hence, we decided to use pairwise comparison to scrutinise all sound fragments that made up the analysed piece. The next issue was that the number of items on the questionnaire would increase, and the response time would increase if all eight acoustic materials were compared. A longer response time heightened the possibility of causing participants to lose their focus. Consequently, there was concern that it would be difficult to ensure the accuracy of the results. To solve this problem, we decided to investigate the participants' impressions in the following way:

(a) We constructed mixed groups of α, β, and γ with all participants, carefully ensuring that the number of students in each group was equal.

(b) We created a reduced set of fragments of the target acoustic materials for each group.

(c) In order to align the relative impressions between all sets of fragments, each set contained identical fragments for reference.

(d) We equalised the number of questionnaire items for each group.

As we used pairwise comparison to capture the participants' relative impressions, we determined that the overall findings could be obtained by adding the results procured for each group. By dividing the set of participants and the set of fragments to be auditioned into several groups, we considerably reduced the time required for each participant to answer the items. Because our preliminary experiment confirmed the methodology, we decided to conduct the main experiment with a larger number of participants.

Table 2. Groups of participants and sound material fragments

Groups for the questionnaire	Sets of sound material fragments
α	A, B, C, F
β	C, D, E, F
γ	E, F, G, H

3.4 Participants

In December 2021, we conducted an experiment to capture 30 participants' impressions using a one-pair comparison method. We recruited the participants in two ways. First, we selected participants from among students who had taken the music composition class. We selected eight participants based on the condition that their reports on music composition practice contain many words and excellent content. Second, we chose 22 participants by recruiting students who had no experience in music composition practice; these students were studying at the Tokyo University of Science and had not had the opportunity to create EAM or to listen to it on a regular basis. We recruited all participants and explained the study's content via e-mail.

3.5 Items of the Questionnaire

We created the questionnaire using Google Forms and used the audition materials for pairwise comparison with the Google Drive sharing function. The questionnaire consisted of Section 1, which contained items about gender, age, occupation, musical genres, and musical experiences, and Section 2, which entailed participants' impressions of the audition materials (obtained via pairwise comparison) to identify the attributes. We set up the impressions of sound fragments along five axes consisting of items about *length*, *height*, *hardness*, *coldness*, and *smoothness* based on the adjectives used in the practice. The questionnaire asked, For instance, when the questionnaire asked about the impression of length 'Which of the two acoustic materials seems longer?' By the same way, we replaced *length* with *height*, *hardness*, *coolness*, and *smoothness*, respectively.

3.6 Grouping of Participants and the Question Sets

In order to evaluate the participants' impressions through pairwise comparison, we divided the eight acoustic materials, labelled A–H, into three groups of four tones each, and we classified each group as α, β, and γ (see Table 2). We included common acoustic materials in each group. The common sounds were used as a basis for merging the results of the questionnaire for α, β, and γ. To eliminate variations in response conditions among the groups, we prepared several versions of the questionnaire with the same number of sounds in the set of acoustic materials, and we shuffled the order of the items on each questionnaire. We also did this to remove the influence of the order in which the participants listened to the acoustic materials on their impressions of the sounds. To shuffle the items on the questionnaire for this purpose, a uniform random number was generated by computer and we manually rearranged the order of the items based on the output of the numbers. We did this because Google Forms does not have such a function, although it would be ideal for the items to be shuffled at the time of submission.

4. RESULTS

4.1 Results: Capturing Participants' Impressions Through Pairwise Comparison

We asked a total of 30 participants divided into three groups (α, β, and γ) to compare their impressions of *length*, *low*, *hardness*, *coldness*, and *smoothness* of the four sound fragments assigned to each group in a round-robin fashion. After evaluating the impressions for each group, we integrated the results for the three groups to obtain the outcomes (see Figure 5).

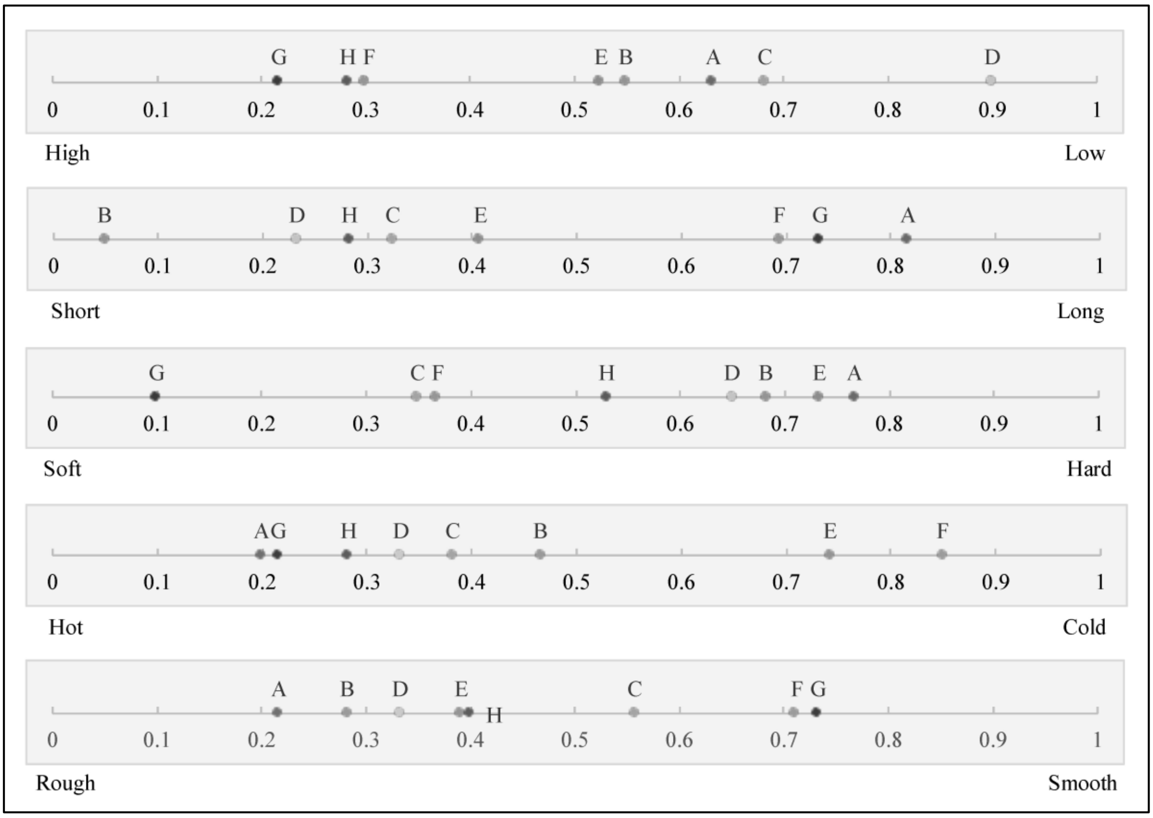

Figure 3. Results of the participants' overall impressions

4.2 Re-analysis of the Piece Based on Data Obtained from Pairwise Comparison

We plotted the acoustic materials in the range of 0 and 1 in each index of *length*, *height*, *hardness*, *coldness*, and *smoothness*; it is possible to clearly show the relative relationships among all acoustic materials in each index. Based on these relationships, we analysed the original musical pieces by examining the amount of contrast in each index in chronological order of the acoustic materials of the original musical piece (see Figure 3). We obtained the data presented in Figure 4 by administering the questionnaire with the original music. The differences in impressions from the immediately preceding sounds are outlined in figures 5 and 6. In previous classes, we taught students that it is possible to compose musical movements by maintaining a high contrast in figurative images. When we applied the data to the temporal arrangement of the acoustic materials of the original piece, we found that the original piece had a high contrast in adjective pairs. Our results demonstrate the validity of this approach.

	A	B	C	B	A	D	B	B	A	C	D	E	F	A	A	B	G	H	A	G	E	F	A	B	E	F	A	G	E	F	H
High - Low	0.63	0.55	0.68	0.55	0.63	0.9	0.55	0.55	0.63	0.68	0.9	0.53	0.3	0.63	0.63	0.55	0.22	0.28	0.63	0.22	0.53	0.3	0.63	0.55	0.53	0.3	0.63	0.22	0.53	0.3	0.28
Short - Long	0.82	0.05	0.33	0.05	0.82	0.23	0.05	0.05	0.82	0.33	0.23	0.41	0.69	0.82	0.82	0.05	0.73	0.28	0.82	0.73	0.41	0.69	0.82	0.05	0.41	0.69	0.82	0.73	0.41	0.69	0.28
Soft - Hard	0.77	0.68	0.35	0.68	0.77	0.65	0.68	0.68	0.77	0.35	0.65	0.73	0.37	0.77	0.77	0.68	0.1	0.53	0.77	0.1	0.73	0.37	0.77	0.68	0.73	0.37	0.77	0.1	0.73	0.37	0.53
Hot - Cold	0.2	0.47	0.38	0.47	0.2	0.33	0.47	0.47	0.2	0.38	0.33	0.74	0.85	0.2	0.2	0.47	0.22	0.28	0.2	0.22	0.74	0.85	0.2	0.47	0.74	0.85	0.2	0.22	0.74	0.85	0.28
Roug - Smooth	0.22	0.28	0.56	0.28	0.22	0.33	0.28	0.28	0.22	0.56	0.33	0.39	0.71	0.22	0.22	0.28	0.73	0.4	0.22	0.73	0.39	0.71	0.22	0.28	0.39	0.71	0.22	0.73	0.39	0.71	0.4

Figure 4. Data obtained by applying the survey results to the original piece

	A	B	C	B	A	D	B	B	A	C	D	E	F	A	A	B	G	H	A	G	E	F	A	B	E	F	A	G	E	F	H
High - Low	—	0.08	0.13	0.13	0.08	0.27	0.35	0	0.08	0.05	0.22	0.38	0.23	0.33	0	0.08	0.33	0.07	0.35	0.42	0.31	0.23	0.33	0.08	0.03	0.23	0.33	0.42	0.31	0.23	0.02
Short - Long	—	0.77	0.28	0.28	0.77	0.58	0.18	0	0.77	0.49	0.09	0.18	0.29	0.12	0	0.77	0.68	0.45	0.53	0.08	0.33	0.29	0.12	0.77	0.36	0.29	0.12	0.08	0.33	0.29	0.41
Soft - Hard	—	0.08	0.33	0.33	0.08	0.12	0.03	0	0.08	0.42	0.3	0.08	0.37	0.4	0	0.08	0.58	0.43	0.24	0.67	0.63	0.37	0.4	0.08	0.05	0.37	0.4	0.67	0.63	0.37	0.16
Hot - Cold	—	0.27	0.08	0.08	0.27	0.13	0.13	0	0.27	0.18	0.05	0.41	0.11	0.65	0	0.27	0.25	0.07	0.08	0.02	0.53	0.11	0.65	0.27	0.28	0.11	0.65	0.02	0.53	0.11	0.57
Roug - Smooth	—	0.07	0.28	0.28	0.07	0.12	0.05	0	0.07	0.34	0.23	0.06	0.32	0.49	0	0.07	0.45	0.33	0.18	0.52	0.34	0.32	0.49	0.07	0.11	0.32	0.49	0.52	0.34	0.32	0.31

Figure 5. Differences in impressions from the immediately preceding sounds

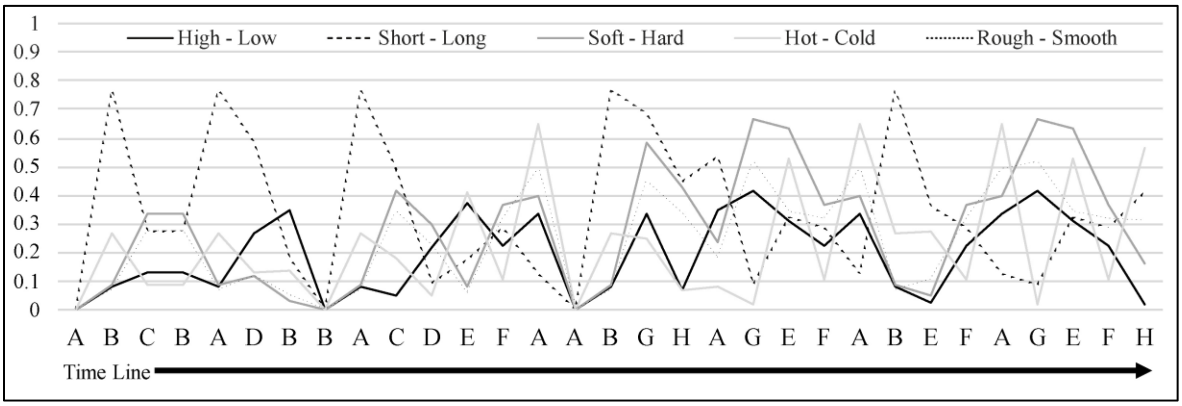

Figure 6. Differences in impressions from the immediately preceding sounds, visualized in a line graph

5. DISCUSSION

We selected the pieces chosen for this study if we graded them as ‘excellent’. We decomposed the pieces into fragments of the acoustic materials that comprised them. Through a pairwise comparison of the participants’ impressions of each fragment, we clarified the relative relationships among the five adjective pairs. We then plotted these relative distances for the original music, and we found contrasts by adjective pair. Consequently, we confirmed the validity of our creative teaching method.

In the future, if the axes of adjective pairs are made biaxial through principal component analysis, the relative relationships of individual acoustic materials could be plotted in 2D space, which could be applied to a model for the automatic generation of EAM. Moreover, we believe that the validity of our study could be further verified by conducting an experiment to evaluate impressions of music by automatically generating listening materials with adjusted contrasts based on our data. In addition, we did not deal with the temporal timing of the appearance of acoustic materials, and it would be possible to obtain more accurate data by adding the temporal distance of each material and its relationship with the silent part to the items to be verified.

We are currently attempting to elucidate the structure of EAM from the angle of cognitive science. One of our goals is to recapture Schaeffer’s perspective on the reception of sound from the standpoint of sound affordance theory. Schaeffer’s theory classifies sound reception into four categories: (1) *écouter* (to listen); (2)

ouïr (to perceive aurally); (3) *entendre* (to hear); and (4) *comprendre* (to understand). This theory emphasises 'reductive listening', which is a form of listening that focuses on 'what kind of sound it is' rather than grasping the acoustic material as a symbol and asking 'What is the sound emitted from'? This kind of listening corresponds to the classification of 'musical' and 'ordinary' listening in acoustic affordance theory (Gavor, 1993). These perspectives are also considered highly compatible with those proposed by Meyer (1954), Huron (2007), and Narmour (1991), who positioned music as a continuum of anticipation. This is because they regarded music as an anticipation of subsequent musical scenes. In EAM, where there is no clear theoretical structure, we consider treating fragments of acoustic materials that appear over time as a series of events to be an appropriate next step. We also believe that the pedagogical method of using figurative language labels for fragments of the acoustic materials addressed in this study could be further explored with the aid of Lakoff's theory of metaphor (1980).

6. CONCLUSION

We posited that there would be a high degree of contrast between figurative language labels in the arrangement of fragments of acoustic materials over time, used in pieces completed as a result of creative instruction, which we evaluated as having 'movement'. Our findings confirmed our hypothesis. The novelty of this study is that captures the primordial factors of why concrete music is perceived as "musical", whereas previous studies have mainly focused on the works of composers who have already established their social status and prestige. This approach is expected to provide an opportunity to share the 'creation' and 'listening' of concrete music—which are recommended by a very limited number of people—with a larger number of individuals.

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