

**The Concepts and Acoustical Characteristics of 'Groove' in
Japan**

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Abstract

The 'groove' sensation is an important concept in popular music; however, the number of quantitative studies exploring it is limited. This study aims to explore the concept of 'groove' sensation and the acoustical characteristics that prompt this sensation in Japan. We conducted two questionnaire surveys on the recognition of the 'groove' sensation and four experiments, which included listening experiments and analyses of performers' sound. The results suggest that the 'groove' sensation was associated with body movement, 'sense of unity', and *nori* (a Japanese word) and tempo and tempo variation contribute to the 'groove' sensation. The results also indicate the diversity of 'groove' in different cultures.

Keywords: groove, *nori*, music psychology

The Concepts and Acoustical Characteristics of 'Groove' in Japan

How can the 'groove feeling' be described? What are the features of performance sounds that result in the groovy feeling? The feeling that 'groove' can prompt in individuals has been described in many different ways. It has been described variously as triggering a sense of unity, a feeling akin to dancing, or a sense of exaltation, as well as many other sensations. It has also been referred to as 'swing' and has been described as a kind of rhythm beat. Previous studies have presented various definitions of groove. According to Pressing (2002), groove is 'a cognitive temporal phenomenon emerging from one or more carefully aligned concurrent rhythmic patterns'. Busse (2002) analyzed swing or groove in the performance of pianists using a groove quantize procedure and suggested that gaps between performances and a score caused groove. Iyer (2002) noted that the concept of groove seemed to have no analogue in rational language. In addition to its diverse meanings based on individual's definitions, groove is also understood differently in different cultural contexts.

In addition to the diversity of its meaning based on individual's conception, groove is understood differently in different cultural contexts. Madison (2006) suggested the influence of Swedish words on the groove sensation; however, despite being an important concept in different cultures, groove has hardly ever been discussed from the perspective of cultural diversity. The evaluation or expression of the groove feeling has diversified significantly with the widespread popularity of Western music in Japan. In Japanese, an individual's impression of a type of music is often described in words that convey emotion, for example,

'happy' or 'sad'. However, when there is no obvious appropriate Japanese word that can adequately describe the emotional response to the music, then foreign words are often used. This is how the word 'groove' came to be used in Japan. Foreign words are sometimes used in unique ways in the Japanese context, and their original meanings often change gradually and diversify. For example, the English word 'naïve' has come to mean 'sensitive' in Japan, and the word 'smart' is often used to describe someone as 'slim', as well as its original meaning. Likewise, the understanding of the word 'groove' has evolved in Japan; it is now used in contexts as diverse as 'groovy recycling', a 'groovy master of a wedding ceremony', or 'groovy digitally altered pictures'. In these contexts, groove means 'nice' or 'good'. Its usage in various contexts clearly reflects the preference for foreign words that sound fashionable. Some new foreign words are used initially by those who are familiar with the field in which the word arises, or those who are more likely to be aware that something new in Japan. This was precisely the situation with the word 'groove'; the usage of the word in the above examples shows how the term is now used to indicate that something is special. Furthermore, the word 'groove' is sometimes translated using the old Japanese word *nori*. (The word *nori* comes from *noh*, which is the traditional Japanese performing art.)

In light of the above circumstances, it seems clear that further elucidation of the role of groove in different cultural contexts will enable us to gain a broader view of what it is. At the same time, we should also identify the common features of groove cross-culturally. Japanese music has developed indigenous music. On the other hand, Japanese people have imported various musical terms from

other countries. Furthermore, in the early 2000s in Japan, those who said something about groove seemed to regard it as a quite significant musical factor. For the above reasons, we decided to explore what groove signified in Japan in that period. First, we specify what kind of feelings the term 'groove' represents before we examine it because a quantitative analysis cannot be conducted if the term has various meanings among different individuals. Second, we examine the acoustical information that might include factors causing 'groove' because groove is something that can be experienced only by listening to music. Therefore, using approaches from music psychology, this study tried to examine what 'groove feeling' signified to individuals and what kind of acoustical characteristics prompted this sensation in Japan in the early 2000s.

As will be discussed in more detail later, when this study was conducted in the early 2000s, only about 30% of all of the participants who were majoring in music were familiar with the word 'groove'. In addition, very few quantitative studies had been conducted on the 'groove feeling'. In order to address this gap in research, this study identified the groove sensation and analyzed the acoustical characteristics that induce it. Shortly after this study had been completed, several other music information-processing studies analyzed drum performances and examined the groove sensation and its acoustical characteristics. These studies applied the results to the artificial performances in music (Okudaira, Hirata, Katayose, 2004; Okudaira, Hirata, Katayose, 2006; Watanabe, Chikayama, 2006). These studies focused on the term 'groove' to create more humane performances in popular music because the 'groove' used to describe the humane aspects of rhythm. Our study progresses as follows:

First, the degree of recognition and the characteristics of 'groove feeling' in Japan are analyzed (Survey1 and Survey 2). Second, we then attempt to identify the acoustical characteristics using a 'listening experiment' wherein we mainly play commercial CDs (Experiment 1). Finally, we conduct some sequential research into the traits of 'groove feeling', focusing mainly on drum performances (Experiments 2, 3, and 4).

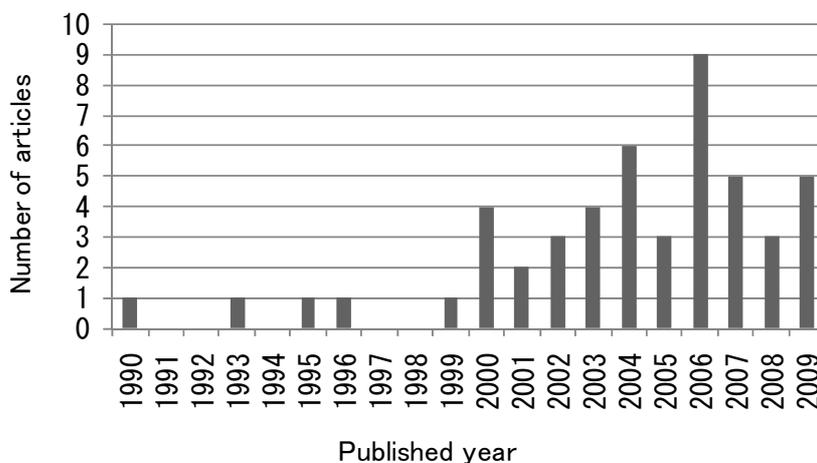
The prevalence and recognition of the word 'groove' in Japan

In the first instance, this study explores how much the word 'groove' was used in published drum magazines and a news paper in the early 2000s. Figure 1 (a) shows how many times the word 'groove' appeared in the contents of the 'Rhythm & drums magazine', one of the most popular drum and percussions magazines in Japan. This magazine was published every alternate month from 1990 to 1994, except in 1990 (when only four issues were published) and 1994 (when only seven issues were published); after 1995, it was published every month. As can be clearly seen in Figure 1, the use of the word 'groove' increased rapidly after 2000.

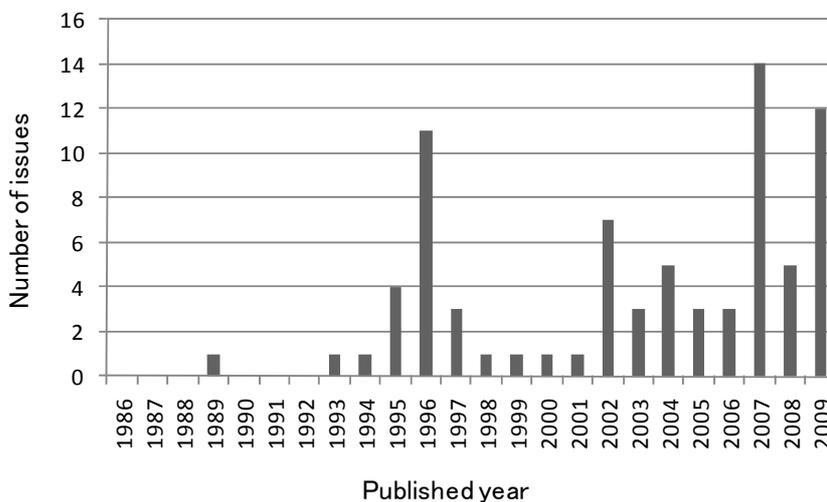
Using the keywords 'groove' or 'groovy', we searched the database of *Yomiuri*, the newspaper with the largest national circulation in Japan. About 10.02 million copies of the morning edition are read daily (average for April 2009) in Japan. The database contains about 5 million articles of back issues dating from 1986. Figure 1 (b) shows how many times the word 'groove' and 'groovy' was used in the newspaper. It was used predominantly in music reviews,

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interviews with artists, and for the introduction of music events. These results indicate that the use of the word 'groove' grew significantly in the years just prior to our study and that groove might have become a more important concept in music in Japan in around 2000. This study was conducted between 2000 and 2002, when the word 'groove' had just begun to grow in popularity in Japan.



(a) Frequency of the word 'groove' in the magazine 'Rhythm & Drums magazine'



(b) Number of articles with the word 'groove' in *Yomiuri*

Figure 1. The number of times the word 'groove' occurred in (a) the content of the magazine 'Rhythm & Drums' and (b) articles in *Yomiuri*.

Around 2000, any mention of the word 'groove' in publications was generally used in relation to rhythm, particularly that of the drum. This can be seen in the following examples:

'wavy' 'groove feeling' (*200 jazz go jiten hensan iinnkai*, 1990)

'groove feeling' also exists in *Tate-nori* (author's note; a vertical movement along the beat)... (Yuhi, 1995)

It makes you feel that once you start, you will never stop. (Rhythm & Drums magazine, November issue, 1995)

The important thing is that you keep the same *nori* (author's note; a Japanese word to describe different kinds of rhythm) as if a locomotive is moving at a steady speed; it gives the same clickety-clack sound. (Rhythm & Drums magazine, November issue, 1995)

'Groove feeling' can be found in African music and you can express it using the drum kit (Rhythm & Drums, February issue, 2000)

Groove makes the audience shake their body every two beats while they are listening to the rock music. Wavy groove is *nori*, which can be found in most popular music. (Yuhi, 1995)

Groove is a wave. It occurs when you subtly change sounds which produce a rhythm. (Ono & Igarashi, 1995)

Groove is the vivid expression of rhythm, known as *nori*. (Okudaira, Hirata,

Katayose, 2004)

As the above quotations make clear, although groove does have multiple meanings, there is some consensus that groove is not a *moment* in music, but a continuous feeling that occurs throughout the performance, for both the performer and the listener. In particular, the drum part plays an important role in creating the 'groove feeling'. It is for this reason that we analyze a drum performance in Experiments 2, 3, and 4, with the aim of identifying the kind of rhythm that might inform the sensation of 'groove feeling'.

However, our first task is to identify the degree to which participants recognized the term 'groove'.

Survey 1

In the following researches, we asked participants whether they were familiar with the term 'groove', to try and identify the degree to which the term 'groove' was recognized at the time.

Method

Participants

The participants in each study were 78 college students (aged 18–28) who were not majoring in music (male: 14, female: 64) for the first survey, 79 college students who were majoring in music (male: 9, female: 70) for the second survey, and 55 college students majoring in music (male: 5, female: 50) in the final survey.

Procedures

Participants were asked to answer the following questions:

Q1. Have you ever heard the word 'groove'? (Yes/No)

Q2. What kind of a performance would you consider groovy? (open-ended question)

Results

Figure 2 illustrates the degree to which the participants recognized the term 'groove'. The 'heard' bar represents the percentage of participants who answered yes to Q1; the 'know' bar represents the percentage of participants who were familiar with groove and so could write down their impressions of groove in Q2.

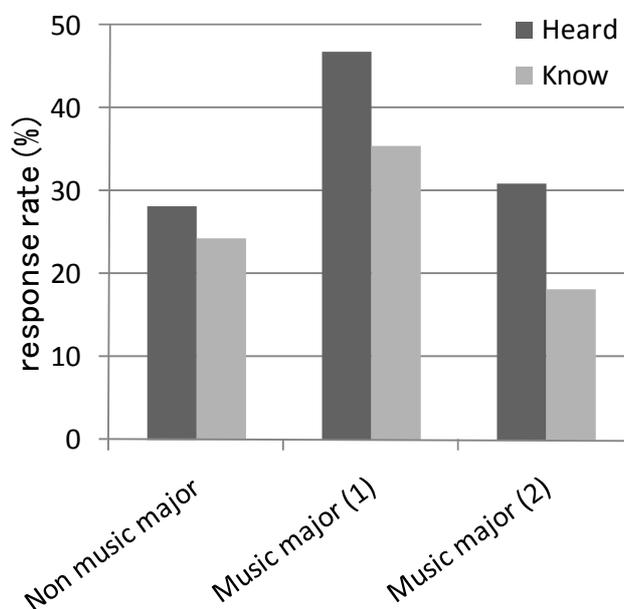


Figure 2. The degree to which college students not majoring in music and college students majoring in music were familiar with the term 'groove'.

We conducted Pearson's chi-square test¹ to examine whether the different types of students (those who were majoring in music and those who were not) correlated with their familiarity with the term 'groove'. The result was marginally significant ($\chi^2 = 3.135$, $df = 1$, $p = 0.077$). However, the difference in the types of student did not seem to correlate with the perceptions of what groovy music would sound like. The difference between types of students was not observed in this matter ($\chi^2 = 0.401$, $df = 1$, $p = 0.527$). These results make it clear that there was no significant difference with regard to the recognition of the concept of groove between students who majored in music and those who did not. However, it was clear that more students who majored in music were more familiar with the term 'groove'.

Survey 2

In the second survey, we used questionnaires to analyze the characteristics that those who were familiar with the term 'groove' thought it entailed.

Methods

Participants

The participants in this study were 19 college students (out of a total of 78) who described their perception of a groovy performance in Survey 1.

Procedure

¹ Pearson's chi-square test is a statistical test used to compare the differences in frequency or percentage of qualitative responses.

Survey forms were distributed and collected during a class at Osaka University (for students not majoring in music). Participants took as much time as they needed to fill in the forms. In this study, we conducted a more in-depth analysis of the students' responses to the question 'What kind of a performance would you consider groovy?'

Results

We classified the students' responses into several types. Table 1 indicates these categories and gives some examples of the specific responses.

These responses were classified into six general groups: body movement, tempo, emphasis of bass sounds, stream (i.e. flow or drive), sense of unity, and other factors. The responses seemed to focus particularly on body movement. Indeed, 14 of the 19 respondents cited body movement as being associated with the groove feeling

In psychology, music is generally analyzed in terms of emotion. Japanese has many emotional words that correspond to the English word 'happy' or 'sad'. However, as many respondents used several different words to explain the groove sensation, it is difficult to identify a Japanese word that could adequately describe the sensation of groove. However, the Japanese word *nori*—a term that was originally used in Japanese traditional music—occurred repeatedly to explain the sensation of groove. We will expand upon this point later.

Table 1. Abstracts from respondents' explanation of what makes a performance have a 'groove feeling'; the number of respondents is in parentheses.

Body movement
I feel rhythm in my body
It is easy to get into <i>nori</i> (3)
dance-inducing
my body is moving spontaneously (2)
it feels 'dance-like' but heavy
Tempo
fast tempo
up-tempo and rhythmical
rhythmic and a little faster tempo
Emphasis of bass sound
bass sound and rhythm are clear
deep bass, low and loud sound
body feels the resonance of the bass sound
Stream
smooth flow
flowing
wavy
Sense of unity
I feel a sense of unity (2)
harmonized
sympathetically resonant
Other factors
vivid (2)
soulful and cool
edge
pieces like R&B
powerful

Another notable commonality among the responses was that many participants associated the sensation of groove with rhythm. Because both of these commonly cited associations are to do with rhythms and beats, it seems reasonable to examine the sensation of groove that people experience during a performance from a time perspective.

Experiment 1

The two surveys discussed above suggest that the degree of recognition of the term 'groove' was not high, but when people did recognize it, most associated the sensation of groove with physical factors. We used a listening experiment based on the semantic differential (SD) method² to analyze the impression and characteristics of a selection of music that was supposedly 'groovy'. We also examined the temporal characteristics of each performance that prompted a 'groovy' sensation. This exploratory research focused on tempo and tempo variations because these factors facilitate the measurement of rhythm.

Methods

Participants

The participants in this survey were 21 college students who had given their impression of the groove sensation in Survey 1 (from the 79 students majoring in music who had participated in the original study).

Stimuli

² Semantic differential (SD) method is used for quantitative analysis of image or affective meanings using bipolar adjective scales.

As stimuli, we chose music from the fusion genre and used music chosen by a professional drummer who identified them as having a groove sensation (Rhythm & Drums magazine, November issue, 1995)³. The following songs were used: 'The One Step' and 'Sicily' (from the album 'Friends' by Chick Corea); 'Stand on It', 'Sling Shot', 'Where Were You', and 'Big Block' (from the album 'Jeff Beck's Guitar Shop' by Jeff Beck); 'Darkside' and 'It's the Little Things' (from the album 'High Bias' by Niacin); and 'Chameleon' (from the album 'Headhunters' by Herbie Hancock).

These songs were played from the beginning for 2 minutes, and they ended by means of a 5-second fadeout. The stimuli were edited using SOUNDEDIT 16 (Macromedia, Inc).

Procedure

The experiment was conducted at Soai University. Each stimulus was played twice in succession, from loudspeakers placed at the front of a classroom. During the first play, respondents only listened; during the second play, they evaluated the tune while they listened. This rating was given according to a bipolar seven-point scale. Twenty pairs of adjectives were used by participants in Survey 1; six pairs were selected based on our previous surveys and fourteen pairs were originally deployed by Iwashita in an earlier study (Iwashita, 1983).

The following items were evaluated: the *nori* is bad—the *nori* is good, wavy—not wavy, serious—funny, the music gives you a sense of unity—the music does not give you a sense of unity, happy—melancholic, slow tempo—up-tempo, rough—elegant, vivid—dull, ugly—beautiful, weak—strong, intense—moderate,

³ We selected jazz or fusion pieces because at that time in Japan, the word 'groove' was mainly used in relation to these genres.

light–grave, groovy–not groovy, the music gives a sense of stability–the music lacks a sense of stability, the music gives an impression of nobility–the music does not give the impression of nobility, blithe–gloomy, bright–dark, your body feels the rhythm of the music–your body does not feel the rhythm of the music, cheerful–plaintive, and this song is my favourite from the selection–this song is not my favourite from the selection.

Results

Figure 3 shows the average value that each piece of music was given in terms of its 'groove value'. Of all the stimuli, the song 'Sicily' was the one that was given the highest average rating of 'groove value'. The song 'Where Were You' was regarded as being the least groovy. An analysis of variance (ANOVA)⁴ was conducted to determine the differences between each tune's average value; the results were significant ($F(8, 152) = 6.748, MSE = 1.368, p < 0.001$). When a multiple comparison was conducted on the stimuli, it was found that the average 'groove value' of 'Where Were You' was significantly lower than that for the songs 'Sicily', 'Sling Shot', and 'Big Block'.

⁴ Analysis of variance (ANOVA) is a statistical test to compare the differences of means of more than three groups.

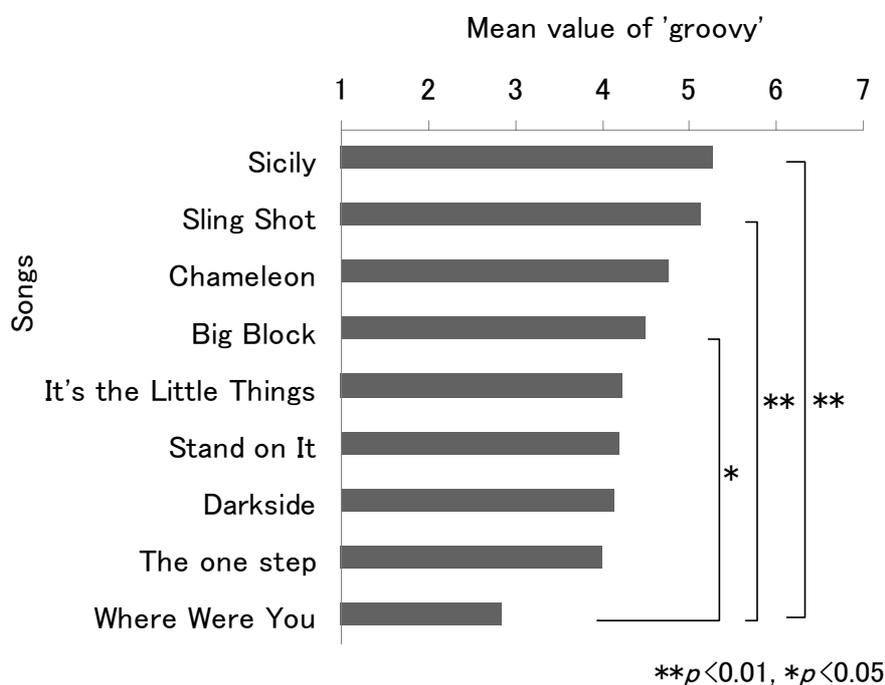


Figure 3. The average 'groove value' for selected song stimuli. Brackets connect songs that have statistically significant differences. Each asterisk represents the magnitude of p -value.

To assess the perceived 'groove value' and acoustic characteristics of each tune, we focused on the temporal aspects of each stimulus; we calculated the Pearson's product-moment correlation coefficient⁵ to measure the tempo (BPM: beat per minute), the variation in the duration of a measure (standard

⁵ Pearson's product-moment correlation coefficient (r) is a measure of the strength of the relationship between two variables. A positive correlation coefficient implies that as values of a variable increase, those of the others also increase, whereas a negative correlation coefficient implies that as values of a variable increase, those of the others decrease. A large absolute value implies a strong correlation. Probability value (p -value or p) is a measure of statistical significance. In general, when p -value is lesser than 0.05, the relationship has a statistically significant meaning. In table 2, r represents Pearson's product-moment correlation coefficient and p represents the probability value.

deviation: SD⁶), and the perceived 'groove value'. 'Where Were You' was excluded because it was deemed to have notably less 'groove value' than the other stimuli. The results of this analysis showed that tempo had a significantly positive correlation with the 'groove value' ($r = 0.842, p = 0.009$). Stimuli that had a faster tempo were regarded as more groovy. On the other hand, the SD of the duration of a measure was negatively correlated with the 'groove value', although this correlation was not significant ($r = -0.398, p = 0.376$).

Next, we analyzed the degree of similarity between the participants' perception of each song's 'groove value' and the description by calculating the correlation coefficient of 'groove value' for each stimulus and item. The results of this analysis are shown in Table 1. Because of the large sample size, the p -value was small for many of the items even though the correlation coefficient was small. However, the 'groove value' of each song was significantly correlated with items such as 'the *nori* is good', 'blithe', 'the music gives you a sense of unity', and 'up-tempo'.

⁶ Standard deviation is the often-used index describing the degree of data variability.

Table 2. The correlation coefficient between the 'groove value' and other items

	Groovy	
	<i>r</i>	<i>p</i>
<i>Nori</i> is good	.522	<.001
Blithe	.514	<.001
You feel sense of unity	.448	<.001
Up-tempo	.409	<.001
Your body feels rhythm	.391	<.001
Happy	.380	<.001
Vivid	.369	<.001
Favorite	.332	<.001
Bright	.311	<.001
Funny	.308	<.001
Intense	.301	<.001
Cheerful	.277	<.001
Strong	.230	.002
Sense of stability	.181	.013
Light	.180	.014
Wavy	-.116	.115
Impression of nobility	.122	.097
Beautiful	-.066	.371
Elegant	.002	.973

We also conducted a cluster analysis on each of the items using SPSS to classify the responses when they were listening to the music. The cluster analysis⁷ was based on the Ward method, and we used the squared Euclidean distance (Figure 4). The result of this analysis suggested that the sensation of groove arises from four kinds of perception: (1) the '*nori* is good', (2) 'you feel

⁷ Cluster analysis is a method for classifying analogous variables. To determine the degree of similarity, Euclidean distance is used. Ward's method, one of the most popular methods, uses the sum of squares. This is a more sensitive method for classification than others.

sense of unity', (3) 'your body feels the rhythm', and (4) 'bring a sense of stability'. In addition, the 'groove value' might vary with the aesthetic aspects of or the emotions, such as beauty or brightness. The correlation between the items and the results of the cluster analysis were consistent with the survey of college students (Survey 1) to some degree.

Dendrogram using Ward Method

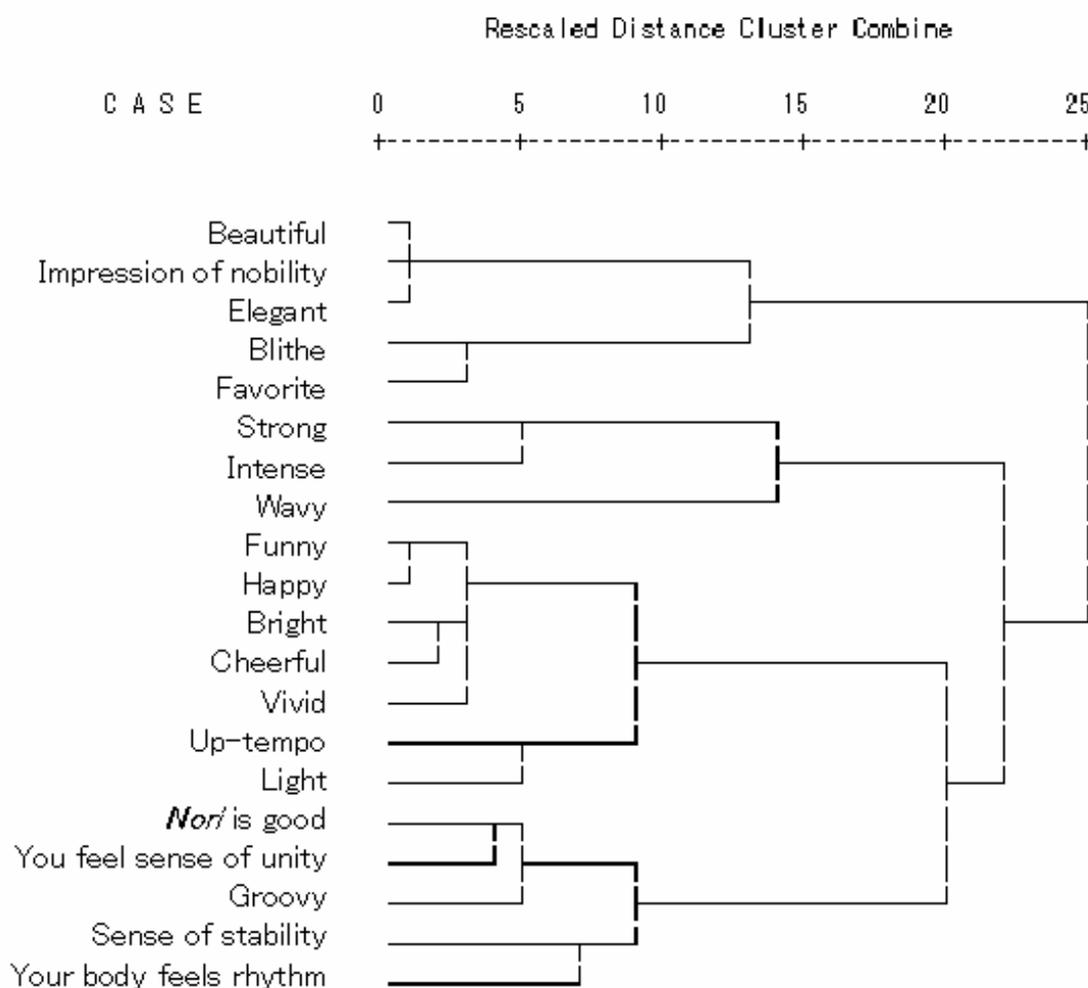


Figure 4. Dendrogram of the cluster analysis conducted on the evaluation items

The results of Experiment 1 indicate that participants' perception that a

song was 'groovy' was significantly correlated with the tempo of the piece, which is a physical characteristic, and it was negatively correlated with temporal variation, although this correlation was not significant. The participants also seemed to associate the groove sensation with *norī* and rhythm. Therefore, the next experiment analyzed drum performance in which rhythm becomes particularly important within popular music performances.

Experiment 2

The purpose of this second experiment was to explore the characteristics of a drum performance played by a proficient drummer in one significant way: identifying whether or not it was regarded as having groove feeling. Given the results of Experiment 1 and Survey 2, and taking into account the interview in 'Rhythm and drums magazine' (November issue 1995), which highlighted the importance of tempo in prompting the groove feeling, it seems clear that drums may play an important role in expressing the 'groove feeling'. In recent times, the word 'groove' is being used in the context of electronic music and the J-Pop scene in Japan. In early 2000, however, it was almost always used to refer to a very specific type of music; in particular, it was often used by drummers.

We therefore conducted an experiment assessing the physical aspects of two types of drum performance: one that was groovy and one that was not groovy; we focused on the temporal aspects. Only one drummer participated in this research. Another experiment was conducted later to ascertain whether his performance was sufficient.

Methods

Participant

In this study, the participant was a Japanese proficient drummer

Procedures

The participant played on his own drum kit in a soundproof room in the Graduate School of Human Sciences, Osaka University. A recording was made of all the instruments used in the performance; further, individual recordings of the bass drum and the snare drum were recorded. The participant gave his performance after practicing each pattern (shown in Figure 5) as much as he wished. At the request of the participant, he played the section between measures five and twenty in two different ways. At the beginning of performance, he played this section without a 'groove feeling', and at the end of performance, he played this section with a 'groove feeling'.

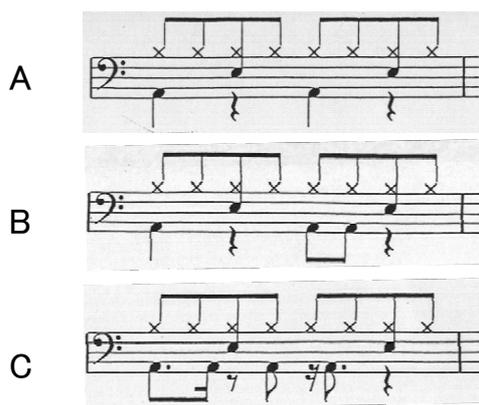


Figure 5. The rhythm patterns played by the performer

The participant played for as long as he wished. He played one set at a

free tempo and another set at a variety of specified tempi (BPM = 70, 100, 160) in each pattern. Twenty-four samples were obtained. In the specified tempo conditions, he began to play after listening to four beats at that tempo. The participant was asked to evaluate his own performance on a 'groove feeling' scale of 1–10 (where 10 was 'very groovy' and 1 was 'not groovy at all').

Measurements

The audio of the performance was recorded on MDs (Victor XM-D11, SONY JA30ES, SONY MDS-101) using microphones (SHURE SM57, SONY ECM-999, SONY ECM-959A), microphone mixers (SONY MX-50), and amplifier (SONY V88ES). The starting time of each sound was measured using SOUNDEDIT 16 (Macromedia, Inc). The first part of our analysis involved determining the duration of a measure. We measured this from the first beat of the bass drum in one measure to the first beat of the bass drum in the next measure; we then calculated the duration of each measure in each trial. Second, we determined the position of each note on the basis of the duration from the first sound of a measure and by calculating the note position of a score (i.e. the theoretical position) in each rhythm pattern. The bass drum and snare drum were analyzed. The cymbal sound was excluded because its sound overlapped with other sounds. We determined the timing gap by subtracting the theoretical figure of the note position from the actual value of the note position.

Results

The participant rated his own performance on a scale of 1–10. He gave himself a rating of 10 in all his groovy performances and of 1 in all his non-groovy

performances. This indicates that the participant was satisfied with the level of 'groove feeling' that he expressed. We conducted an independent sample t test⁸ on the performance at a free tempo; the results showed that the tempo in the groovy performance was significantly faster than the tempo in the performance that was not groovy. The following results emerged from this experiment: In pattern A, the performance was given at a BPM of 144; this performance was regarded as groovy; however, the performance that was given at a BPM of 140 was not regarded as groovy ($t(30) = 9.205, p < 0.001$). In pattern B, the performance that was played at a BPM of 137 was regarded as a groovy performance while the performance played at a BPM of 135 was not regarded as a groovy performance ($t(30) = 4.485, p < 0.001$). In pattern C, a performance played at a BPM of 115 was regarded as a groovy performance while the performance given at a BPM of 113 was not regarded as groovy ($t(30) = 6.288, p < 0.001$).

The next stage of our experiment involved calculating the duration of each measure in each performance (Figure 6). All the performances that were perceived to be groovy had shorter time measures, except the performance that was conducted at a BPM of 160 in pattern C. The t test indicated that the duration of an average measure in performances that were found to be groovy was significantly shorter than the duration of the average measure in the performances that were not found to be groovy ($t(11) = -2.721, p = 0.020$). This clearly indicates that groovy performances are played at a significantly faster tempo than performances that are not groovy.

⁸ T test is a statistical method used for analyzing differences between averages of two groups.

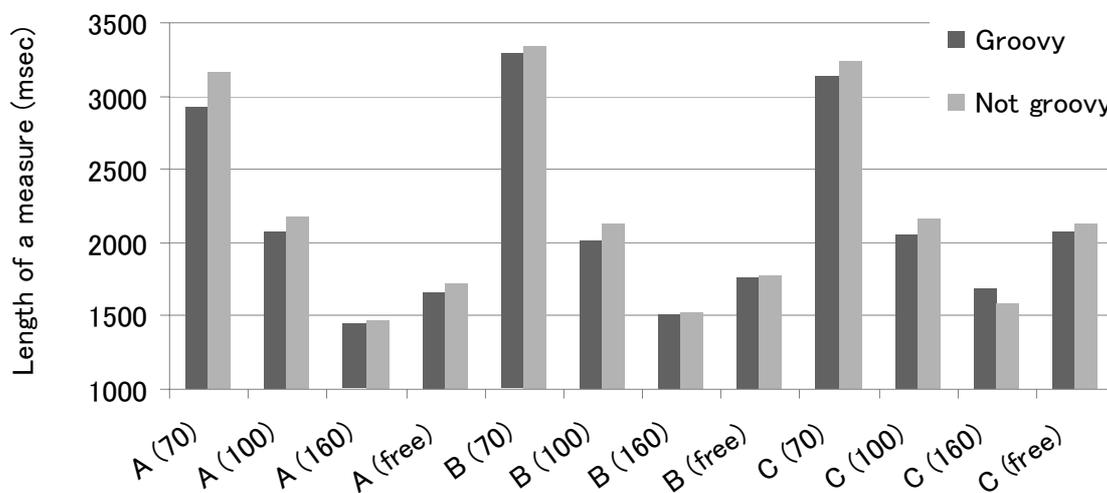


Figure 6. Duration of an average measure in each performance

We also analyzed the temporal variation of each performance. First, we calculated the SD of the duration of a measure. The temporal variation among the performances was also analyzed. First, a SD of the duration of the measures was calculated. As made clear by Getty (1975), the longer the time lag between two sounds, the more difficult it is to distinguish whether the time lags made by two sounds are equal. Therefore, the SD of the duration of each measure was divided by the duration of a measure to eliminate the influence of tempo on the results (Figure 7). The data suggested that the values of groovy performances given at a tempo of 100 in pattern C and those given at a free tempo were higher, but in all other groovy performances, the measure duration varied very little. The result of the *t* test showed that in most of the groovy performances, the variation of the duration of a measure was significantly smaller than in performances that were not found to be groovy ($t(11) = -3.410$, $p = 0.006$). This suggests that performances that were found to be groovy had less variation in the tempo than

performances that were not found to be groovy. The tempo variation of all performances that were regarded as groovy varied between 0.0056 and 0.0072.

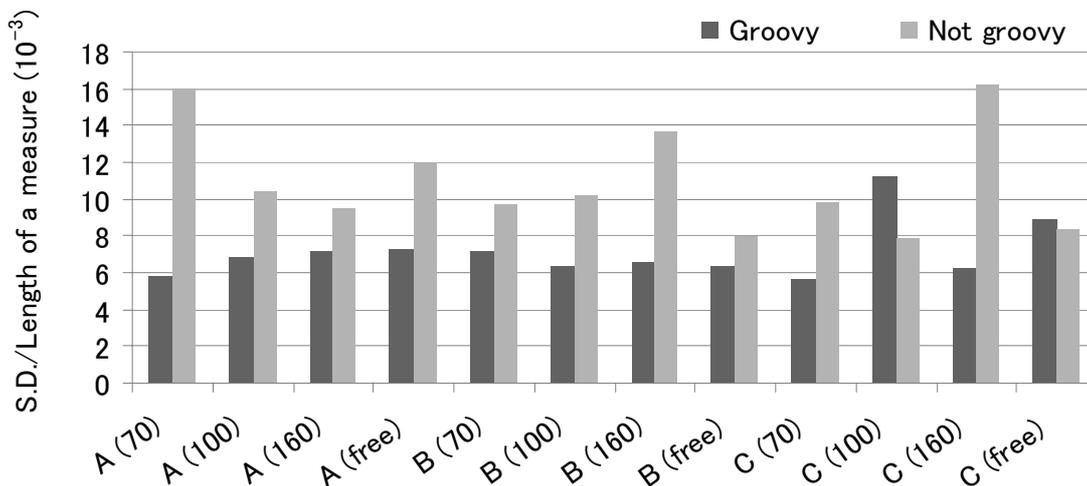


Figure 7. Variation of the duration of a measure for each performance

We analyzed the variation of each sound in the different rhythm patterns using the timing of the bass drum and snare drum beats. Since the starting point of the sound was unclear under the measuring condition, the sound of the cymbal was excluded. Figure 8 indicates the average timing of the beats of the bass drum and snare drum in pattern C. Pattern C had the highest number of measure points. The first bass drum sound is not represented in Figure 8 because this was the sound that was used as the base point. The time of beat remained relatively constant regardless of tempo and groove. Compared with the score (the theoretical position), the second sound of the bass drum was found to be a little premature, whereas the fourth sound of the bass drum often came a little later than the position suggested by the score. The sound of the snare drum was almost identical to the score. Pattern A and B also tended to

depart slightly from the score regardless of tempo or 'groove value'. This implies that these variations in beat can be attributed to the influence of the performer's individual character or the rhythm pattern itself rather than 'groove feeling'. Therefore, instead of calculating each note's specific variation value, we calculated the SD of each sound to help elucidate how the performer beat out a regular rhythm. In particular, we measured the rhythmic patterns in the performances that were played in a free tempo because these patterns were likely to be the easiest to play (Figure 9).

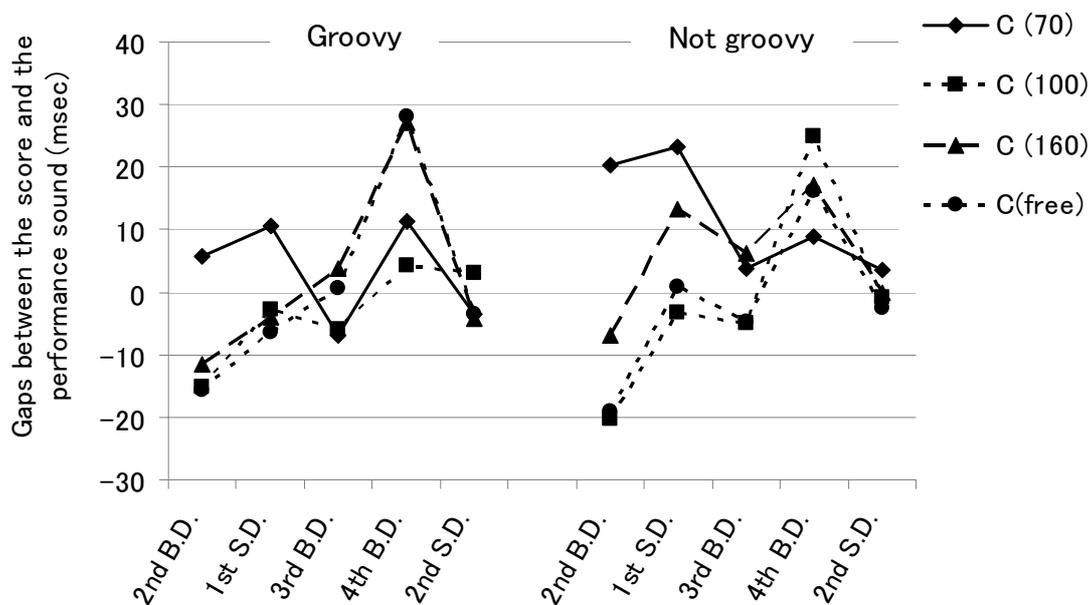


Figure 8. Differences between the score and the sound of the performance. Negative values indicate that the sound was ahead of the prescribed rhythm, and positive values indicate that the sound was a little later than the theoretical value.

THE CONCEPTS AND ACOUSTICAL CHARACTERISTICS OF 'GROOVE' IN JAPAN

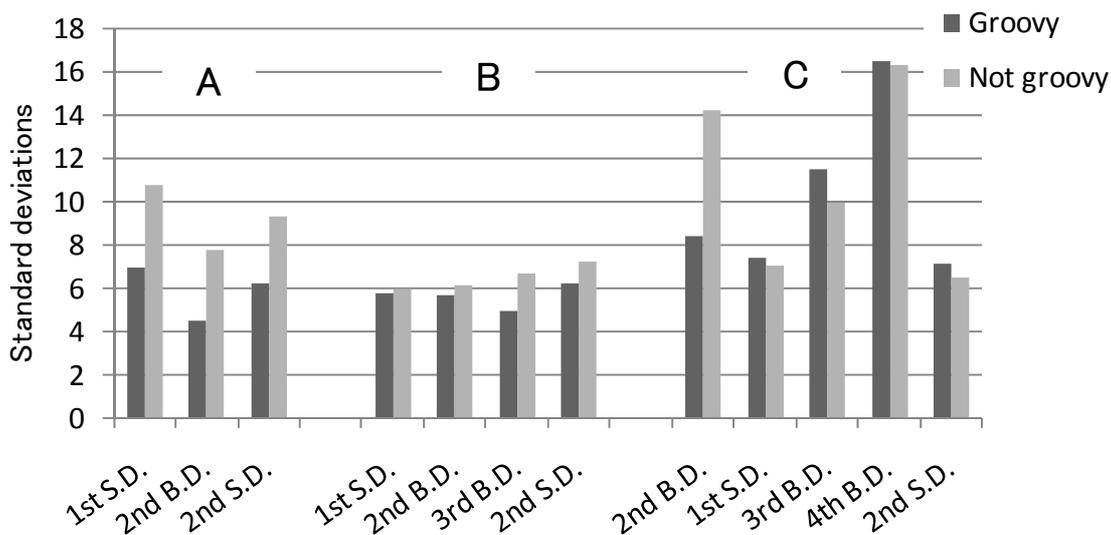


Figure 9. The SD of the beat timing for each note in each rhythm pattern

In patterns A and B, there was less variation between the timing of the beat points for all notes in the groovy performance. Table 3 indicates the average SD for each rhythm pattern. For the groovy performances in patterns A and B, the disparity between each sound was small.

Table 3. The 'groove feeling' and the SD of the disparity between the sound and the score

	Groovy	Not groovy
A	5.9	9.3
B	5.7	6.5
C	10.2	10.8

(ms)

These results indicate that participants regarded groovy the performances that had a faster tempo and where both the tempo change and tempo variation were small. Additionally, they rated as groovy the performance in which gaps between each sound within rhythm were smaller. However, whether this finding can be applied more generally is unclear at present, because the performance of only one drummer was assessed. It was also unclear whether performers and audience members understood 'groove feeling' in the same way. Therefore, in the next experiment, we created an artificial performance, which included characteristics that seemed to correlate with 'groovy' in this experiment. We then examined whether participants regarded the performance as 'groovy' while they were listening.

Experiment 3

This experiment was aimed at revealing whether the acoustical characteristics that were found to correlate with the performer's assessment of 'groove feeling' in Experiment 2 would also influence how the audience felt about 'groove feeling'. We assessed whether these factors extended to the audience by creating an artificial performance, which included the characteristics of a groovy performance that had been identified in Experiment 2.

Methods

Participants

In this experiment, the participants were 55 college students who were majoring

in music (male: 5, female: 50). Ten participants out of the total number of participants gave their own impression of what 'groove feeling' was.

Stimuli

We constructed some artificial patterns from the rhythm used in patterns B and C in Experiment 2; we excluded the cymbal, because the sound overlapped with other sounds and we would be required to factor in the relationship between the sound of the drums and the cymbal in our analysis.

We used the bass drum and snare drum sound (Roland, TD-10) as stimuli. All of the following stimuli used the same sound, which was created using SOUNDEDIT 16 (Macromedia, Inc.). Each rhythm pattern was transmitted at a BPM of 70 and 160; a BPM of 137 was used for pattern B, and a BPM of 115 was used in pattern C. These two were the free tempi BPMs that were performed in Experiment 2. Next, we inserted a silent pause between the first and second sounds for each measure, so that the SD of the length of measure became 6, 18 msec. There were 18 different stimuli: two rhythm patterns, three kinds of tempo, and three kinds of tempo variation.

Procedure

This experiment was conducted in an audiovisual classroom at Soai University. Each of the stimuli was recorded on MD and was played once from loudspeakers placed at the front of the room. Participants were asked to evaluate eight items according to an 11-point bipolar scale after the stimuli were played or just before they ended. All stimuli were under 70dB.

Results

Figure 10 shows the average value rating of the 'groove feeling'. Participants regarded the performance that had a tempo of 160 and a tempo variation of 6 in pattern B, and the performance that had a tempo of 115 and a tempo variation 6 in pattern C, as the pieces that were the most groovy.

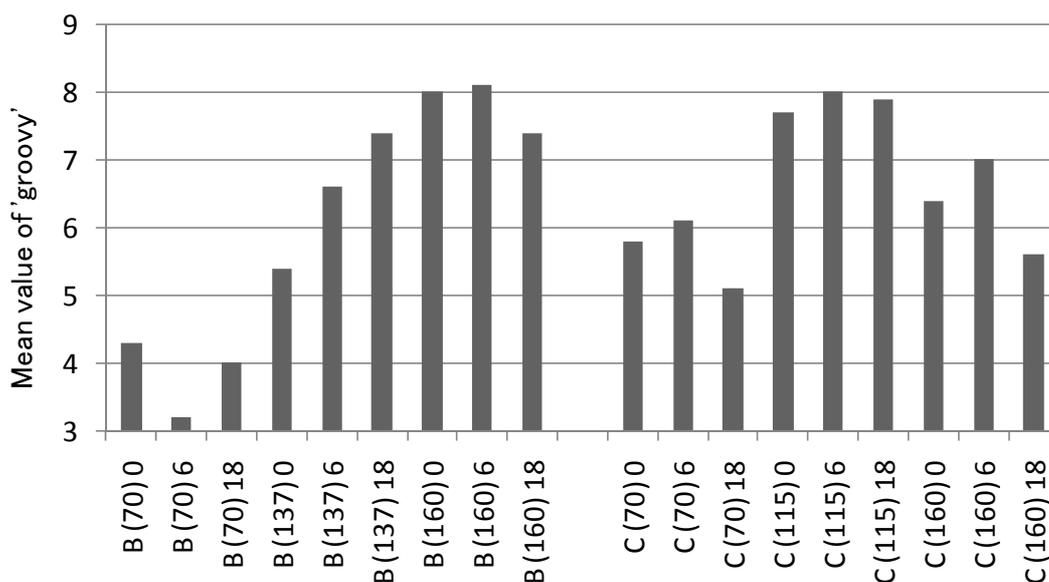


Figure 10. The average rating of evaluation of 'groovy'. The letters represent rhythm patterns, the numbers in parentheses represent the tempi, and the last numbers represent the tempo variations (SD).

We conducted a two-factor ANOVA on tempo and tempo variation for each rhythm pattern. In pattern B, the main effect⁹ of the tempo was significant ($F(1.204, 10.840) = 9.772$, $MSE = 21.071$, $p = 0.008$); however, the main effect of the tempo variation was not significant ($F(2, 18) = 0.683$, $MSE = 1.675$, $p = 0.518$). The interaction¹⁰ between tempo and tempo variation tended to be

⁹ Main effect is the effect induced by each independent variable.

¹⁰ An interaction is the effect resulting from a combination of independent variables.

significant ($F(2.017, 18.155) = 2.807$, $MSE = 4.824$, $p = 0.086$). A multiple comparison of the tempi suggested that a tempo of 160 was regarded as significantly more groovy than the other two tempi (Bonferroni, $p < 0.05$ in all tempo). In pattern C, the main effect of the tempo was not significant ($F(2, 18) = 1.550$, $MSE = 24.635$, $p = 0.239$), but the variation among the tempi tended to be significant ($F(1.262, 11.357) = 3.605$, $MSE = 2.291$, $p = 0.077$). The interaction between the tempo and the tempo variation was not significant ($F(4, 36) = 0.827$, $MSE = 1.566$, $p = 0.517$). A multiple comparison of tempo variation indicated that the highest rate of grooviness was found in SD 6; however, there was no significant difference (Bonferroni, *n.s.*).

Table 4. The correlation coefficient between groovy and each item

	Groovy	
	<i>r</i>	<i>p</i>
You feel sense of unity	.881	<.001
Blithe	.868	<.001
Your body feels rhythm	.778	<.001
Nori is good	.761	<.001
Good performance	.725	<.001
Wavy	.553	<.001

Table 4 shows the correlation coefficient between 'groovy' and each item. The highest correlation coefficient was 0.881 for the item 'sense of unity', and

the lowest correlation coefficient was 0.553 for the item 'wavy'. All items were found to correlate significantly with 'groove feeling'.

Participants evaluated the following stimuli as groovy: performances given at a fast tempo in pattern B and performances given at a moderate tempo variation in pattern C. This moderate tempo variation was similar to the tempo variation at which the performer played in Experiment 2.

'Groove feeling' was found to correlate significantly with other items such as a sense of unity, particularly those items that deeply related to 'groove feeling' in Experiment 1. This suggested that 'groove feeling' was evaluated in the same way in both the drum solo and when all the instruments played together.

Experiment 4

This experiment investigated whether an individual performer was able to distinguish the 'groove feeling' in his performance.

Methods

Participants

For this experiment, our participant was the same drummer who had performed in Experiment 2.

Stimuli

We assessed the performer's assessment of 16 measures in two types of performances that were regarded as 'groovy' and 'not groovy' in Experiment 2.

Procedure

We created two sets by arranging all stimuli randomly. A 10-second time lag was introduced between each stimulus and set. The participant listened to the stimuli at the volume he found most comfortable. The participant evaluated whether or not stimuli were groovy on a scale of 1–10 after or just before the end of performance. After the listening experiment, we gave the participant a questionnaire asking about which note he had paid particular attention to during the performance; we collected this on a later date.

Results

We only examined the last part of the data, because the participant found the last half of the experiment easier to evaluate than the first. Figure 11 indicates the evaluation that he gave to each pattern.

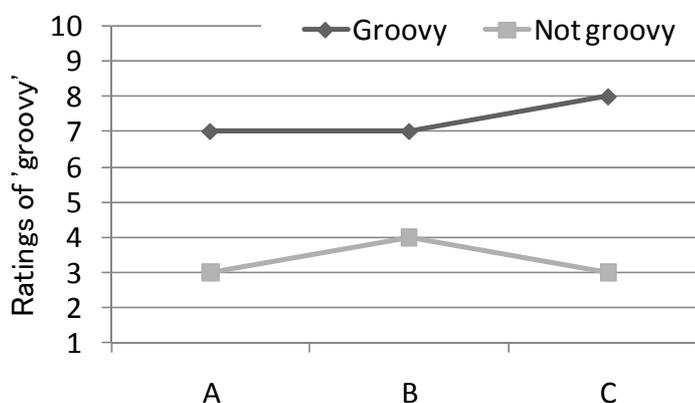


Figure 11. Performer's self-evaluation of the performance

The participant evaluated all of the groovy performances as more groovy than the non-groovy performances. He regarded pattern C as the most groovy pattern. The most significant difference was between the groovy performance

and the non-groovy performance in pattern C; the discrepancy between these two performances was the least significant in pattern B. In other words, for the performer, the grooviness of pattern C was the easiest to discern and the grooviness of pattern B was the most difficult to identify. The performer thought that the second, fourth, sixth, and eighth note of the cymbal in patterns A, B, and C were the most important, and the fourth note of the bass drum in pattern C was the most important. The cymbal sound was not included in Experiment 3.

Discussion

This study investigated the nature of the concept of 'groove feeling' and attempted to identify what kind of acoustical characteristics prompt 'groove feeling'.

Surveys 1 and 2 suggested that in Japan, in the early 2000s, 'groove feeling' was not a well-known concept and the term 'groove' was used to refer to only a limited number of concepts, which related to rhythm or body movement. More specifically, Survey 1 showed that some students who were majoring in music had heard of the term 'groove'; however, the percentage of students who understood the meaning was around the same whether or not the students had majored in music. In Japan, students majoring in music tend to study Western classical music or Japanese traditional music and there is little opportunity for them to study popular music. In other words, the students were unlikely to have learned about groove as part of their higher music education. The results of the survey on the term 'groove' might be explained in some way by this context.

The results of Experiment 1 showed that, for participants, 'groove feeling' was strongly associated with concepts that were allied to rhythm or a sense of unity, while they were listening to the music. The results of Experiment 3, in which participants evaluated only the groove created by the drum sounds, also suggested the same association. Therefore, the evidence suggests that 'groove feeling' might be evaluated according to its rhythm rather than its melody or harmony.

Yamasaki (2002, 2004) found that listeners could understand the emotional expression of a performer by his or her drumming sounds. Further research is therefore necessary to explore the relationship between groove and emotion.

The specific way in which the word 'groove' is used also must be analyzed because groove is a foreign word for Japanese people. In Japan, many foreign words are represented with *katakana*, one of the Japanese characters, without translating, and they often retain their original pronunciation. This tendency also extends to musical terms, particularly when Japanese music does not have an equivalent term. In addition, because the original meaning of some foreign words changes over time when they are used in a Japanese context, this aspect also requires further study.

Another remarkable aspect of our study that would benefit from further research is the fact that, as our listening experiment made clear, groove seems to be significantly related to *nori*, which is a term that originated in the context of *Noh*, the traditional Japanese performing art. The term *nori* is today often used to describe people's impression of rhythm in popular music such as *tate-nori*

(vertical-nori), *yoko-nori* (horizontal-nori), *mae-nori* (anterior-nori), *ato-nori* (posterior-nori). Indeed, some people even call groove a type of 'so-called *nori*' (Arai et al., 1998). *Tate-nori* and *yoko-nori* mainly refer to the movement of the body or head in a vertical or horizontal direction in tune with the rhythm. On the other hands, *mae-nori* and *ato-nori* mainly means the slight timing change of rhythm or beat which cannot be written in a score: *mae-nori* comes slightly before a note, whereas *ato-nori* comes slightly after a note.

Because of varying interpretations, however, these kinds of *nori* cannot be defined easily, just as in the case with groove. Moreover, *nori* is often used in the context of music to describe groovy, up-tempo, or rhythmical music, like in the case of '*norinori na rock*'. It is also used to describe body movement, including singing and dancing, or the feeling of excitement. In addition to this, the Japanese frequently use *nori* to describe a situation where things are going well or gaining momentum, or to describe personality (a good *nori* is a social and cheerful character). In this way, the Japanese tend to associate the word *nori* with the word 'groove', even though the former does not quite capture the essence of the latter.

This study provides an alternative perspective on groove. Words equivalent to *nori* words in different languages will bring forth new aspects of groove. It would be beneficial for future research to try to understand how the concept of groove differs from or is similar to its meanings in other cultures. It would also be useful to explore how the concept of groove has changed over time in Japan.

The listening experiment using commercial CDs also showed that tunes

that had a higher tempo and where the tempo variation was small was regarded as more groovy. However, the evaluation of the drum solo suggested that the influence of tempo or tempo variation on listeners' evaluation of 'groove feeling' varied depending on the exact rhythm patterns. This means that listeners' impression of the 'groove value' of a piece of music was affected by the rhythm pattern. In particular, when the performer was allowed to play at a free tempo, the tempo was the fastest in pattern A, which had the simplest rhythm. In contrast, the pattern C was the most complicated rhythm and this was played at a slower tempo. This may mean that performances that are regarded as groovy may have an appropriate tempo because of the rhythm pattern.

However, it should be noted that this study analyzed only the superficial aspects of rhythm, such as tempo and tempo variation. Therefore, the variation of the timing of the beat and the volume of the piece may significantly vary according to the rhythm pattern. After this study had been completed, Okudaira, Hirata, and Katayose (2004) investigated different types of groovy performance by a professional drummer. They noted that the timing of the beat point compared to a metronome showed a gap of several milliseconds between a tight pattern and a loose pattern. These gaps compared to a metronome were within 8 ms in the tight pattern. Thus, it was reasonable to set a variation of the measure's duration at 6 ms in this study.

In light of the fact that the concept of 'groove feeling' was mainly used to refer to popular music such as jazz, our approach of analyzing, in detail, the drum—one of the most widely used instruments—with regard to rhythm in popular music seems reasonable and relevant. Furthermore, we included

students who majored in music as our participants because an experiment on emotion conveyance in music has shown that these students are able to interpret the emotion of a performance with greater accuracy than students who major in other streams, for example, art (Shimosako & Ohgushi, 1996). In this study, we assumed that students who majored in music would also be more accurate evaluators of rhythm. However, we did not analyze characteristics of each sound in the rhythms of our experiments. For this reason, detailed information such as aspects of the performance that participants might regard as recognition cues may have been overlooked. This aspect will benefit from further study.

We suggest that our experiments on groove and its acoustical characteristics have demonstrated that a performer's sensation of 'groove feeling' can, to some degree, be successfully conveyed to audience members from the perspective of musical communication. First, the audience members tended to regard the tempo variation in rhythm pattern C of Experiment 3, which reflected the sound of the actual performance as the most groovy. This was also the pattern where the performer considered his performance as the one with the most 'groove feeling'. Pattern C might be a better stimulus to evaluate the 'groove feeling' of a performance, rather than other rhythm patterns; this is because pattern C included the largest number of sounds. The fact that the tempo variation varied significantly in pattern C implies that the performer's sensation of 'groove feeling' was also conveyed to audience members to some degree. The 'groove value' under 'free tempo' condition was also higher than that under the other tempo condition. In addition, these results may be

influenced by rhythm patterns. The syncopic structure of pattern C might influence listeners to evaluate the rhythm as more 'groovy'. This may imply that some sound structures or rhythm patterns, unlike others, tend to be perceived as groovy. This presumption is convincing from our own musical experiences. Future studies need to examine the impacts of rhythm patterns.

However, the detailed characteristics of each sound that the performer might express were not reflected in Experiment 3. This might indicate that detailed characteristics contribute to the accurate conveyance of 'groove feeling'. In pattern B, instead of tempo variation, a faster tempo seemed to contribute to a higher 'groove value'. Indeed, the performer played significantly faster in the groovy performance than in the non-groovy performance during trials that had no tempo limitation in Experiment 2. From this, it can be inferred that the performer himself regarded the performance at a faster tempo as having a groovy sound. Conversely, audience members tended to regard a faster performance as groovy than the performance which the performer regarded as the most groovy. Two factors may affect this phenomenon. First, as Experiment 1 showed, participants tended to regard a performance at a faster tempo as groovy. Second, the number of sounds which acted as a cue for 'groove feeling' was too small in Experiment 3. In fact, the cymbal sound was excluded in Experiment 3 despite the fact that in Experiment 4, the performer regarded the cymbal as an important factor in the expression of the groove sensation. These results suggest that tempo which is an easy cue may prompt audience to perceive a performance as groovy, rather than the more subtle trigger of the timing of the performance. This study does not elucidate the visual, situational,

or social factors. Although acoustic features induced groove, the perceived performance sound was also affected by various factors such as whether the performance was live or recorded, the performer, or how the audiences reacted to the performance. These factors should be examined in future. Our results suggested that in the early 2000s in Japan, the term groove described specific acoustical features for both performers and audiences. This aspect is significant when we research groove from a cultural perspective because the connotations of groove gradually diversify in musical scenarios and other situations. We do not exactly understand how the concept of groove has changed because we did not conduct time-series researches. Therefore, a non-experimental approach, e.g. musicology may be able to explore a phenomenon such as groove. If changes occur with respect to musical terms or concepts in not only Japan but also other countries, international comparisons on these phenomena will enable us to be aware of how discourses on popular music penetrate different societies. Future studies should follow the transition of groove in the new era.

Conclusion

This study revealed the psychological aspects of 'groove feeling' using data from the early 2000s in Japan. The results suggest that the concept of 'groove feeling' was recognized as a relatively specific term, which was strongly related to rhythm. Our data also suggests that a faster tempo and appropriate tempo variation functioned as cues that prompted the expression and recognition of

'groove feeling'.

More recently, the term 'groove' has come to refer to a wider spectrum of concepts in Japan. The meaning of groove has diversified as the term itself becomes more recognisable in Japan. Future studies need to explore how the term 'groove', a new foreign term for music, has spread and changed its meanings or remained unchanged.

Acknowledgements

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