

# Control of Personal Tempo to Support Individual Action and Cognition

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**Abstract.** We live in our own rhythms in daily lives. Human life is closely related to rhythm as the words “talk rhythm,” “getting into the rhythm” and the “Biorhythm” show. The rhythm is important for us to live in order and cheerfully. Each person has his/her own action rhythm called the “Personal Tempo.” It is the basic rhythm observed in person’s voluntary actions, such as tapping on a table. Psychology has been studying this phenomenon for long years. By measuring the personal tempo, person’s psychological condition can be inferred in all situations because personal tempo changes within a certain width according to person’s psychological condition, while it basically shows homeostasis. Most studies have focused on relation between personal tempo and physiological measures, such as cardiac rate, but not on control of cognitions and actions by controlling personal tempo. In this paper, a control method of individual action by controlling the personal tempo is proposed. Drum beat pattern is used to control the personal tempo. We show the effectiveness of this method by applying this to cooking, especially chopping by a knife.

**Keywords:** personal tempo, rhythm, action control, sound rhythm.

## 1 Introduction

The times when music is carried every times. The spread of the portable music player is who makes i-pod of the Apple Co in recent years.

In previous works, due to rhythm sound causes synchronous reaction, listening rhythm sound cause physical rhythm, but there are no psychology studies about individual rhythm or characteristic and there has been no study that tried to materialize rhythm supporting.

This paper discusses rhythm sound based personal tempo is valuable for physical rhythm. We investigate how effect does the sound when monotonous action by experiments. We discuss the future of supporting method by sound rhythm based personal tempo from investigate result in the seventh chapter.

## 2 Related Research

### 2.1 About a Personal Tempo

A personal tempo is a rhythm feeling that exists inside the individual, and the principle that has been researched in physiology from of old. There is a personal tempo between 68bpm (bit per minute) - 158bpm. Moreover, the speed of the tempo is admitted to change by the interaction with the mental status, and when the changing tempo is removed, too the homeostasis that returns to former state with the time passage is admitted to be had [2]. Personal tempo is reported to be no origin from the physiology function, peculiar to the individual, and change by feelings and the environment [3], but details of them are not clear.

The personal tempo is individual and different from others. As for the relation between human and the rhythm are deep as words such as "Rhythm of life" and "Rhythm of the conversation" show from our experience. It is thought that it has some influences on the action so that it is suitable from there to rhythm, not suitable or differences of others' tempo speed are admitted. In communications with others, there is something that the relation between speakers and communications of the smoothness degree is examined as the research theme of having the personal tempo [4]. As for communications with the others having similar rhythm feeling, the thesis that the tune tendency is seen at the early stage of communications was reported.

### 2.2 Relation between Locomotor Rhythm and Sound Rhythm

As for related research and related psychology experiment concerning the sound rhythm, especially, many research papers from musical aspect are announced. The early research on the locomotor rhythm and the sound rhythm is the research of "Effect of drawing in" that appears when the walking operation is done while listening to music. This paper reported that we cause a synchronous reaction easily as for the rhythm, the sound rhythm causes the locomotor rhythm, and the locomotor rhythm causes the sound rhythm[5]. Moreover, many researches of the music recommendation system have reported in recent years from to being able the easy treatment of music by data and becoming of individual music data are hugeness.

From such the background, many products and research about relation between the music recommendation system and the movement are reported.

### 2.3 About a Personal Tempo and the Locomotor Rhythm

We feel some rhythms in living, and act as synchronizing with the rhythm. As the example, it is seen a lot in monotonous constant operation such as the walking operation and the pedaling of bicycle, and their rhythms of the action are matched to the rhythm of listening music. Relation between the action that have constant rhythm and the personal tempo is admitted by a lot of related researches. Moreover, when it is made to think and to come round by something to worry about, our finger and foot might be moved in unconsciousness by a constant rhythm. This is the example of the natural embodiment feeling the rhythms. The relation between rhythm perception and a personal tempo can be expected from these while thinking.

### 2.4 Support of Monotonous Locomotor Rhythm

In this research, we reports on the verification results that the sound rhythm based on a personal tempo gives what influence and drawing in to individual feelings and the locomotor rhythm in a monotonous behavior pattern. The system that supports our action and cognition by personal tempo based on personal tempo is useful, if there is considerable validity in the results.

In the verification experiment, we use the drum rhythm based on a personal tempo and focus attention on cutting the material in cooking as action of locomotor rhythm, we consider what influence the action synchronized in the rhythm based on a personal tempo. Figure1 shows the rhythm support model. The early research reports the utility of the rhythm support of monotonous locomotor rhythm such as the walking operation and pedaring of the bicycle, and we develop it and focus attention on a little complex work pattern of cutting rhythm basic operation in this research. Cutting is work that the rhythms exists, and the good effect can be expected.

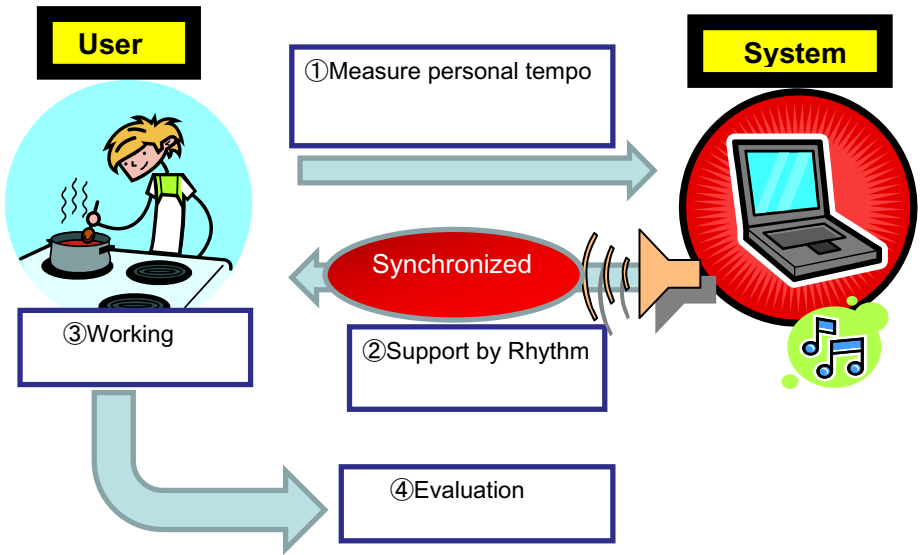


Fig. 1. A Model Which Supports Rhythm in Daily Life

## 3 Outline of Systems

The third chapter presents the experimental system that uses it for the verification and describes which the sound rhythms to select in a prior experiment.

### 3.1 Support by Drum Rhythm Pattern

In this research, it paid attention only to the drum rhythm as the sound rhythm for the rhythm support. We need to specify the sound rhythm to support it because the music

is composed by various sounds and musical instruments at the same time. The drum rhythm is bases, and supports the basis of the rhythm of the music. Various patterns exist in the drum rhythm, and it is composed by the combination and repetition.

We use 5 kinds of typical examples and 7 kinds Basic examples of each musical genre of the drum rhythm pattern in this research.

Typical examples are;

*Metronome (2beat) / 4beat / 8beat / 16beat / Shuffle Beat*

Basic examples of rhythm of each musical genre are;

*Rock / Samba / House / Techno / Funk / Ska / EuroBeat*

Total 12kinds

12 all kinds of patterns were made with MIDI sound source software LM-7 by using Cubase (by the Steinberg).

### 3.2 Details of the Experimental Systems

This system measures user's personal tempo immediately before working, because the personal tempo is not always constant. It shows in Figure 2 as an example of the system screen.



Fig. 2. A Screen Image of System

It is measured by keyboarding the Space key in user's comfortable rhythm according to the instruction of the system screen. In this research, we define the keyboarding tempo is the personal tempo, BPM (bit per minutes) signify the speed. The speed and the rhythm pattern of the rhythm can be changed and reproduction/be stopped on the system screen.

## 4 Experiments

In this research, it experiments on the rhythm support as the behavior pattern that the singsong is admitted for the work cut while cooking. First of all, we verify which rhythm pattern worked easily in the work that each testee cut in experiment1. Next,

we verify what change was seen by changing the speed of the sound rhythm of the rhythm pattern in experiment 2. The rhythm pattern is result of experiment1.

The Testees were ten university students of 20-24 years old, and they are independently verified it respectively.

**4.1 Experiment 1**

The measurement of the personal tempo is input by using an experimental system immediately before work begins. It was to measure after it had been taught to testees, "Please strike key at a pleasant speed when it walked not too fast but not too late" in the measurement of the personal tempo. The measurement was finished, the sound rhythm started, the testees started cutting the material. The flowing rhythm flowed sequentially the one made at the same speed as a personal tempo, reproduced one by one by about two minutes one rhythm pattern, and made it answer the evaluation item by oral. Is the evaluation item natural compared with each rhythm pattern. Do you feel that it is fast unnatural. The sensibility was evaluated by the SD (Semantic Differential) method of seven stages and six items in a comparative content of feeling were done.

**4.2 Experiment 2**

One rhythm pattern is chosen by the rhythm pattern evaluation of each testee is the highest in experiment1,

- 1. speed that makes the personal tempo +10bpm fast
- 2. speed that makes the personal tempo +20bpm fast

In two rhythm support, it is made to answer the evaluation by oral just like experiment 1, and we consider what change is seen between result of experiment1 and above two cases in the sensibility evaluation.

**5 Consideration**

**5.1 Verification Result**

In the paper, we propose the rhythm support based on a personal tempo that existed inside the individual, and we do the verification experiment by the drum rhythm system based on user's personal tempo. It is because the early research that was not considering a rhythm feeling different depending on the individual. Our report proves the personal tempo is within 68bpm-158bpm (Refer to Table 1).

**Table 1.** Personal Tempos of Subjects

Testee	A	B	C	D	E	F	G	H	I	J	Average
<b>Personal tempo(bpm)</b>	100	68	69	78	128	80	95	100	117	80	91.5

The tendency to which the preference was not so shown because suitable for the rhythm of the cut work and not suitable became important in the evaluation when be working, and it was selected by a pattern like the *Samba* rhythm and the *House* rhythm. It is because their rhythm is not too monotonous but not too complex. This is thought that the evaluation was high from the point corrected that it is possible to synchronize again when the gap is caused in the work rhythm and the heard sound rhythm easily. Therefore, it can be said that the pattern that is not liked monotonous sound rhythm even if it is a monotonous work rhythm but a little complex composition that can be corrected will be liked.

Next, the tendency that the rhythm support evaluation when being working by presenting the sound rhythm that hastened +10bpm from a personal tempo becomes higher was shown in the same rhythm pattern since the evaluations of experiment 1 and experiment 2 were compared. This is because a personal tempo is drawn in to the rhythm by fast support, and the rhythm of the cut work is promoted more of +10bpm because the act of cutting the material is done from a personal tempo a little by a fast rhythm. Moreover, we pay attention to the fall of the evaluation in the support of +20bpm fast rhythm. There were a lot of opinions that it was not easy to work because the sound rhythm was too fast as for +20bpm though it became easy to work in +10bpm.

We targeted the cutting rhythm to support of the work in the research. The utility of support by the sound rhythm based on a personal tempo was confirmed in the locomotor rhythm that the work of the cut work was drawn in to the sound rhythm in the pattern that the testees felt worked easily from the result of the questionnaire. There were a lot of opinions of having felt support and the constant rhythm existed.

## 5.2 Problem

The problem in this research has the measuring method of a personal tempo. It is necessary to examine the method of putting besides the rhythm expression by the hand because the measurement of a personal tempo is thought expressing targeting timing and the rhythm of key stroke is not only the finger but also expresses the rhythm by the foot and the body. In the measuring method, it was necessary to investigate user's psychological condition more in detail, and to arrange the condition like the same place and time zone.

The personal tempo changes on each occasion. It is thought that it is load for the users to measure it in every case in the action of daily life, and they have to measure it when we take the system within daily life. It is necessary to make the system automatically measure it from the rhythm expression of the user, and to reduce the user's load.

Moreover, the user wants to extract it psychological condition automatically in the future. It is thought that the psychological condition is predictable to measure all testee's information with compress strength of keyboard when the personal tempo is expressed, the ventricular rate, and the psychology rating equipment of the stress meter. We want to verify continuously in the future, and to increase the number of case samples.

## 6 Future Work

The experiment verification in the effect of drawing in of the sound rhythm by an experimental system based on a personal tempo was done in this text.

It is thought that this research has a good influence on the working user when it is reluctant compared with work and work that monotonous operation continues excluding the operation targeted by this research. It relates to the car stereo based on the verification result of this text, and the support of the driver who drives a motorcar will be examined in the future. The driver's personal tempo and psychological condition are recommended, and the system takes into consideration, and recommends the best music for each occasion and the sound rhythm that takes the place of it from the information automatically by the car stereo. As the support target, it wants to take various information and support that not only the support of work of driving of controlling the attention rousing and irritation but also support, the road situation, and the weather of the place that communications in the car are related to the driver of consideration into consideration, and to propose the supporting method based on a personal tempo.

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