

# Supporting Conversation via Use of Personal Tempos

Kosuke Adachi, Naoya Nobutani, and Yoshio Nakatani

**Abstract—** We feel own rhythm in life. The relation between human and the rhythm is deep as the word called the rhythm of talk, the rhythm of life and the Biorhythm show. The rhythm is important and live cheerfully for us. Rhythm feeling that each person has is called Personal Tempo. It is basic action in time according to man's voluntary movement. This is a principle that has been researched for a long time in Psychology. It is likely that measuring the tempo is effective to measure the psychological condition in all situations because personal tempo has accurate homeostasis, and changes by feelings and the situation. Most studies have focused on relation between personal tempo and man's basic operation like pulse and walking operation, but not focused on relation personal tempo and man's action patterns in the life. In this paper, we propose conversation support by arranging personal tempo using drum rhythm patterns.

**Index Terms—** personal tempo, conversation support, drum rhythm pattern and music

## I. INTRODUCTION

People typically have daily life rhythms that can be expressed by the pace they walk at or the speed of their conversations and so on. That speed represents one's individuality, and can be particular to the individual person. Appropriate support for that rhythm can be expected to have a good influence on people's behavior and cognition. In contemporary society, where the people's natural rhythm can tend to be disturbed by stress or a sense of stagnation, the expectation is that normalizing people's disturbed rhythms and psychologically adjusting them could reduce that stress.

This study focuses on conversation, which is the basis of communication, and proposes a conversational support system via use of rhythm. Support via paying attention to the listener proved to be effective in a verification experiment. People can occasionally feel awkward when speaking at conferences or conversing with someone new. It is thought that this sense of incompatibility is caused by the difference

in pauses between speakers, with having been reported that it is related to the speaker's personal tempo [1]. The awkwardness and sense of incompatibility could be improved by adjusting the differences in tempos, for example the timing of nodding and speed of speech. The authors succeeded in improving the tempo of behavior that controls the sense of rhythm of an overall conversation, such as through nodding, by involving the listener in speaker's personal tempo when two people were talking, and constructed a system that supports communication.

## II. PROCEDURE FOR PAPER SUBMISSION

### A. Background

It has recently been reported that one in 15 people suffer from depression, and contemporary society has the problem of stress resulting in a mental burden. Many sources of stress derive from interpersonal relationships. Social activities involve a lot of chances to talk to someone for the first time and scenes such as conferences where one needs to converse with a number of people, thus making it important how well they speak in these situations and make mutual concessions. It is essential in conversation to measure the gap between the other party and how they match each other's rhythms. The use of a system to support the rhythm of conversations, which can differ with the individual person, can help mitigate awkwardness and any sense of incompatibility, thus achieving support that allows one to comfortably talk to someone new while also allowing those on a different wavelength to successfully make compromises with each other.

### B. Personal tempos

A personal tempo is a biological rhythm that is particular to the individual. It is a speed particular to an individual that is naturally expressed in a free environment without any restrictions in activities in daily life such as talking and walking [2] [3]. It is called "Self-paced tempo" or "mental tempo". It has been researched in physiology for some time now with a lot of experiments having already been conducted in the first half of the 1900's. It is related to people's walking pace and pauses in their conversation, [3] and often measured by the tapping on a desk repeatedly with a finger. Generally, it is clarified that there is a personal tempo between 380 milliseconds to 880 milliseconds, which is between about 0.4 seconds to about 0.9 seconds, at Topping's intervals. Especially, it is clarified that there is the tempo of the favor, which is felt the most naturally, between 500 milliseconds to 600 milliseconds [2]. The tempo changes to match it via a

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K. Adachi is with the Graduate School of Science and Engineering, Ritsumeikan University, Kusatsu city, Shiga, 525-8577 Japan (phone: +81-77-561-5932; fax: +81-77-561-5203; e-mail: [cc000065@ed.ritsumei.ac.jp](mailto:cc000065@ed.ritsumei.ac.jp)).

N. Nobutani is with the Graduate School of Science and Engineering, Ritsumeikan University, Japan, and is now with the Yokohama Minatomirai Office, Fuji Xerox Co., Ltd., No.6-1, Minatomirai, Nishi-Ku, Yokohama-shi, Kanagawa, 220-8668 Japan (phone: +81-045-755-5111).

Y. Nakatani is with the Graduate School of Science and Engineering, Ritsumeikan University, Kusatsu city, Shiga, 525-8577 Japan (phone: +81-77-561-5932; fax: +81-77-561-5203; e-mail: [nakatani@is.ritsumei.ac.jp](mailto:nakatani@is.ritsumei.ac.jp)).

mental interaction, with it being said that the change in tempo is homeostatic in that it returns to the original over time once the variation factor is removed. Personal tempo is said a rhythm of the favor of the individual, but the problem is consistency of time whether it is always the same if it is the same situation under or not. Table.1 shows various studies about consistency of time of personal tempo according to the problem. In the tap movement with most reports, all study show the very high correlation coefficient that 80 or more. This report proves that the individual consistently has a personal tempo and it is not influenced easily by a chance error margin.

Table. 1. List of studies about consistency of time

Study	Number of people	Interval	Problem					
			tap	Writing	Reading	Swinging arm	Walking	Ergometer
Lankes(1914)	47	7 days	0.85	-	-	-	-	-
Braun(1927)	31	1 day	0.9	-	-	-	-	-
Allport & Vernon(1933)	25	28 days	0.96	0.87	0.88	-	0.82	-
Rimoldi(1951)	17	15 days	0.87	0.89	0.83	0.78	-	0.75
Mishima(1965)	10	1 year	0.99	-	-	-	-	-
Suginoura(1965)	57	3-10 months	0.88	-	-	-	-	-
Smolik(1975)	60	1 day	-	-	-	0.94	-	-
Taguchi et al(1981)	5	7 days	-	-	-	-	-	0.73
Taira(1983)	17	7 days	-	-	-	-	-	0.98
Collyer et al(1984)	16	1 hour	0.91	-	-	-	-	-

C. Support for individual actions

It is easy to cause synchronous reactions with rhythm. According to research [4] that treats it as a cycle in that a rhythmic sound causes a locomotor rhythm and a locomotor rhythm causes a rhythmic sound, Nobutani did a verification experiment on a monotonous locomotor rhythm, being the cutting of vegetables with a kitchen knife while cooking, and intended for an individual by using a rhythmic sound based on a personal tempo. The results confirmed the effect on the locomotor rhythm by adjusting their personal tempo being adjusted by the rhythmic sound, with a significant effect being shown. And even if it is the same tempo speed the influence on actions can greatly differ according to the pattern of the rhythm. The effect of complex rhythms such as Samba, House, and 16 beats, in particular, has been confirmed. It is thus said that a drawing in an individual locomotor rhythm to a specific rhythm pattern can be beneficial.

D. Personal tempos and conversation

An example of research on personal tempos and communication with others involves the relationship between the difference in personal tempos of the speakers and degree of the smoothness of communication being examined [1]. This research states that the speaker's personal tempo is related to the speaker's alternation latency and that tempo of the speaker who initiates the conversation provides for the beginning timing of the second speaker. The research states that a tune tendency can be seen in the early stage of communication in one with a similar sense of rhythm.

Moreover, it has been revealed that mutual understanding of the recognition of the "pauses" of each other is important for two people to smoothly communicate, and is thought that a system could be used to extract the difference in speech tempos of speakers from observing a speaker's speech tempo and any correlations, and then be used to adjust any gap in "pause" tempos by providing speech when the speaker alternates, and thus supporting it more smoothly.

With the rhythm of conversations when to nod is also important, in addition to the speech tempo and "Pauses". There are a number of preceding studies that have addressed nodding. It is thought that a nod is one of the listener reactions and important in smooth communication. A professional counselor, who is specialist listener, stated that conversations can be brightened and the speaker's wave rode by returning answers that flow and match the talker's rhythm when talking one to one [7]. According to that type of research the listener's nods and the timing of when they start speaking are very important to talk rhythmically, and at first it is necessary to pay attention to the listener as support to the conversation.

III. CONTENT OF PROPOSAL

The study expands upon the objective from the individual level to a plurality of people's coordinative behavior and proposes a system that supports two people's conversation behavior via personal tempo (Figure 1). The support procedure involves first measuring the talker's personal tempo and then providing the listener with external stimuli that consists of a rhythm of the same tempo. The system utilizes vibratory stimulation with a Samba rhythm pattern, which proved effective in support in experiments at the individual level. The listener feels the vibration of external stimuli via the tip of a finger and talks while being drawn into the talker's personal tempo. It is thought that the listener's reaction is that it makes speaking easier for talker than before because it concedes to the talker's sense of rhythm by being drawn into their rhythm. The rhythm might arise via the entire conversation, the talker's rhythm be interactively drawn into the listener's rhythm, and it become a rhythm that it is easy to listen to for the listener because they get drawn into it, and the talk advances for the talker at advantageous terms. A rhythm arising in the conversation results in the conversation being stress-free and good communication.

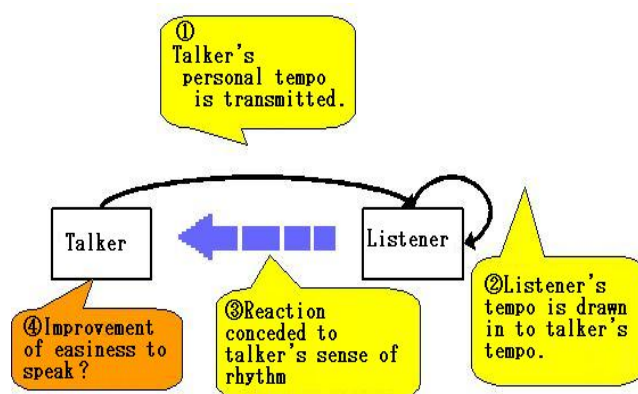


Fig. 1. Support image chart

#### IV. SYSTEM CONFIGURATION

##### A. Support by drum rhythm pattern

This study pays attention only to the drum rhythm as a sound rhythm for the rhythm support. Because usual music is composed by ringing of various sounds and musical instruments at the same time, it is difficult to analyze which element of music (melody, rhythm, and key, etc.) gives the effect. The drum rhythm is base of music most, and supports the basis of the rhythm of music. Drum rhythm influences a personal tempo most immediately, so this study chooses drum rhythm.

There are various patterns in the drum rhythm, and it is composed by the combination and repetition. This study uses the Samba rhythm because the effect of drawing in was able to be confirmed most in monotonous movements in the prior experiment [5]. The upbeat and the down beat are built into the Samba rhythm just well, and it is thought that it is easy to correct when the gap with the locomotor rhythm is caused. So this study continuously uses it.

The rhythm pattern of Samba refers to the textbook of the drum rhythm [8], and uses the music made with MIDI sound source software LM-7 made by Steinberg Ltd.

##### B. Outline of proposed system

The assumption is that the system is used to measure the talker's personal tempo and then the listener is provided with the rhythm as an oscillating rhythm, resulting in them being drawn in, and the rhythm of the entire conversation is adjusted using it, and a support system in which the sense of touch was used via a vibration device that was made for trial purposes. Figure 2 shows an image of the system. As a support procedure the speaker's personal tempo was first measured. Next, a personal transmitter, hereinafter referred to as "transmitter", generates a vibration based on the measured speed and provided to the listener as a vibration. The listener then talks with the speaker while feeling vibrations via their finger.

The support of rhythm would appear to influence conversations in various ways, but because individual variations are large with respect to the content and the number of utterances per conversation "pauses" in the conversation were paid attention to, and the research focused on examining the influence on how to time the listener's nods. This allowed a comparative study of what changes occurred from the support to both the speaker and the listener. The method of using the "Sense of touch" whereby the rhythm vibration was felt by the skin was adopted in this research, although "Aural" via hearing the rhythm was targeted in the research on individual support. It depends in the case of sound on the idea actually felt and the effect of support that is more intuitive will depend on the consideration of the influence on the conversation, with aural being expected to be effective.

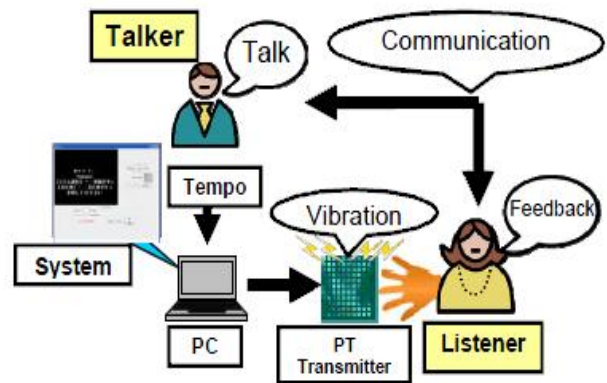


Fig. 2. System configuration chart

##### C. Tempo measurement system

A system to measure the personal tempo of the speaker was made using Java. A PT transmitter to reveal the rhythmic vibration and the speaker's tempo to the listener by improving the speaker was also made. The measuring method involves booting up the system on a notebook computer and is measured using the tapping method in which it strikes the key at a speed at which the key to the keyboard feels comfortable to the forefinger. After the measurement a rhythmic sound based on the personal tempo speed of the speaker is then selected. The sound the rhythm uses is patterned on the Samba rhythm as its effectiveness was proved when researching the individual support and is made of MIDI. It is converted into an oscillation rhythm by the musical signal being passed onto the PT transmitter, and through a finger that the speaker puts on the corn of the speaker.

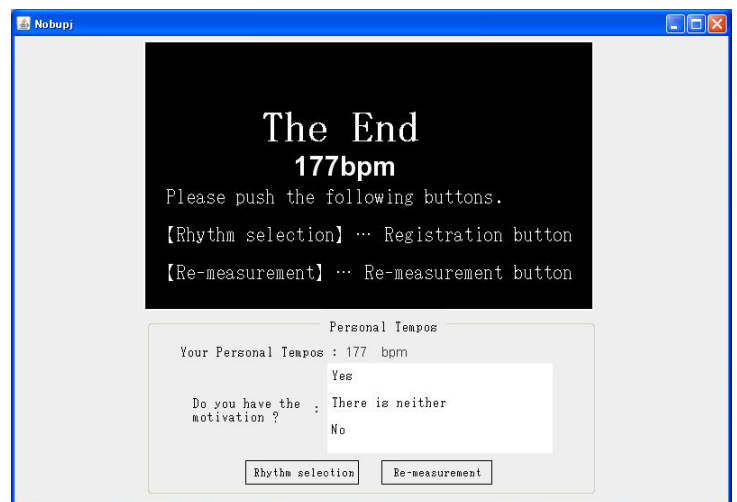


Fig. 3. Example system screen

## V. EVALUATION EXPERIMENT

### A. Experimental method

The experiments involved the two roles of a speaker and a listener. They also involved comparing cases with and without use of the system. The conversation was not just free conversing and instead required the speaker to introduce them self and the listener to listen to the speaker with a view to then facilitating a comparison. The speaker was required to complete the sentences involved in their introduction prior to the experiment using a self-introduction format provided in advance by the experimenter, and then to read the sentences. The comparison between the two patterns of with and without the system was intended for use in examining how the two patterns differed, with the experiments therefore being used to verify two experimental groups: a group to be examined with the system first followed by an examination without the system, and *vice versa*, and taking into account that which experiment should be done first, the one with or without the use of the system, could affect the result.

### B. Evaluation method

12 pairs were evaluated. The evaluation method used to verify the effect of the support included a subjective evaluation via questionnaires being provided to the speakers and listeners, as well as objective evaluations that quantitatively evaluated changes in personal tempos, the number of nods during the experiment, and stress values via monitoring salivary amylase.

## VI. RESULTS AND DISCUSSION

### A. Experimental results

Figure 4 shows the changes in the personal tempos prior to the experiment and both with and without the system. Figure 5 shows the number of nods as reactions of the listeners, Figure 6 is a comparison of increase and decrease of number of nods, and Figure 7 stress loads. The values in Figure 6 represent that the examined persons felt more stressed when the values are small and less stressed when the values are large.

The free description questionnaire revealed that the listeners felt themselves drawn into the conversation, possibly indicating they were affected by the support of the system.

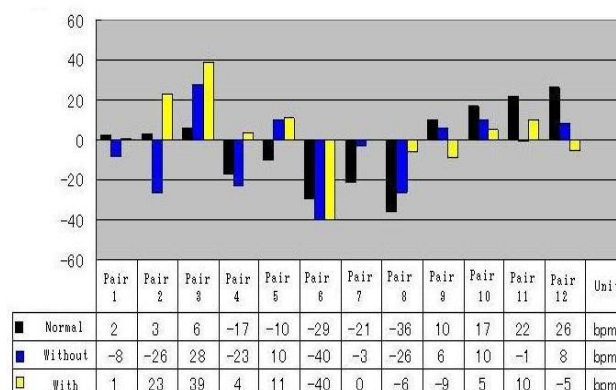


Fig. 4. Differences in personal tempos

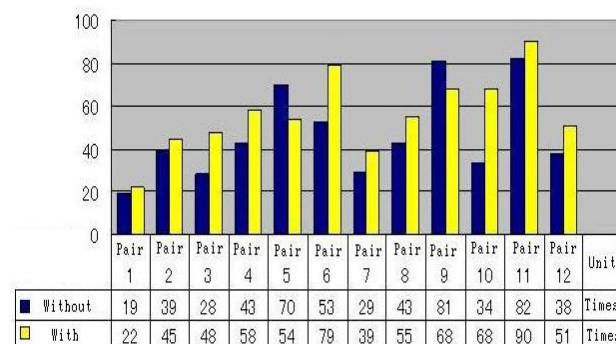


Fig. 5. Changes in number of nods

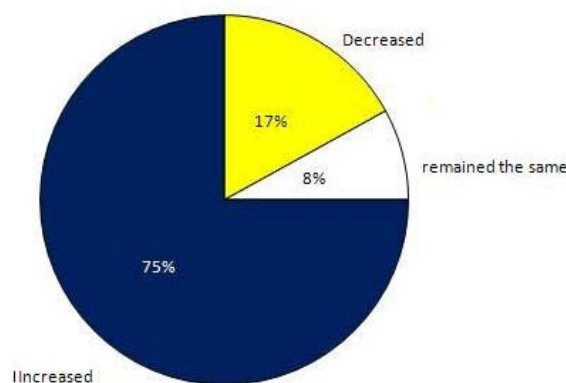


Fig. 6. Comparison of increase and decrease of nods

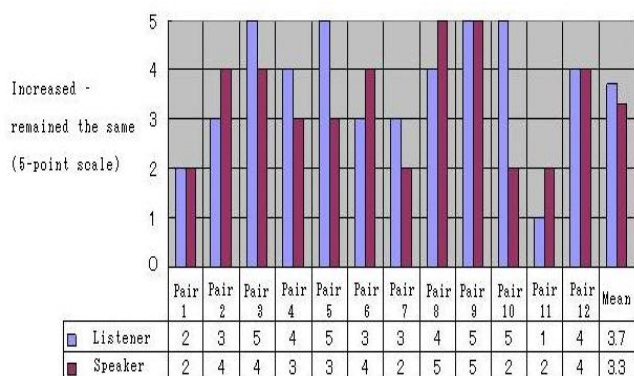


Fig. 7. Changes in stress values with and without the system

### B. Discussion

As shown in the evaluation experiment an increase in the number of nods by the listeners through the support, the questionnaire stating their feelings of being drawn into the conversation and other factors indicated that the listeners were drawn into the personal tempo of the speakers, which might have possibly led to an increase in nonverbal communication, which then provides rhythmical “pauses” in the conversation, namely of nods serving as the listeners’ reaction. In addition, changes in the measured values via monitoring salivary amylase revealed the support to the listeners was psychologically positive. These results explain that drawing the listeners into the personal tempo of the speakers by means of haptic stimuli allows the listeners to listen to the speakers without feeling stressed so that they can then convey their reaction to the speakers through nodding in thus filling in the “pauses” between the speakers and listeners. Nevertheless, a failure to demonstrate the effect on the speakers would appear to indicate the necessity of support for the speakers by drawing them too into the personal tempo.

## VII. FUTURE STUDY

### A. Future plans

In the future the authors intend to address support for the people speaking, which have remained an issue. By shifting the examinees from being the listeners to the speakers preliminary experiments have taken place in examining how manipulating the speakers’ personal tempo could control their speed of speech. The results of the experiment will be used to develop a system that can be used to ensure smooth conversation between both the speakers and listeners via manipulating the speed of utterances.

### B. Preliminary experiment

A study has reported that a person with a fast personal tempo does not necessarily speak fast, indicating little correlation between the two factors [1]. However, changes in the speed of utterances being made by manipulating personal tempos would leave room to verify that as there seem very few cases reporting such changes taking place. Taking into consideration the successful support for individual behavior

via the drawing in effect [5] personal tempos may actually account for the speed of utterances.

A preliminary experiment is therefore currently in progress on support that focuses on the speaker. The experiments measure a speaker’s personal tempo and draw the speaker into the tempos, both faster and slower than the measured tempo, in examining changes in their speed of utterances.

The methods of measurement will include measuring the speed of utterances via video-recording conversations and measuring stress values via monitoring salivary amylase.

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