



Technical Note

Characteristics of Buddhist chanting in Japanese temples

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ABSTRACT

Buddhist monks change the way of voice production according to the ceremony, and associated acoustic changes have not yet been examined scientifically. In this study, three kinds of chanting voices were recorded in Japanese Buddhist temples and analyzed. The difference in voice production between chanting and normal speech was reflected in the loudness, fundamental frequency, pitch strength, and spectral centroid, which is characterized by autocorrelation function. Voice production in each stage of Nembutsu-Wasan singing was characterized by the loudness, fundamental frequency, and pitch strength.

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1. Introduction

Churches and temples can be a place of worship used for prayers, preaching, or chanting a sutra. The effects of aspects of the style of ceremony, such as source location and direction, in Japanese churches and temples on acoustic characteristics have recently been clarified [1,2]. Although voices also play important roles in the ceremony, the acoustic characteristics of the voices in Japanese temples has not received adequate attention in the literature.

Most activities performed in temples are related to speech and similar to singing. Extensive research has revealed the acoustic characteristics of the singing voice to be the fluctuation component of vibrato, which is a quasi-periodic fluctuation component of the fundamental frequency [3–5], and a salient frequency component around 3 kHz, which is called the singer's formant [5–7]. The characteristics have also been identified in Western classic and Japanese traditional singing [8,9].

Buddhist monks control their voices according to the ceremony and sutra, but the acoustic changes in this regard have not yet been examined scientifically. To clarify the acoustic change, we recorded and analyzed Buddhist chanting for different sutra and way of voice production.

2. Methods

2.1. Investigated temples and monks

Temples A and B investigated belongs to the Hongan-ji and Otani denominations of True Pure Land Buddhism (Jodo Shinsyu), respectively. They were built of wood and mortar in 1661 and 1895, respectively. The altar of the Buddhist temple has two side chapels, one on either side of the altar. The congregation sits on the floor in the central aisle. The floor is covered by straw mats (tatami) except for the wooden board in the altar. Fig. 1 shows the ground plans of the temples investigated. The volumes of the temples estimated from the floor areas and average ceiling heights A and B were 554 and 637 m³, respectively, which are considered typical of Japanese temples [10].

Two males participated in the investigation of temple A. One is a practical Buddhist monk and the other is a monk who has received limited training. Four males and one female, all practical Buddhist monks, participated in the temple B.

2.2. Chants

Three Buddhist sutra were chanted. One was the Hyobyaku message, which is chanted in one of the most important Buddhist memorial services, Houonkou. To compare the acoustic characteristics of the basic way of reading the sutra and speech, Hyobyaku messages were chanted in the manner of a usual ceremony (H1) and in the manner of ordinary speech (H2) only in temple A. The

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second sutra was Nenbutsu–Wasan singing, which has “crescendo” and “allargando” features, if we use the terms of western music, in three stages. Pitch rises when Nenbutsu–Wasan is sung from the first to third stages. In Nenbutsu–Wasan singing, Nenbutsu and Wasan are sung alternately in three consecutive stages, e.g., Shojyu Nenbutsu (N1) might be followed by Shojyu Wasan (W1), Nijyu Nenbutsu (N2), Nijyu Wasan (W2), Sanjyu Nenbutsu (N3), and Sanjyu Wasan (W3). In Nenbutsu singing, Chinese holy phrases called Nenbutsu are sung. Nenbutsu consists of only six syllables – “NA-M[U]-A-M[I]:-DA-BU-[TSU]” – and is repeated. In Wasan singing, Japanese hymns are sung. The third sutra was Hakkotsu no Ofumi (Of), which was selected by Rennyo, the eighth chief priest of Jodo Shinshu. The term “Ofumi” is used only by the Otani denomination of Jodo Shinshu, and the term “Gobunsoyo” is used only by the Hongan-ji denomination of Jodo Shinshu.

2.3. Monk and receiver locations

Monk locations were considered to be the actual monk position during ceremonies in each temple. Monk 1 (M1) was placed in front of the altar and directed towards the altar. This is the most common location for Buddhist monks to chant a Buddhist sutra toward the altar. Monk 2 (M2) was placed slightly on the left at the front of the temple and directed towards the right lateral wall, matching the location where Buddhist monks recite Hakkotsu no Ofumi. The receiver (R) was placed in front of M1 as shown in Fig. 1. The receiver was a dummy head with binaural microphones (KU-100, Neumann). The dummy head microphone was located at the head height of a person sitting on their heels, 0.9 m from the floor. The dummy head always faced forward towards the center of the altar. The chanting sounds were recorded by a laptop computer at a sampling rate of 48 kHz and a sampling resolution of 24 bits through the microphone and an AD/DA converter (Audio-Fire8, Echo Digital Audio). All measurements were taken while the temples were unoccupied.

2.4. Method of analysis

To characterize chanting sounds in the temples, we analyzed spectra, the A-weighted equivalent continuous sound pressure level (L_{Aeq}), and parameters extracted from the autocorrelation (ACF) and inter-aural cross-correlation function (IACF) [11]. The ACF parameters, τ_1 and ϕ_1 , are the time delay and amplitude of the first maximum peak and are related to the fundamental frequency and pitch strength of the complex sounds [12,13]. The third ACF parameter, $W_{\phi(0)}$, is the width of the first decay and corresponds to the spectral centroid [11,14]. The IACF parameter,

the interaural cross-correlation coefficient (IACC) is related to the subjective diffuseness and apparent source width [13,14]. When the IACC is 1, people can clearly perceive the direction of the sound source. As the IACC approaches zero, people can hear the sound, but the sound is diffuse [13,14]. We calculated the spectra, L_{Aeq} , τ_1 , ϕ_1 , $W_{\phi(0)}$, and IACC as functions of time. The window size or

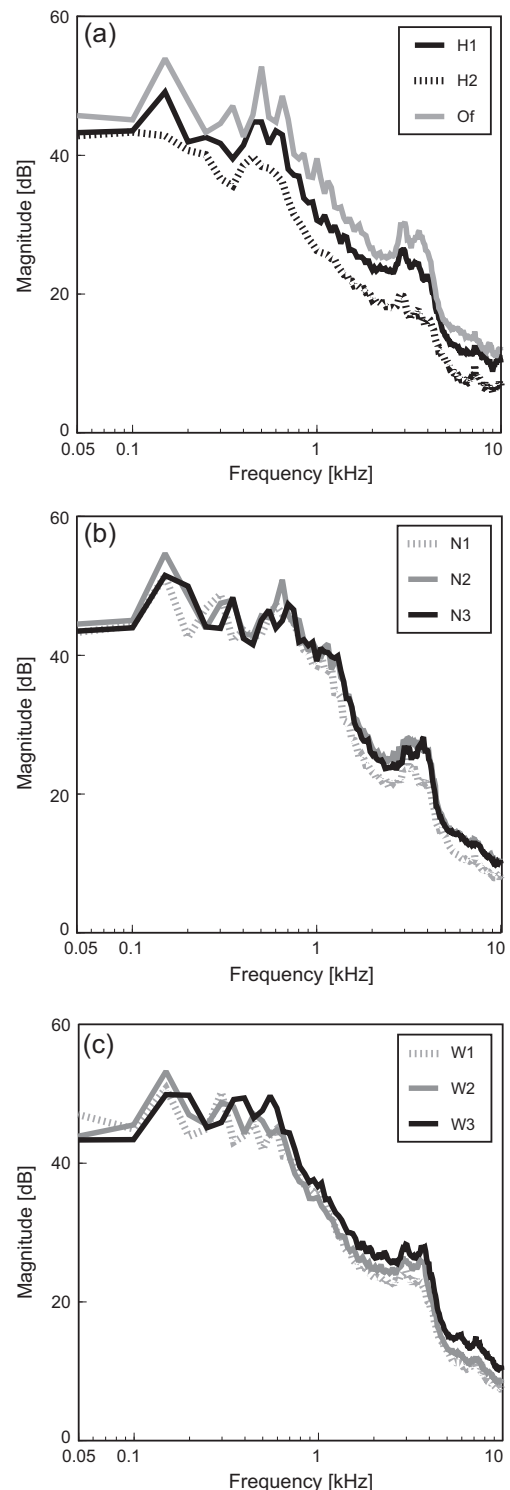


Fig. 2. Averaged spectrum for (a) Hyobyaku messages chanted in the manner of a usual ceremony (H1), and ordinary speech (H2), and Hakkotsu no Ofumi (Of), (b) Nenbutsu singing in Shojyu (N1), Nijyu (N2), and Sanjyu (N3), and (c) Wasan singing in Shojyu (W1), Nijyu (W2), Sanjyu (W3), in temple A.

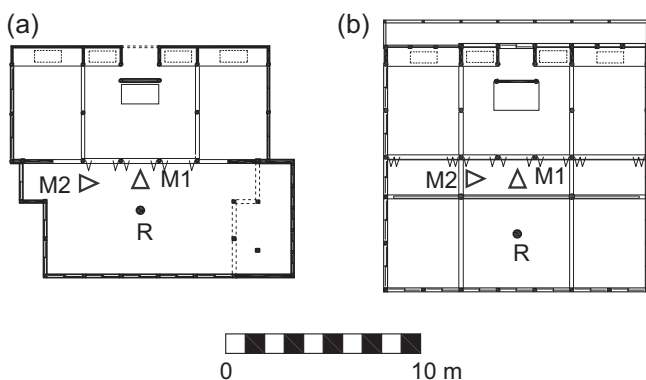


Fig. 1. Ground plans of temples (a) A and (b) B with monk (M1 and M2) and receiver locations (R) (same scale for the two temples).

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