Paper2

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Background

Perception of temporal aspects of the sound is crucial to human beings as it forms the acoustic basis for speech identification. Temporal resolution and temporal integration are two of the very important fundamental temporal processes (Eddins & Green, 1995) wherein the former refers to the ability to detect changes in stimuli over time, while the latter is the ability of the auditory system to integrate energy over time (Moore, 2007). Functionally, these abilities serve to regulate speech perception in quiet as well as in adverse listening conditions. Moore (2007), identified the importance of these abilities also in music perception.

Clinically, several tests have been designed and standardized to assess temporal processing. The deficits in temporal processing could be evidenced as poor scores in tests such as Gap Detection Test (GDT), Temporal Modulation Transfer Function (TMTF), Brief Tone Audiometry, tests of temporal masking (backward and forward masking) and tests of temporal ordering (Shinn, 2003).

Considering the importance of temporal processing in daily listening, auditory training has been attempted as a rehabilitative strategy to improve it. Rabin, Reich, and Roth (2013) conducted a study wherein gap detection training was provided to the participants (older and young individuals) spread over 10 days. The gap detection thresholds of older participants which were poorer than the young participants were found to be similar after the fourth session of training. They also observed retention of effects of training. Auditory based cognitive training was provided to a group of older adults by Anderson, Schwoch, Clark, and Kraus (2013), to investigate its effect on speech in noise perception, processing time and short term memory. The study revealed increased precision in the temporal encoding of sound at the sub-cortical level. Similarly, Yathiraj and Mascarenhas (2003), provided training for children with auditory processing disorder to improve their abilities on auditory integration, auditory separation and recognition of low redundancy, auditory memory and duration pattern recognition. The results of the study revealed a significant positive effect of the therapy regime on the children's perceptual abilities. Interestingly, the outcomes of training in temporal processing have been reported to generalize to its functional aspects such as sound localization and speech perception in noise (Eggerrmont, 2015).

Music is known to have pervasive influence on human beings. With specific reference to auditory system, superior functioning are found in peripheral as well as central auditory system (Kraus, 2012; Musacchia, Sams, Skoe, & Kraus, 2007; Micheyl, Carbonnel, & Collet, 1995; Ishii, Midori-Arashiro, & Desgualdo-Pereira, 2006; Jeon & Fricke, 1997; Nikjeh, Lister & Frisch, 2008; Oxenham, Fligor, & Mason, 2003; Rammsayer & Altenmuller 2006). With temporal processing being no exception, trained musicians are reported to possess better temporal processing skills compared to non-musicians (Fernandes, Bhat, Srivastava, & Udupa, 2012), attributable to the systematic training in the perception and production of fine variations in amplitude, frequency, and temporal aspects of musical notes (Parbery-Clark, Skoe, Lam, & Kraus, 2009; Bertrand, 2001). This has triggered investigations to document the use of musical training as a means to improve temporal processing (Overy, 2003).

Another form of art which is closely related to music is dance. Dance is always choreographed to a music due to which individuals who undergo dance training are invariably exposed to music as well. Similar to music training, dance training emphasizes the perception of temporal aspects of music while the body movements are expected to be in synchrony with it. In terms of Indian dance and music, *'tala'* is the measure of time and *'laya'* is the rhythm. For the dancers it is mandatory to attain knowledge of *tala* and *laya* (the temporal aspects) to be able to master the art. However, while the musicians train their ears specifically to perceive the intricacies in temporal, loudness and pitch variations in music, dancers represent the variations in music through their body. For a dancer, the primary focus is on the body movements, and the music to which the dance is choreographed serves as the reference for representation of the *tala* and *laya* through these movements. Therefore, dance training involves systematic exposure to music and one can speculate that dancers will have training related advantage in auditory processing. If this speculation finds experimental evidence, dance can be used as a rehabilitative method to improve auditory processing. Therefore, the present study aimed to document auditory temporal processing abilities in professional dancers, and verify whether they are superior compared to non-dancers in their abilities.

Music is a skill that is not universal; not everybody can undergo musical training and achieve expertise. Dance, on the other hand is a little more widespread, considering recreational dancing as a more common entertainment.

3

However, no studies have been conducted to see the effect of dance training on temporal processing skills. The preliminary way of ascertaining such an effect is comparing the temporal processing of dancers and non-dancers. Hence, in the present study, an attempt has been made to compare the performance of dancers and non-dancers on tests of temporal processing.

Material and Methods

18

The study aimed at assessing the effect of dance training on temporal processing abilities. The effect of dance training was derived by documenting temporal processing abilities in a group of dancers and comparing it with that of an equivalent group of non-dancers. The group difference in temporal processing abilities, if any was to be attributed to the dance training.

Furthermore, comparisons were made within the two groups to investigate for the presence of ear effect, if any.

i) Participants

There were two groups of participants with ten individuals in each group. The first group constituted of dancers, age ranging between 21 to 28 years (mean age: 24.4 years). There were 2 males and 8 females in this group. The participants were professional dancers who were trained in the Indian classical form of Bharathanatyam for more than 7 years, and practiced for a minimum of twenty hours per week. They had started formal training in dance at a mean age of 7;9 years. Of these participants, two had passed senior grade examination and eight had passed proficiency grade examinations in dance conducted by the Karnataka Secondary Education Examination Board (KSEEB). Also, these participants had not undergone any form of musical training. Informed consent was obtained from the participants before they were recruited for the study.

The second group was composed of individuals (2 males and 8 females) with no formal training in either dance or music with their ages ranging from 18-29 years (mean age: 22.1 years). They had exposure to music for less than 7 hours a week, information regarding which was obtained on a structured interview. Out of the ten participants only two indulged in recreational dance twice or thrice a year. All the participants were native residents of Karnataka with four of them pursuing their Bachelor's degree program and four of them pursuing their Master's degree program. One participant was student of doctoral program and one participant had a Master's degree and was working.

ii) Stimuli/Material

The tests administered were Gap detection test (GDT) and Temporal Modulation Transfer Function (TMTF), separately for the two ears of the participants. The testing was carried out using maximum likelihood procedure (mlp) toolbox. This toolbox implemented mlp in Matlab (Grassi, and Soranzo, 2009).

iii) Procedure

The individuals were taken as participants for the study if they had pure-tone thresholds within 20dB for all the octave frequencies between 250 Hz and 8 KHz and no history of middle ear-related problems, which was confirmed on immittance audiometry. Information regarding the demographic data, years of training, number of hours of practice and history of ear related problems was obtained from the participants through a structured interview. Pure tone audiometry and immittance audiometry were carried out in a sound treated room. Only those individuals who satisfied the subject selection criteria underwent further assessment.

The stimuli were routed from an Acer ASPIRE ONE D270 note book and were presented through TDH 39 headphones of the Audiometer GSI 61calibrated according to ANSI- S3.1 1999 standards. The stimulus was presented at each participant's most comfortable level (varying from 45-60 dBHL). The following tests were administered.

i. Gap Detection Test

The participant's ability to detect a temporal gap in the center of a 750 ms broadband noise was measured. The noise had 0.5 ms cosine ramps at the beginning and end of the gap. In a three-interval alternate forced-choice task, the standard stimulus was always a 750 ms broadband noise with no gap whereas the stimulus with the gap served as the variable stimulus. The gap duration varied automatically according to the client's performance. The participants were instructed to indicate the position of occurrence of the variable stimulus. The threshold for gap detection was arrived at after the presentation of thirty sets of the stimuli.

ii. Temporal Modulation Transfer Function

Temporal modulation refers to a reoccurring change (in frequency or amplitude) in a signal over time. A 500 ms Gaussian noise was sinusoidally amplitude modulated at modulation frequencies of 8, 16, 32, 64 and 128 Hz and was presented at most comfortable level. The stimuli had two 20ms raised cosine ramps at onset and offset. Modulated and unmodulated stimuli were equated for total RMS power. Three interval forced choice method was used for response acquisition, wherein the participants had to detect the modulation and determine which interval contained the modulated noise. Depth of the modulated signal was varied from 0 to -40 dB [modulation depth= 20 log(m)].

Results

The data obtained were statistically compared between the two groups- dancers and non-dancers. Comparisons were also made to analyse variations within the groups, between the two ears. One way MANOVA was done to see the significant difference between the two groups for the scores of GDT and TMTF. In order to see for presence of significant difference between mean of the scores obtained from two ears of the participants, paired t-test was done.

a. Results of between group comparisons

The mean and standard deviation of right and left ear GDT scores of the two participant groups, along with the results of MANOVA (for between group comparisons) are given in

Table 1. TMTF scores of the two groups and the MANOVA results for the same are depicted in Figure 1. As can be observed from Table 1, the mean of gap detection thresholds of participants in the dancer group was lesser than that of the non-dancers. However, results of one way MANOVA showed that the mean differences were not statistically significant.

Insert Table 1 here

TMTF was administered on both the groups for modulation frequencies 8 Hz, 16 Hz, 32 Hz, 64 Hz and 128 Hz in right as well as left ear. Observation of the mean and standard deviation of the scores for each frequency (Figure 1) showed that mean scores have become less negative as the modulation frequency increased. This was true for dancers as well non-dancers in both ears. However, dancers are seen to have more negative scores than non-dancers indicating their skill to detect higher frequency modulations better. Results of MANOVA revealed significant difference between the two groups for TMTF scores, for 16 Hz, 32 Hz, 64 Hz and 128 Hz. However, no significant difference was seen for 8 Hz modulation frequency in either ear.

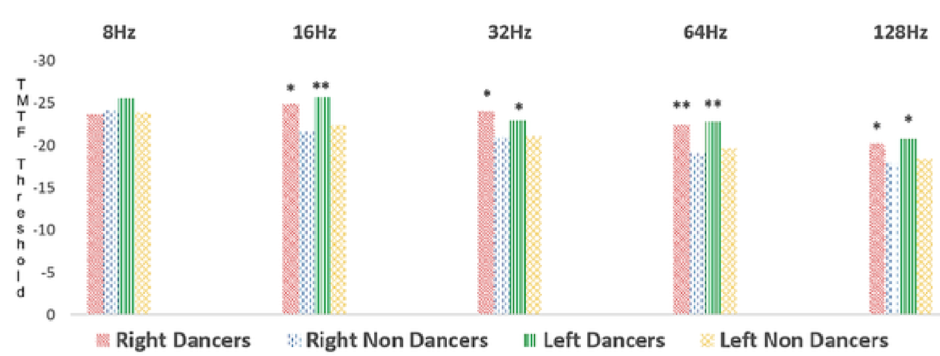

Fig 1: Mean modulation detection threshold for right and left ears of the two groups of participants

**P value <0.05*
***P value <0.001*

b. Results of Within-group comparison

Paired t-test was used to find out ear differences within each group, between the right and left ears. No significant difference was observed between the two ears' performance in either GDT or TMTF, except for at 8 Hz modulation frequency (T 2.31, df:9, $p<0.05$).

Discussion

The present study aimed to explore the temporal processing abilities of dancers and compare it to that of non-dancers. Overall, the observations revealed better temporal processing skills in dancers. The difference however was statistically significant only in the TMTF tests, at 16, 32, 64 and 128 Hz. The threshold of GDT is known to reach adult values after the age of 7 years (Shinn, Chermak, & Musiek, 2009). Since the participants of the study were adults, it can be assumed that the maximum score obtainable in GDT was attained by all of them through the course of natural auditory development. Nonetheless, there is an observable difference between the two groups in their thresholds on the GDT. In TMTF, the better threshold in dancers was significant only at higher modulation frequencies. This could again be attributed to the fact that the task is relatively easier at lower modulation frequencies, and gets tougher as the modulation frequency increases. At these increased modulation frequencies superior temporal processing skills of dancers is revealed.

Dance training involves imbibing rhythms through the body, and the observation that a finer variation in an auditory stimulus is perceived despite any special training in that direction was novel. To the best of our knowledge, previous studies have not explored the auditory temporal processing abilities in dancers. Better temporal processing skills have been shown to be important for localization, listening in quiet as well as in the presence of noise and perceiving music[7]. More research evidence in this direction would reveal the usefulness of dance training as a means for improving auditory temporal processing skills.

REFERENCES

Anderson, S., White-Schwoch, T., Parbery-Clark, A., & Kraus, N. (2013). Reversal of age-related neural timing delays with training. *Proceedings of the National Academy of Sciences*, *110*(11), 4357-4362.

ANSI S3. 1-1999 (R2008). (1999). Maximum permissible ambient noise levels for audiometric test rooms.

Drake, C., & Bertrand, D. (2001). The quest for universals in temporal processing in music. *Annals of the New York Academy of Sciences*, *930*(1), 17-27.

Eggermont, J. J. (2015). *Auditory Temporal Processing and Its Disorders*. OUP Oxford.

Grassi, M., & Soranzo, A. (2009). MLP: A MATLAB toolbox for rapid and reliable auditory threshold estimation. *Behavior research methods*, *41*(1), 20-28.

Ishii, C., Arashiro, P. M., & Pereira, L. D. (2006). Ordering and temporal resolution in professional singers and in well tuned and out of tune amateur singers. *Pró-Fono Revista de Atualização Científica*, *18*(3), 285-292.

Jeon, J. Y., & Fricke, F. R. (1997). Duration of perceived and performed sounds. *Psychology of Music*, *25*(1), 70-83.

Kishon-Rabin, L., Avivi-Reich, M., & Roth, D. A. E. (2013). Improved gap detection thresholds following auditory training: evidence of auditory plasticity in older adults. *American journal of audiology*, *22*(2), 343-346.

Kraus, N. (2012). Biological impact of music and software-based auditory training. *Journal of communication disorders, 45*(6), 403-410.

Micheyl, C., Carbonnel, O., & Collet, L. (1995). Medial olivocochlear system and loudness adaptation- Differences between musicians and non-musicians. *Brain and Cognition*, *29*(2), 127-136.

Musacchia, G., Sams, M., Skoe, E., & Kraus, N. (2007). Musicians have enhanced subcortical auditory and audiovisual processing of speech and music. *Proceedings of the National Academy of Sciences*, *104*(40), 15894-15898.

Nikjeh, D. A., Lister, J. J., & Frisch, S. A. (2008). Hearing of note: an electrophysiologic and psychoacoustic comparison of pitch discrimination between vocal and instrumental musicians. *Psychophysiology*, *45*(6), 994-1007.

Overy, K. (2003). Dyslexia and music. *Annals of the New York Academy of Sciences*, *999*(1), 497-505.

Oxenham, A. J., Fligor, B. J., Mason, C. R., & Kidd Jr, G. (2003). Informational masking and musical training. *The Journal of the Acoustical Society of America*, *114*(3), 1543-1549.

Parbery-Clark, A., Skoe, E., Lam, C., & Kraus, N. (2009). Musician enhancement for speech-in-noise. *Ear and hearing*, *30*(6), 653-661.

Rammsayer, T., & Altenmüller, E. (2006). Temporal information processing in musicians and nonmusicians. *Music Perception: An Interdisciplinary Journal*, *24*(1), 37-48.

Sangamanatha, A. V., Fernandes, J., Bhat, J., Srivastava, M., & Prakrithi, S. U. (2012). Temporal resolution in individuals with and without musical training. *J Ind Speech Hear Assoc*, *26*, 27-35.

Shinn, J. B. (2003). Temporal processing: the basics. *The Hearing Journal*, *56*(7), 52.

Shinn, J. B., Chermak, G. D., & Musiek, F. E. (2009). GIN (Gaps-In-Noise) performance in the pediatric population. *Journal of the American Academy of Audiology*, *20*(4), 229-238.

Yathiraj, A., & Mascarenhas, K. (2003). Effect of auditory stimulation in central auditory processing in children with CAPD. *Unpublished project, All India Institute of Speech and Hearing, Mysore*.

Eddins, D. A., & Green, D. M. (1995). Temporal integration and temporal resolution. *Hearing*, *1028*, 1022-1029.

Moore, B. C. (2007). *Cochlear hearing loss: physiological, psychological and technical issues*. John Wiley & Sons.

Figure legend:

Fig 1: Mean modulation detection threshold for right and left ears of the two groups of participants

Table 1: Mean, standard deviation, F value and df (error) of GDT for right and left ears of the two groups of participants

Ear	Right		Left	
Group	Dancers	Non-Dancers	Dancers	Non-Dancers
Mean (millisecond)	2.33	2.59	2.51	2.73
S.D	0.52	0.55	0.64	0.67
F(1, 18)	1.15		0.55	
df (error)	1	1	1	1

Note: p> 0.05 for both the ears

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13 www.psy.unipd.it
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<%1

14 Jain, Chandni, and Jitesh Prasad Sahoo. "The effect of tinnitus on some psychoacoustical abilities in individuals with normal hearing sensitivity", The International Tinnitus Journal, 2014.
Publication
<%1

15 apc.psych.umn.edu
Internet Source
<%1

16 Peter, Varghese, Kogo Wong, Vijaya Kumar Narne, Mridula Sharma, Suzanne C. Purdy, and Catherine McMahon. "Assessing Spectral and Temporal Processing in Children and Adults Using Temporal Modulation Transfer Function (TMTF), Iterated Ripple Noise (IRN) Perception, and Spectral Ripple Discrimination (SRD)", Journal of the American Academy of Audiology, 2014.
Publication
<%1

17 journal.frontiersin.org
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18 Ibraheem, Ola, and Mohammad Hassaan. "Psychoacoustic Characteristics of Tinnitus versus Temporal Resolution in Subjects with Normal Hearing Sensitivity", International
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