The Enhancement of Music Performance With EEG-Biofeedback: a Replication

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Abstract

A replication of the advantages of slow wave neurofeedback training for optimising musical performance Egner (2003) was undertaken by examining solo instrumental performance in music students, and for the first time examining novice musical ability by assessing their amateur singing ability. As before slow wave training benefited performance in comparison with faster wave training and a non-training control group.

1. Hypothetical effect of Alpha-Theta Neurofeedback

HISTORICAL reports linking unconscious thought with the creative process (Coleridge, 1816; Breton, 1924; Koestler, 1964) provide us with accounts including description of imagery that suggest the experience of hypnagogia (the transient state experienced as waking becomes sleeping, which is often accompanied by visual imagery and fragmentary thoughts). Hypnagogia has been identified in the Electroencephalogram (EEG), as the point which theta band (5-7 Hz) amplitude becomes more pronounced in relation to that of alpha (8-11 Hz). It is hypothesised that the practice of sustaining hypnagogia, without falling asleep, as guided with EEG feedback (neurofeedback) training, will benefit creativity in live performance.

2. Randomised Controlled Trial

IN a randomised controlled trial, 24 music students volunteered to join the study (10 females, 14 males; mean age 26, $\pm$ 9.27). Recruits were randomly assigned to EEG training group (8 to Alpha-Theta, 8 to Sensori-Motor-Rhythm (SMR)) or a passive Control group (n=8). SMR training has not previously effected music performance, and an such was included as an experimenter contact and expectation matched group. There was one control drop out. All participants were instrumentalists with a novice level of singing ability.

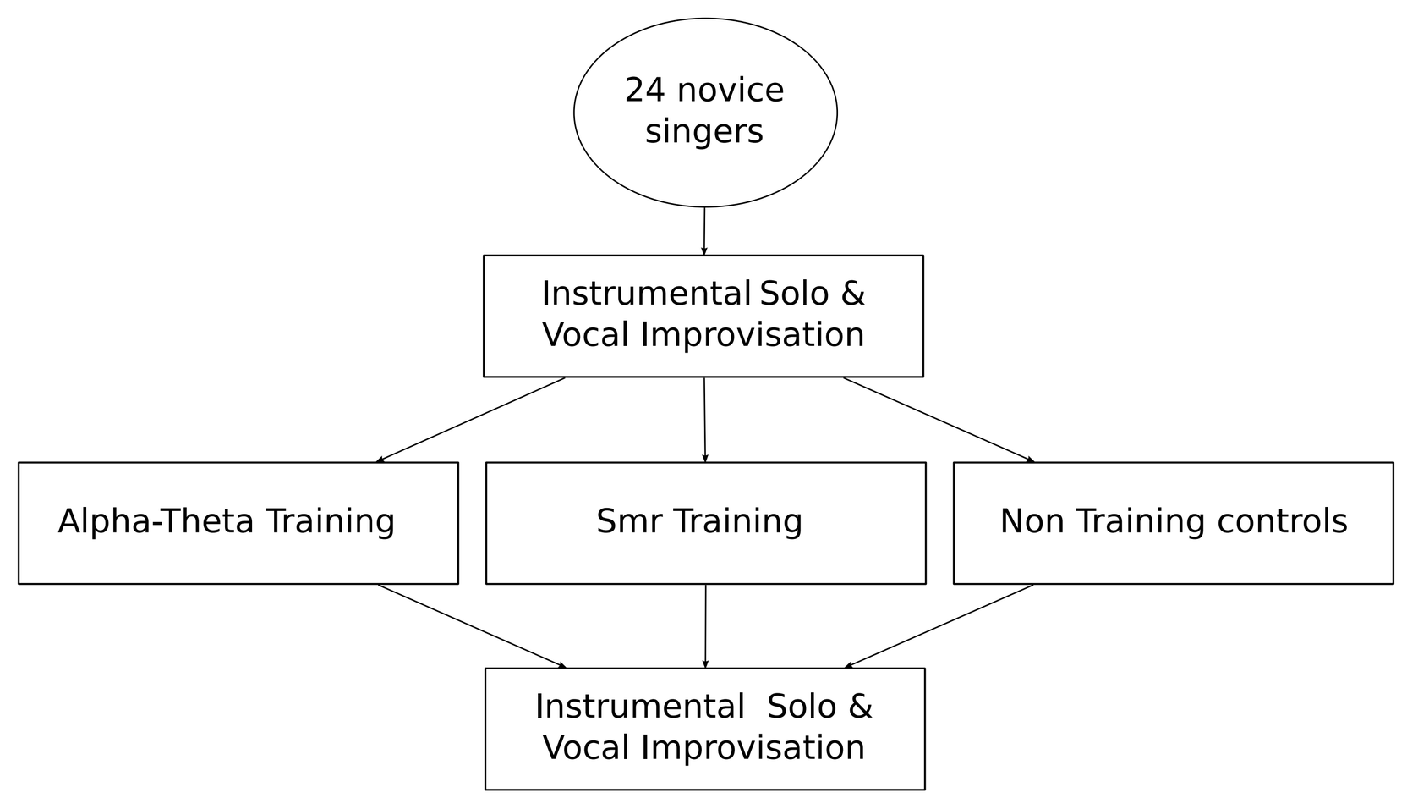

Figure 1: *Experimental Design*

3. Live Music as A Creative Process

PARTICIPANTS performed instrumental solos of their own choice on camera prior to and following the intervention. The footage was presented in an order and group blind sequence to two expert assessors, who rated Technical Competence, Musicality, and Communication variables developed from the consensual assessment technique (Amabile, 1996).

Improvised non-expert vocal performance was assessed with Stripsody see Figure 6, an informal music notation based on cartoon strips.

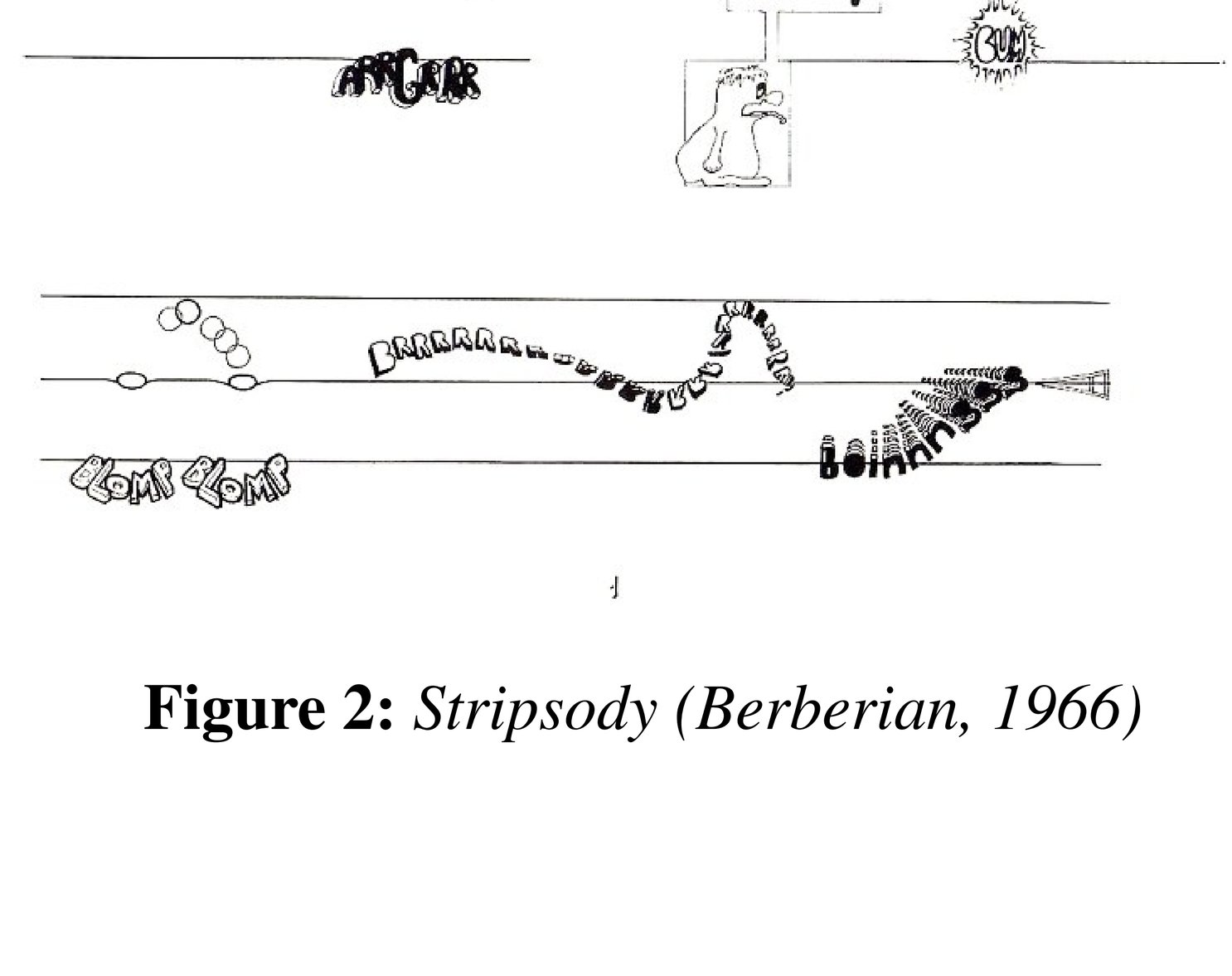

Figure 2: *Stripsody (Berberian, 1966)*

4. Neural Practice for Creativity

NEUROFEEDBACK training was carried out with EEG Spectrum International, Inc. EEger software (Version 4.13c) using the Thought Technology pre-amp and Procomp amplifier. The EEG is recorded from Pz (central parietal location), and referenced to the left earlobe. The electrical signal is processed digitally and bandpass filtered so that the feedback indicates the relative amplitudes of theta and alpha EEG bands.

Figure 3: *Alpha-Theta training*

In alpha-theta training, a participant relaxes with their eyes closed as if going to sleep, the feedback is auditory (see Figure 3). A background sound fades between sea (theta) and river (alpha) sounds in relation to thresholds set by the experimenter. Momentary increases in either band are also signalled. If the participant falls asleep and delta waves (<4Hz) become dominant, feedback is stopped.

5. Inter-Rater Agreement

CRONBACH alpha measurements of changes in the entire sample disclosed rater agreement of .977 for ratings of Instrumental change and .984 for Stripsody. Plots of the rated change scores are seen in Figure 4.

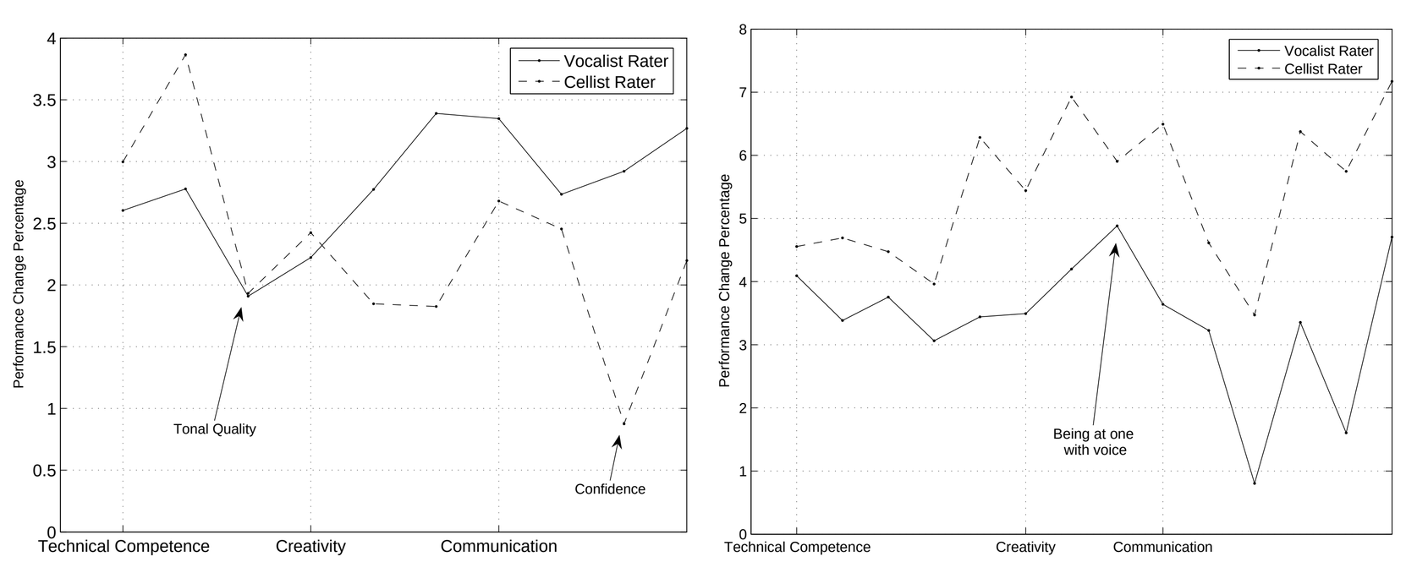

Figure 4: *Rated Changes in Instrumental and Stripsody*

6. Replication of Instrumental Improvements

IN a constructive replication of the findings of Egner and Gruzelier, Neuroreport (2003), the performance of Instrumental Solos improved following Alpha-Theta training in Overall Performance, Musicality, Communication, but also in Technique: Overall p=.02, Rhythmic Accuracy, Security p=.02, p=.05, Tonal Quality p=.04, Musicality p=.01, Stylistic Accuracy p=.06, Imagination p=.02, Expressive Range, p=.01, Communication p=.05, Commitment p=.05, Confidence p=.01, Sense of Performance p=.02 (see Figure 5).

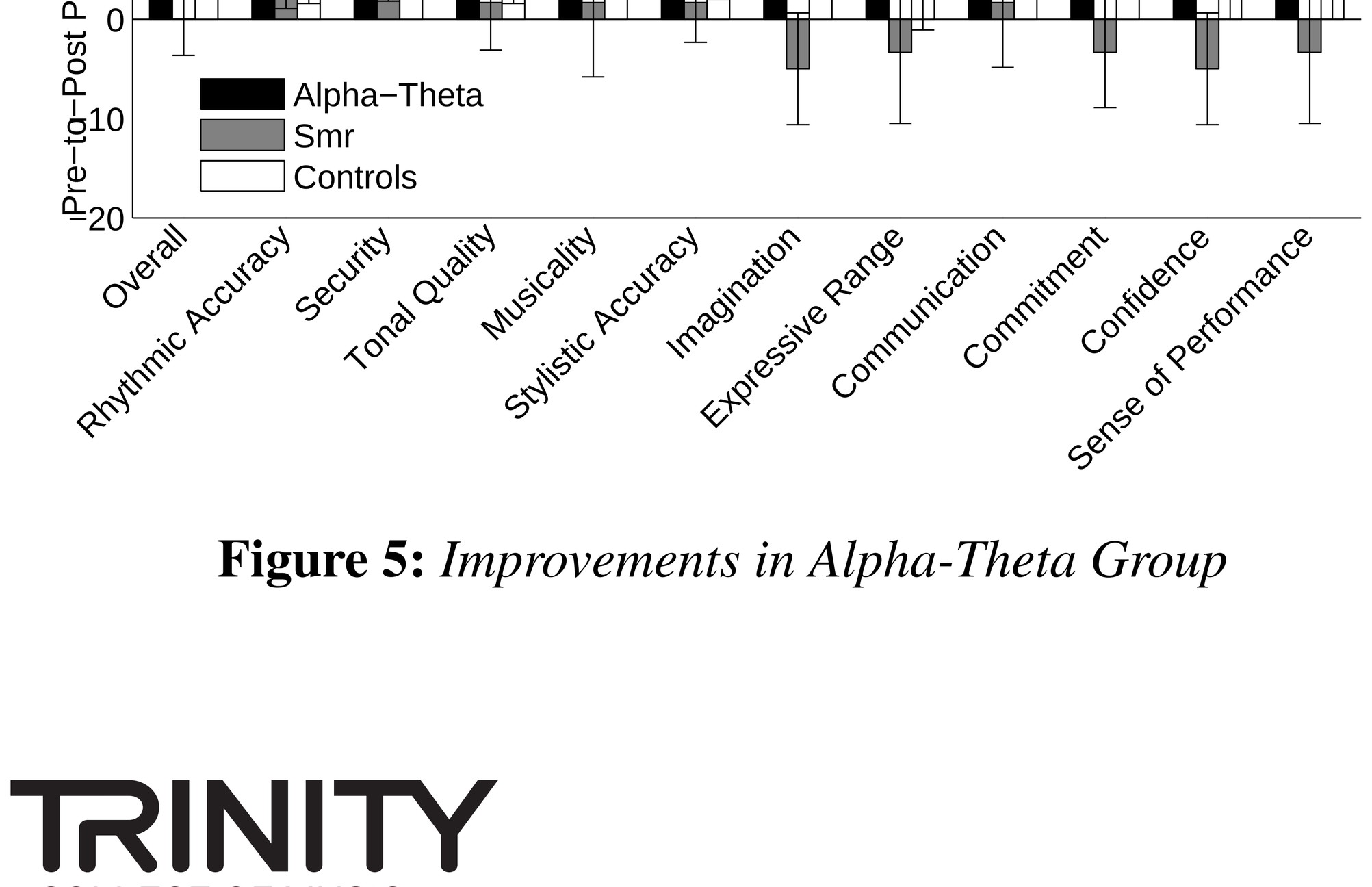

Figure 5: *Improvements in Alpha-Theta Group*

7. Stripsody: Vocal Improvisation Improvements

ALPHA-THETA enhanced predominantly the communication variables as shown in Figure 6, for the vocalist rater: Confidence p=.007, Enjoyment p=.023, for the cellist rater: Communication p=.006, Deportment p=.010, Commitment p.018, Confidence p=.012, and Enjoyment p=.014. Interestingly there were also technical improvements in Diction p=.025, Pitch p=.004, and Breathing p=.003,. Stripsody did not provide scope for improved musicality including creativity in novice singers.

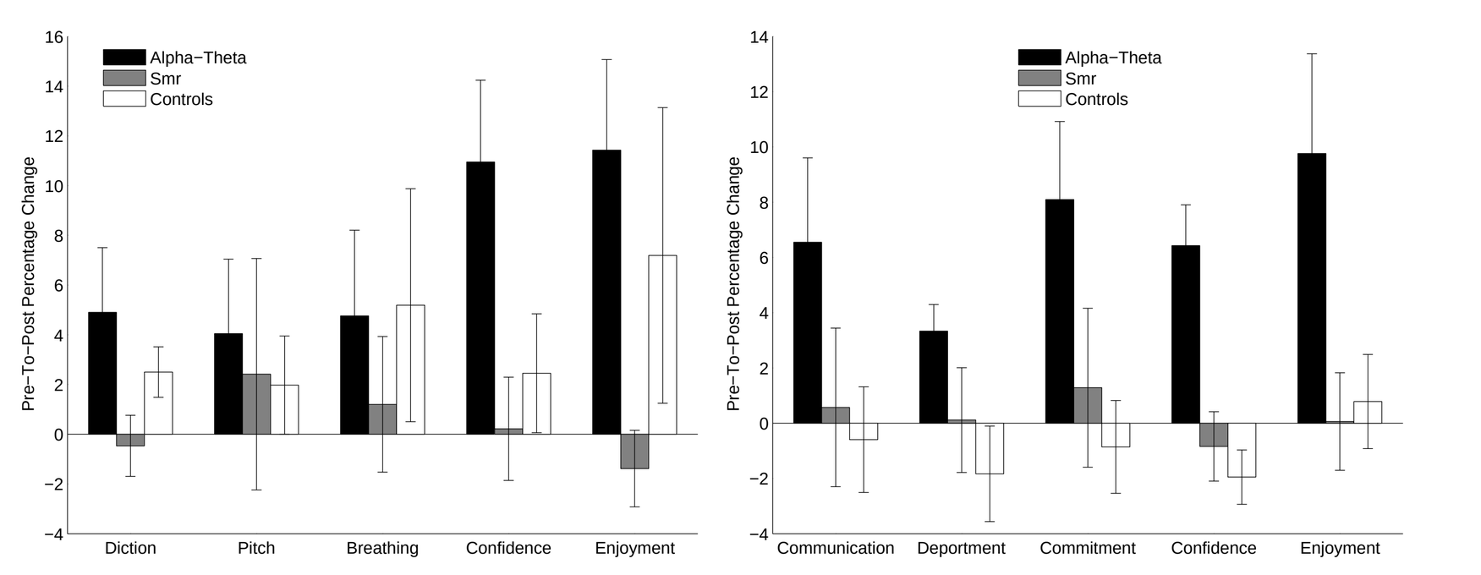

Figure 6: *Vocal and Cellist Raters on Stripsody*

8. Lay Ratings of Folk Song

INTERESTINGLY, improved Communication in the Alpha-Theta group was also seen in a separate assessment of traditional folk singing by non-expert raters. In this result, Confidence, Expressiveness, and Stage Presence were all reported as improved Following Alpha-Theta, all improved following training (p¡0.001).

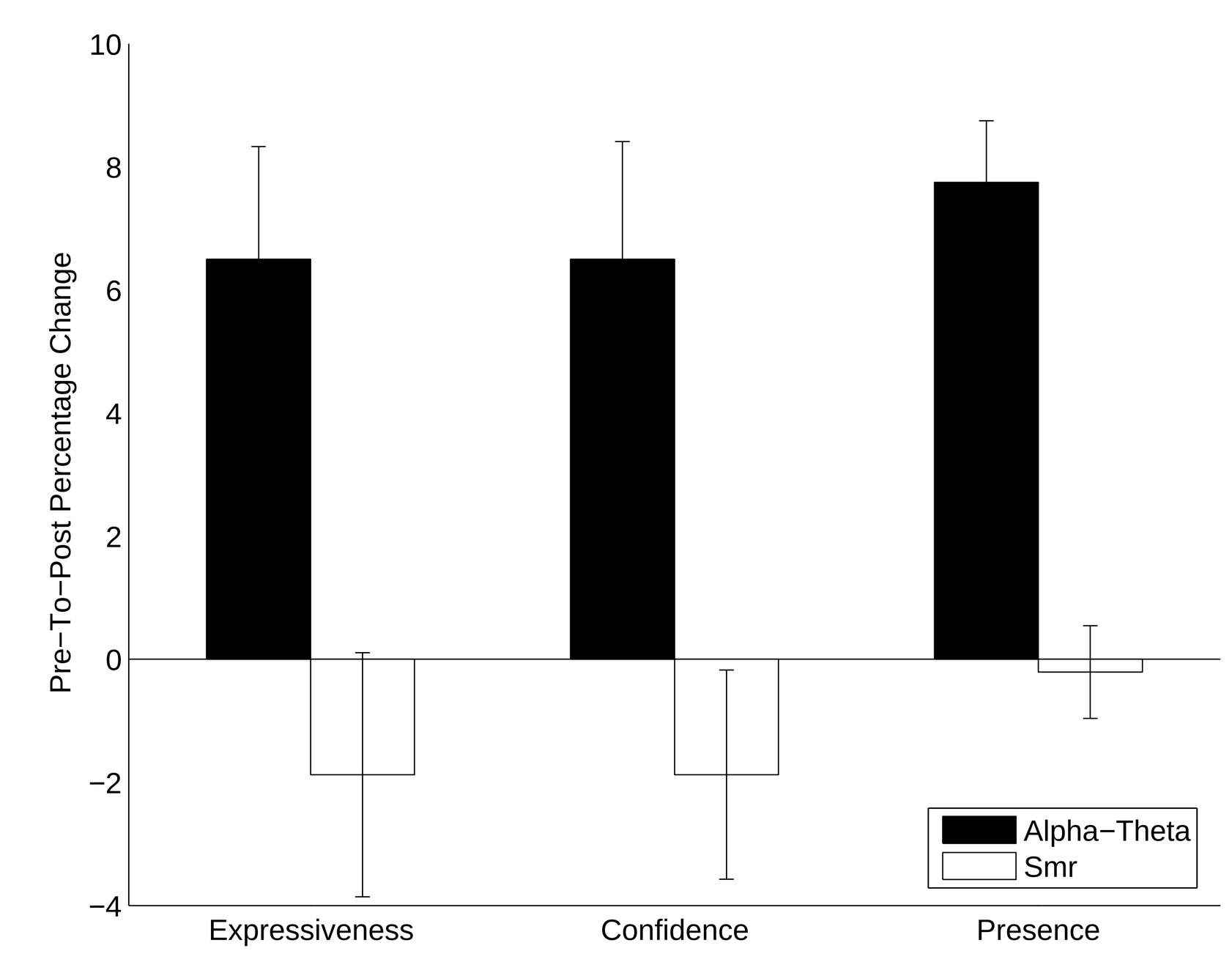

Figure 7: *Change in Performance*

9. Conclusions

THIS is the third experiment involving conservatoire musicians in which Alpha-Theta training has positive outcomes for instrumentalists. Here we extended this to show that it also benefited their novice singing ability. Here there were advantages to Communication and Technique, though our vocal improvisation exercise appeared not to allow demonstration of musicality. We also demonstrated that advantages to their singing ability as reflected in folk singing were apparent in lay ratings of confidence, expressiveness and stage presence. Examining a correlation between the theta to alpha ratio learning index across the ten sessions a significant correlation is found with ratings of confidence (r=0.882, p<.02). This attests to the impact of the hypnagogic training in musical performance enhancement.

10. Acknowledgements

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