

Perspectives of the brain mechanism for playing the piano in the light of complementary and alternative medicine (CAM)

Abstract

Integrative Medicine (IM) and Complementary and Alternative Medicine (CAM) have been gradually prevalent. Authors are involved in IM, CAM, music therapy and piano-playing. Perspectives of the brain mechanism for piano playing are described. Responsible of area in the brain include primary motor cortex (M1), dorsal pre-motor cortex (dPMC), ventral pre-motor cortex (vPMC), primary somatosensory cortex (S1), superior parietal lobule (SPL), inferior parietal lobule (IPL). Various integrated images and music are created and preserved, and then data will be changed into motion and playing the piano by the mechanism of sensory-motor transformations. Further research development concerning these will be expected.

Keywords: pianist, sensory-motor transformations, brain mechanism, central nervous system, music presence, music therapy

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Abbreviations: IMJ, Integrative Medicine Japan; SPL, superior parietal lobule; M1, primary motor cortex; GMV, gray matter volume; CAM, complementary and alternative medicine, CNS, central nervous system

Commentary

Integrative Medicine (IM) and Complementary and Alternative Medicine (CAM) have been gradually prevalent for decades.¹ Authors research group have continued clinical research and management of IM as Shikoku Island division of Integrative Medicine Japan (IMJ) for years.² Among them, we have enlightened the benefit of IM and CAM for various opportunities such as balneotherapy, art therapy, hospital art, music therapy and various activities related to music and piano-playing.³⁻⁶ As authors are physician, music therapists and pianists, some perspectives of the brain mechanism for piano-playing will be described in this article.

Neuromusicology has been a novel scientific discipline, which connects scientific aspects of musical study and nervous system of the brain.⁷ It can clarify the influence of the music for various aspects of human brain. By decoding brain function with or without music presence, music therapy can be applied to certain patients as CAM.

Several human organs are involved in piano-playing. The movement originates from the cerebrum, from which neural circuits pass in the spinal cord.⁸ Through the central nervous system (CNS), peripheral nerves exist to all body. Since the piano is played with 10 fingers of both hands, commands are sent to forearms, hands and fingers by the nerve conduction of the brachial plexus.

This mechanism means the innervation for moving fingers. Actually, fingertips push the keyboard with different strengths, and then sensory nerve to touch plays an important role. The feedback is crucial for subtle adjustments. Furthermore, humans are equipped for innervation of autonomic nerves. During the performance, the balanced situation of sympathetic and parasympathetic nerves would be indispensable.

From autonomic nerve and hormonal points of view, a research for piano-playing was performed for an internationally famous

pianist by measuring functional magnetic resonance imaging (fMRI), pupillometry and other markers.⁹ As a result, positive correlations were found among pupil diameters, psychological situation and physical motions. By neuroimaging method, relationship of noradrenergic (NE) activity and mental music cognition were observed.

When playing the piano, clinical process is usually going in the following order: i) Before starting the action of playing the piano, one the mind, ii) Move the body, sit in front of the piano, check the position of the keyboard, and touch the keyboard with the fingers, iii) Imagine the melody that you are about to start, and prepare which finger to put which keyboard, iv) During the performance, always keep in mind the next consecutive music development in advance, v) Keep on playing the music piece as music note with three elements of melody, rhythm, and chord, vi) Express the music with heart as if certain image, landscape, soundscape or may be present by satisfactory speed, strength and tune.¹⁰

For better performance of piano-playing, several artful methodologies are required. Using Chopin's "Revolutionary" Etude, anthropometrical study was conducted for elite pianists.¹¹ The data included the quantification of the joint angles of the wrists, elbows, shoulders and trunk by the measurement of motion capture system.

Playing the piano associated with simultaneous reading musical notes would be an extremely complex task that requires much practice for years. For this activity, several specific high degree components are involved, such as movement skills, effective visual-motor transformation, combination of music components of rhythm, pitch and music texture. There is a report that the pianist was received fMRI while playing the piano.¹² In addition to the temporary primary motor cortex (M1) that gives commands to the muscles, activities are also observed in the primary sensory cortex (S1) and the premotor cortex and parietal cortex. The function of the temporary sensory cortex is the part where information on the physical sensation "somatosensory" from within one's own body. They include the positions of fingers and hands, associated with flexion/extension status. Just before the playing performance, the responsible parts are already activated.

In the parietal region of the brain, there are superior parietal lobule (SPL) and inferior parietal lobule (IPL) (Figure 1). For human

feeling, visual, auditory and somatosensory data are input to the SPL as physical information. These various data are assembled into certain information that can be understood for an overview.¹³ Consequently, the data are sent to the IPL, and additional information are added such as tactile sensation and muscular sensation. As a whole, it becomes possible to comprehensively understand current situation of internal body and external circumstances out of the body. Finally, the image of piano-playing would be constructed comprehensively. As mentioned above, this process enables to finally execute the actual activity of the premotor cortex. As mentioned above, a series of integrated images are created and preserved in SPL and IPL areas. These are called sensory-motor transformations.

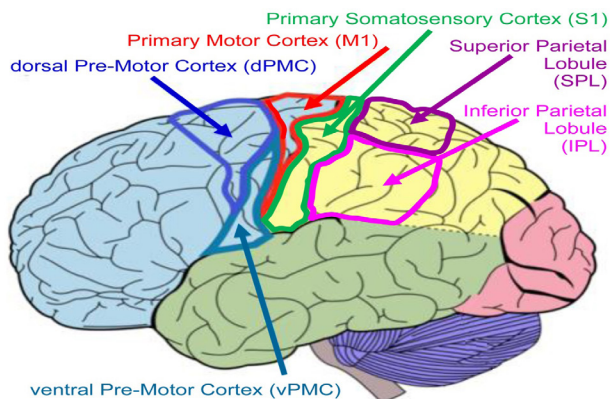


Figure 1 The cortical involvement for various music performance and piano playing

Some impressive reports are found. Regarding musical research, the changes in corticospinal activity were observed in professional pianist found. The protocol included transcranial magnetic stimulation which was by the motor imagery of music chords.¹⁴ As a result; corticospinal facilitation was modulated according to the motor plan without actual execution. In the latest report, comparative study was conducted for brain atrophy and age-related cognitive decline between 30 older musicians (70.8years) and age-matched subjects (71.4years). Musicians showed larger gray matter volume (GMV) with related cognitive maintenance in older age.¹⁵

Conclusion

In summary, some perspectives of brain involvement for piano playing are introduced. Pianists seem to have beneficial stimulation for years. Further detail research will be expected in this filed.

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Conflicts of interest

The authors declare no conflicts of interest.

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References

1. Chatterjee A. Why do chronic illness patients decide to use complementary and alternative medicine? A qualitative study. *Complement Ther Clinical Pract.* 2021;43:101363.
2. Bando H. Recent topics of complementary & alternative medicine (CAM) include music/art therapy and hospital art. *Int J Complement Alt Med.* 2021;14(3):100–101.
3. Tanaka K, Nagahiro S, Bando H. Further Hospital Art Development of Masking Tape Using Thin Film Sheet. *Asp Biomed Clin Case Rep.* 2021;4(3):195–198.
4. Nishikori Y, Bando H, Yoshioka A, et al. Trials of Additional Effective Movements for Music Therapy Session for the Elderly. *Curr Res Complement Altern Med.* 2020;4:138.
5. Yoshioka A, Bando H, Nishikori Y, et al. Recent status of hydrotherapy and balneotherapy with clinical beneficial effects. *Int J Complement Alt Med.* 2019;12(6):217–219.
6. Nakanishi A, Bando H. Development of Health Resort Casino System in Integrative Medicine. *Int J Conf Proc.* 2019;1(5):ICP.000521.2019.
7. Filimon RC. Aspects related to the interconnection between music and the human brain. Scientific discoveries and contemporary challenges. *Artes J of musical.* 2021;24:224–241.
8. Choi US, Sung YW, Ogawa S. Brain Plasticity Reflects Specialized Cognitive Development Induced by Musical Training. *Cereb Cortex Commun.* 2021;2(2):tgab037.
9. Endestad T, Godøy RI, Sneve MH, et al. Mental Effort When Playing, Listening, and Imagining Music in One Pianist's Eyes and Brain. *Front Hum Neurosci.* 2020;14:576888.
10. Bando H. Music Therapy. Singapore: Raffles Connect PTE; 2020.
11. Turner C, Visentin P, Oye D. Pursuing Artful Movement Science in Music Performance: Single Subject Motor Analysis With Two Elite Pianists. *Perceptual and Motor Skills.* 2021;128(3):1252–1274.
12. Meister IG, Krings T, Foltys H, et al. Playing piano in the mind—an fMRI study on music imagery and performance in pianists. *Brain Res Cogn Brain Res.* 2004;19(3):219–228.
13. Royal I, Vuvan DT, Zendel BR, et al. Activation in the Right Inferior Parietal Lobule Reflects the Representation of Musical Structure beyond Simple Pitch Discrimination. *PLoS One.* 2016;11(5):e0155291.
14. Rossi S, Spada D, Emanuele M, et al. Cross-Modal Audiovisual Modulation of Corticospinal Motor Synergies in Professional Piano Players: A TMS Study during Motor Imagery. *Neural Plast.* 2019;2019:1328453.
15. Yamashita M, Ohsawa C, Suzuki M, et al. Neural Advantages of Older Musicians Involve the Cerebellum: Implications for Healthy Aging Through Lifelong Musical Instrument Training. *Front Hum Neurosci.* 2022;15:784026.