To amuse the muse of the brain by heart

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Music sets cognitive judgments in motion of how we experience melodies by heart. Since ancient history we are aware that music is capable of arousing all kinds of emotional experiences, expressed through, for instance, the shedding of tears, relaxation, facing a spectrum of beautiful colours, recall memories etc. In contrast, music may also irritate us or, like the mysterious sounds of Pan in mythology, even provoke panic. Recently, in Oliver Sachs's latest book *Musicophilia*, the story is told of a person who was struck by lightning and hereafter became obsessed with learning to play the piano. In concert with this observation, neurological afflictions also have an impact on how we undergo music. Through studying the underlying changes in the brain of patients, Sachs tried to elucidate some aspects of the effect of music on our emotions. He concludes that, like our capability to speak, music is able to identify us as unique human beings. Hence, basic mechanistic questions are: what is the nature and effect of music on cerebral function and can music be applied to improve our mental health?

In addition to the emotional effects, music is also able to bring on physical effects such as fainting or give rise to dancing like Terpsichore, one of nine muses, did, according to Greek mythology. Since the goddess muses live on Mount Olympus, it is feasible that, in addition to their accountability for arts, they also have to perform some physical exercise. Albeit that cerebral exercise and physical exercise can be deemed as two sides of the same coin, on occasions they may merge at the edge and affect both mental and physical health.

In this issue of the Netherlands Heart Journal, Burggraaf et al. performed a laudable attempt to study whether music may have therapeutic effects through inducing neurocardiological training effects among musicians when compared with normal case controls [1]. In the wake of an increasing inactive lifestyle, the authors hypothesise that the favourable modulation of the autonomic system during physical exercise (and the subsequent triggered changes in somatosensory neural input to the brain stem) is comparable with the effects of sedentary exercise, such as making music. Surrogate parameters such as heart rate, blood pressure and baroreflex sensitivity are assessed between the two groups.

The relevance of the topic is provided by the cultural development of an unhealthy inactive lifestyle, which may in turn initiate a progressive increase in body weight and subsequently enhance the incidence of diseases, such as diabetes and atherosclerosis. So, albeit that the subject of students of the premedical school has merits and deserves further attention, the flaws of the present study are not very helpful in providing a reliable insight into whether or not active music making may be (neurophysiologically) comparable with physical exercise.

In general, with regard to the present cross-sectional non-randomised pilot study, it is debatable whether the baseline characteristics of the enrolled young musicians and their controls are indeed comparable. A major setback in this regard is the fact that the authors do not supply the results of the lifestyle questionnaire Compendium of Physical Activities. With respect to the authors' research questions, the observed differences may therefore be due to normal variance among a population. In a pivotal study randomisation, follow-up and motivational aspects are of paramount importance to provide insight into reliable outcomes. Also measures can be taken into account of nervous trafficking by, for instance, making use of fMRI, during active music making. To substantiate a matching behaviour of the nervous system

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following physical and musical exercise, it is difficult to determine and precisely localise, without direct single-neuron recording, whether or not we are dealing with the same nerve cells. Second, the same nerves may convey different sequences of signals which in turn are thought to induce different cerebral responses. Even more complex is taking into account the descending information from the forebrain as a consequence of musically induced emotions. In this regard, motivational aspects of the subjects studied may also be of relevance.

Third, nearly all studies where authors validate the neural effects of exercise on neural plasticity in the CNS are performed with some form of peripheral electrical stimulation (transcutaneous electrical nerve stimulation or acupuncture); these modalities were not used in the present study. So, whether the same nervous pathways are recruited during active music making remains to be seen. Fourth, to the best of our knowledge it has not been demonstrated that musicians have a better exercise performance after music making. This caveat, however, may be related to regression of the effect over time. In this regard it is worth noting that the effect on insulin sensitivity following vigorous physical exercise is significantly reduced after 24 h [2]. The duration of the suggested beneficial effects of music making on the brain remains unknown since a sustained effect of music making has not been demonstrated.

Fifth, it has been known for many years now that physical exercise is limited following activation of motor

neurons in the dorsal horn [3]. It seems unlikely that music making activates the same system.

Finally, the outcomes can not be generalised because the investigators did not investigate whether individuals without any musical experience may profit from making music.

In spite of these flaws the subject of neural mechanisms underlying the generation of musical-induced emotions, as addressed in the present pilot, warrants further research.

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