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MUSIQUE DU SOMMEIL

I.Levine

On recoit "la musique du sommeil" (MS) à l'aide du programme "la musique du cerveau" (MC) qui est basé sur la transcription sonore de l'activité électroencéphalographique (EEG) lors des différents états fonctionnels de l'organisme au moyen d'un algorythme élaboré par le Pr. I.Levine (1991). Grâce à ce programme on recoit "une carte musicale" de principaux états fonctionnels de l'homme. L'intérêt d'une telle recherche serait donc d'apporter aux sujets une représentation intelligible de leur propre état fonctionnel cérébral. Les harmoniques varient non seulement en fonction de l'état affectif des sujers pendant l'éveil, mais également en fonction des différents stades de sommeil.

Méthodes

Pour étudier la passibilité de l'influence de MS sur les insomniaques, on a examiné 40 patients à l'âge de 18 à 60 ans et la durée de maladie d'un mois à 20 ans. La recherche incluait les tests électrophysiologiques (EEG en état de veille, ainsi que de surcharges verbales et non verbales et la polysomnographie chez 15 patients), psychologiques (MMPI et évaluation de l'anxiété) et les enquêtes (d'évaluation du sommeil), effectuées avant et après le traitement de MS. Avant le traitement, on enregistrait le polysomnogramme et choisissait les fragments de stade 2, sommeil lent profond (SLP) et sommeil paradoxal (SP) (dans 2 canaux de EEG), correspondant tout-à-fait aux critéres de Rechtschaffen A. et Kales A. (1968). Puis on transformait des fragments choisis de l'EEG en musique et composait la MS (5 minutes pour le stade 2, 3 minutes pour SLD, 2 minutes pour SP et de nouveau 2 minutes pour stade 2). Le traitement durait 15 jours quand tous les soirs chaque patient écoutait sa musique propre.

Résultats

Après le traitement les insomniaques se sentaient mieux et l'estimation du sommeil (d'après les enquêtes) était plus hautes. On marquait la réduction de l'anxiété et de la dépression. On fixait pendant l'examen électrophysiologique l'accroissement expressif de la puissance de theta et de beta et le changement de la réaction de l'hémisphère droit sur les surcharges verbales et non verbales. On doit noter l'améliorateon expressive de la structure du sommeil: l'augmentation du temps de sommeil total, de la durée de SLP et SP, du nombre des cycles, de l'indice d'efficacité du sommeil; la diminution de la veille au cours du sommeil, du nombre d'éveils, du nombre de mouvements.

Discussion

Sur le plan thérapeutique, le fait de pouvoir entendre objectivement la musique probuite par le cerveau au cours du sommeil, amène les patients à

améliorer individuellement leur propre sommeil de facon plus précise et subtile qu'à l'aide de somniphères et tous les patients ont préféré la MS. La base psychologique de cette influence est la diminution de la dépression et de l'angoisse. Du point de vue neurophysiologique on trouve à la base des mécanismes cérébraux de cet effet le renforcement simultané de l'action des systémes somniphères de SLP et SP, aussi que le changement des relations interhémisphériques.

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"MUSIC OF THE BRAIN" IN TREATMENT OF INSOMNIA PATIENTS (DOUBLE BLIND RESEARCH).

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The "Music of the Brain" (MB) program enables transformation of EEG into music (Levine, 1991). As a result, there creates a "musical map" of main functional states of a human being - super active, active and relaxed staying awake, NREM and REM sleep - with further reverse influence of the obtained MB to form an appropriate functional state. The aim of study was the evaluation of efficacy and safety of MB in insomnia patients (IP). 58 IP were studied (aged 18 - 60): **1st group** - **principal** (44 IP) and **2nd group** - **placebo** (14 IP) (the MB of another person was taken as a placebo). Methods of investigation: clinical examination, sleep questionnaires, EEG (spectral analysis in active and relaxed wakefulness also during verbal and nonverbal tests), standard polysomnography, psychological tests (MMPI, Spielberger test). Creation of music: fragments of EEG (stage 2 - 5 minutes, delta-sleep - 3 minutes, REM - 2 minutes) converted into music. During 15 days every night the patient was listening to his personal music (1st group). In 1st group MB improves the subjective and objective sleep parameters: sleep duration increases (at the expense of delta-sleep and REM), waking time and number of awakenings decrease. MB decreases the depression and anxiety and improves the interrelations of the hemispheres. Our results show that MB is very effective nonpharmacological method of treatment of IP.

“Brain Music” in the Treatment of Patients with Insomnia*

Ya. I. Levin

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The effects of a new nonpharmacological method of treating insomnia — “brain music” — were studied. The method is based on the transformation of the EEG into music using a special algorithm developed by the authors. Sleep polygrams were recorded and analyzed, and EEG segments corresponding to different sleep phases were identified using standard criteria, and were transformed into music. Patients listened to the resulting audiocassettes before going to sleep. Clinical, questionnaire, psychological, and electro-physiological (polysomnographic, electroencephalographic) methods were used before and after 15-day treatment courses in 58 patients with insomnia, who were divided into two groups: group 1 (44 patients) formed the experimental group, and group 2 (14 patients) formed the “placebo” group (in whom the “brain music” of a different patient was used). “Brain music" was found to have positive effects in more than 80% of the insomniac patients both from the point of view of subjective sensations and in terms of objective studies, i.e. neuropsychological and neurophysiological investigations. The high efficacy of “brain music” in patients with insomnia was combined with an absence of side effects and complications.

Sleep disturbances are common in the present world. Special questionnaire studies conducted in a variety of countries have shown that 38-45% of the population have inadequate sleep, and nearly a third of the population suffers from episodic or continuous sleep disturbance, needing specialist treatment [3]. Some 1.5-3% of the population constantly and 25-29% episodically take sleeping pills [3, 4, 6].

Sleep disturbances mostly consist of insomnia. Insomnia is defined as a state of having difficulty going to sleep and remaining asleep, and is often combined with daytime weakness, exhaustion, and reduced work capacity [3, 5].

The treatment of insomnia is currently dominated by pharmacological methods [1, 3, 4, 6, 8]. Problems arising from these methods include the development of tolerance, dependence, somatic complications, etc. Thus, the development of non-pharmacological methods is very relevant. Diverse therapeutic approaches have been suggested, including various types of electrical stimulation, phototherapy, psychotherapy, and acupuncture/reflexology [1, 2].

The aim of the present work was to study the effects of a "brain music" program on patients with insomnia.

General Features of the Program. The “brain music” program was created on the basis of our 1991 suggestion for transforming the spontaneous bioelectrical activity of the brain — the EEG — into music. The program was developed by D. G. Gavrilov (Brain Sound Compiler, ©1992-1996) to operate in Windows (versions 3.0, 3.11, 95) for IBM-compatible personal computers.

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* The material in this paper has been presented previously, at the Second International Meeting on Psychiatry and the Central Nervous System, November 2, 1994, Paris.

The program allows the following functions: recording of 16-channel EEG traces; analysis of three types of spectral analysis based on rapid Fourier transformation; automatic and/or manual removal of artifacts; numerical expression of percentage powers for the main frequency ranges (□, □, □, □$_1$ and □$_2$) in each lead; identification of the frequency at which power is maximal, for each lead; transformation of the EEG into music (18 different transformation algorithms); selection of one of 120 musical instruments for each channel; changes in the musical tempo; variation in the volume of each channel; transposition of the music of each channel to different octaves; changes in various musical parameters (legato-staccato, addition of major and minor chords, etc.); analysis of the note patterns of each channel. The result is the creation of a "musical map" of the main functional states of a human being — hyperactive, active, and relaxed consciousness, and slow and rapid sleep, with subsequent exposure to the resulting "brain music" with the aim of inducing the corresponding functional state.

The "brain music" program includes elements of music therapy and biological feedback, but there are a number of differences from these methods for regulating functional states.

TABLE 1. Dynamics of Subjective Sleep Characteristics (in Points) during "Brain Music" Treatment

Parameter	Baseline	After first listening session	After course of treatment
Time to go to sleep	2,9	3,3*	3,9* **
Duration of sleep	2,6	3,1*	3,9* **
Number of nocturnal wakings	3,4	3,8	4,4* **
Sleep quality	3,1	3,5*	4,2* **
Number of dreams	3,5	4,0*	4,1*
Quality of morning waking	3,1	3,3	4,1*
Total assessment	18,6	21*	24,6* **

Notes. Asterisks indicate significant differences ($p<0.05$); one asterisk is for comparisons with baseline, two for comparisons between the first listening session and the end of the treatment course.

TABLE 2. Dynamics of Compressed Spectral EEG Analysis after "Brain Music" Treatment (Data on the Powers of Each Frequency Range are Shown as Percentages of the Total Power for Each Hemisphere)

Range	Before treatment	After treatment
□	7,4/8,3	5,4/5,2*
□	**16,9/19,6**	13,2/15,4
□	**42,7/38,1**	54,3*/52,7*
□$_1$+□$_2$	33,0/34,0	27,1*26,7*
□+□/□$_1$+□$_2$	**0,74/0,82**	**0,69/0,77**

Notes. The numerator shows the right hemisphere, and the denominator shows the left hemisphere; asterisks indicate significant changes within the appropriate hemisphere (p<0.05); significant differences compared with healthy subjects are underlined (p<0.05); significant differences between the right and left hemispheres are indicated in bold (p<0.05).

TABLE 3. Dynamics of the Main Sleep Parameters in Insomniac Patients during “Brain Music” Treatment

Measure	Before treatment	After treatment
Sleep duration, min	324,5	431,2*
Time to go to sleep, min	56,4	9,4*
Waking during sleep, min	57,2	17,8*
Number of wakings (per h of sleep)	3,8	1,6*
Number of cycles completed	3,2	5,1*
Number of movements per h of sleep	9,4	3,3*
□ sleep, min	32,8	67,6*
Rapid sleep, min	58,7	96,5*

Notes. Asterisks indicate significant differences (p<0.05 and 0.01).

Patients were treated using the following scheme for recording EEG traces, processing them, and converting them into music:

1) Four monopolar leads were used for recording EEG traces; left and right forehead and left and right center; visual analysis was performed (using a survey function) of all segments of EEG traces (for all channels) for selecting fragments and removing artifacts (movement, electrode, and other artifacts); from these edited EEG segments, fragments were selected for transformation into music;

2) Piano (No. 1, “Acoustic Grand Piano”) was used for all leads; the playing rate of the melody was 120.

A total of 58 patients with insomnia were studied. Patients for treatment did not have severe somatic or mental pathology, i.e., they did not have neurotic insomnia; patients with psychophysiological insomnia were also excluded.

The results of treatment with “brain music” were assessed using double blind studies, in which the placebo consisted of “brain music” from another patient. Two groups were used. Group 1 (44 patients) listened to their own music, and group 2 (14 patients) listened to placebo music.

In group 1, 32 patients underwent the complete diagnostic and therapeutic cycle including polysomnography; in 12, the efficacy of treatment was assessed without polysomnography. All patients of group 2 underwent polysomnographic studies before and after treatment with “brain music”. Insomniac patients were aged from 18 to 60 years (mean 43 years), and had body weights of 50-98 kg. The duration of illness ranged from 1 month to 20 years (mean 30 months), and the frequency of insomnia averaged 5.4 times per week. Of the patients, 60.3% were women. All were right-handed. A variety of sleeping medications had been used by 85% of the patients, in most case benzodiazepines, and all noted the need to increase their daily doses, resulting in significant levels of restlessness. Various plant-derived sleeping medications had been used by 15% of patients. Treatment with “brain music” was conducted after patients had stopped taking all psychotropic agents (including sleeping pills) for at least two weeks.

Complaints of difficulty going to sleep were recorded by 84.5% of patients, while 75.9% reported frequent night waking, and 51.7% had early morning waking. All three complaints were present simultaneously in 16 patients.

The following investigations were performed:

1) Clinical studies. The somatic, neurological, and mental status of patients was recorded, including the severity of pre-, intra- and post-sleep disturbances.

2) Questionnaires. Patients were asked to complete a questionnaire to assist analysis of the effects of “brain music”; these used a five-point scale to assess the following parameters: time taken to go to sleep, duration of sleep, number of night wakings, quality of sleep, quantity of dreams, quality of morning waking (morning well-being); the maximum total number of points was 30. Questionnaires were completed on three occasions (baseline, after the first listening session, and after courses).

3) Psychological testing. We used MMPI (Minnesota Multiphasic Personality Inventory) test, that could evaluate the actual psychic state and the peculiarities of personality and Spielberger test that could evaluate the personal and reactive anxiety.

4) Electroencephalography:

a) In the conscious state. EEG traces were recorded with subsequent compressed spectral analysis in the state of relaxed consciousness and during verbal and nonverbal tasks (for assessment of interhemisphere interactions). (Verbal tasks consisted of thinking of seven color names for each of seven letters, seven composers’ surnames for each of seven letters. The nonverbal task consisted of mental spatial rotation of a cube and pyramid with one shaded side, shown on a diagram, to make the shaped side at the front, at the back, at the side, and at the top.) Four monopolar EEG leads were recorded: from (he right and left forehead and from the right and left center. The power of the following frequency ranges were analyzed: □, □, □, $\square_1$ (13-20 Hz), and $\square_2$ (20-32 Hz). The dynamics of the absolute power levels of these frequency ranges were assessed, as were the dynamics of the relative power levels of each frequency range (as percentages of the total EEG power in each hemisphere). Additionally, the dynamics of the ratio of slow and rapid rhythms $((\square + \square)/(\square_1 + \square_2)$ was analyzed; this reflects [he interaction of the deactivating and activating systems of the brain.

b) During sleep. Nocturnal polygraphic studies were performed, with recording of those parameters needed for identification of different phases of sleep: these included the EEG, the electrooculogram, and the electromyogram. EEG traces were recorded with four monopolar leads, on the left and right forehead and the left and right center.

The significance of the measurements was evaluated using nonparametric statistical methods (the Wilcoxon and Wilcoxon-Mann-Whitney criteria).

“Brain music” was obtained from insomniac patients as follows. The sleep program was analyzed and fragments of sleep stages and phases (at least 7 min, to allow for subsequent editing out of artifacts) were selected, these being the ones best fitting the standard criteria [5, 9]. From the edited traces, EEG fragments of the following duration were selected: 5 min for the second stage of sleep; 3 min for the □ phase (including 1 min of the third and 2 min of the fourth stages of sleep); 2 min for the rapid sleep phase. A tape recorder was used to construct compositions consisting of 5 min of the second stage, 3 min of □ sleep, 2 min of rapid sleep, and a further 3 min of the second stage. Patients listened to this composition each evening on lying down to sleep. Treatment courses lasted 15 days.

The program for investigations and treatment was as follows: stage 1 (first day): interviews with patients, clinical examination, filling in of questionnaire for subjective evaluation of sleep, psychological tests, adaptation to nocturnal studies; stage 2 (second day): nocturnal polygraphic investigations; stage 3 (third day): creation of "brain music"; stage 4: questionnaire assessment of main sleep parameters in the morning after the first listening; stage 5 (at the end of treatment): repeat performance of all the studies listed above.

Questionnaires showed that patients were not satisfied with the duration and quality of their sleep, or with the prolonged process of going to sleep. Psychological tests were used to assess patients as highly anxious (personal anxiety = 48 points, reactive anxiety = 56 points, compared with levels of 37 and 39 points respectively for healthy subjects of comparable age and gender; $p<0.001$). In the MPT test, the highest points on the personality profile were in scales 2 and 1 (heights no more than 70 Units), and the lowest point was on scale 9, indicating clear depressive tendencies and preoccupation with the state of health among patients of this group. However, all these tendencies were within the normal ranges.

Compressed spectral EEG analysis of traces recorded from insomnia patients in the state of relaxed consciousness showed reductions in the absolute and relative powers of the □ range, with an increase in the relative powers of the □ and □$_1$ + □$_2$ ranges. The coefficient of the interaction of slow and fast powers was higher in patients with insomnia than in healthy subjects.

Verbal and nonverbal testing of insomnia patients gave results rather different from those obtained in healthy subjects There was greater deficit in the functional capacity of the right hemisphere in primary assessments of stimulus importance: in healthy subjects, the right hemisphere responded to nonverbal and verbal tasks, while in patients the right hemisphere responded only to nonverbal tasks. There were no differences in left hemisphere functions: both patients and healthy subjects produced left hemisphere responses only to verbal tasks.

Polysomnographic investigations revealed significant changes in patients as compared to healthy subjects (only significant differences, at $p<0.05$, 0.01 and 0.001 are given): there were reductions in the total duration of sleep, in the durations of □ sleep and rapid sleep, and in the number of completed cycles, with increases in the time for going to sleep, waking during sleep, number of wakings, and movements during sleep.

Thus, this set of clinical, psychological, and electrophysiological investigations of insomnia patients revealed objective signs of sleep disturbance in patients with depressive-hypochondriacal and anxious tendencies in their personality structures, along with changes in the ratios of activation and deactivating systems of the brain and features of interhemisphere interactions, which appear to provide the psychological and neurophysiological bases of insomnia.

Group 1. Questionnaire assessment of the major sleep parameters showed that after the first episode of listening to "brain music", positive changes occurred in nearly every sleep parameter, reaching statistical significance for improvements in sleep quality, in reductions in the time taken to go to sleep, as well as in decreases in the number of dreams (Table 1). By the end of courses of "brain music" therapy, all subjective characteristics of sleep were significantly improved, the greatest successes consisting of increases in the duration of sleep and increases in evaluations of sleep quality (150% and 130.2% respectively as compared with the baseline points scores). The smallest (but nonetheless statistically significant) effects of "brain music" were on the subjective evaluations of dream activity (117.1% of the baseline points score).

The total point scores improved by one third, to 24.6 points (132.3% of baseline; see Table 1).

"Brain music" therapy significantly reduced the level of personal and reactive anxiety in patients (to 38 and 43 points respectively; $p<0.01$). The MPT test showed significant reductions in scales 2 and 1, along with increases in scale 9, which can be interpreted as reductions in depressive and hypochondriac tendencies.

An important point is that assessment of therapeutic efficacy by patients and physicians were in almost complete agreement, with "excellent" or "good" results reported by 88.7% and 84.1% respectively.

After treatment, there were increases in the power of the □ range and reductions in the power of the □ range, along with tendencies to reduce slow rhythm power (reaching significance in the left hemisphere) in both hemispheres (Table 2). The right hemisphere in patients showed restoration of primary assessment functions for nonverbal and verbal stimuli, though the rhythm pattern differed from that recorded from healthy subjects.

Significant positive changes were obtained in sleep structure after treatment with "brain music" (Table 3). There were increases in the total duration of sleep, the duration of □ sleep and the rapid phase of sleep, with reductions in movement activity during sleep; nocturnal waking time decreased, as did the number of wakings, and the number of completed sleep cycles increased.

All 44 patients of group 1 preferred "brain music" to other pharmacological and nonpharmacological therapies.

Group 2. Questionnaire evaluations of the main sleep parameters showed that the first session of listening to "brain music" produced positive changes in many sleep characteristics, reaching statistical significance for increases in sleep quality, reductions in the time taken to go to sleep, and increases in the duration of sleep. By the end of courses, all subjective sleep parameters showed significant improvements compared to baseline, though there were no significant changes in comparison to measurements taken after the first session. It is important to emphasize that improvements obtained immediately after the first session of listening and then showing no further improvement represents a typical example of the placebo effect [7]. It may be relevant that these changes were mainly attributable to seven patients (50%), in which they were most marked, while changes in the other seven patients were typical of the placebo effect. The total points score improved to 116.9% of the baseline value.

Treatment of group 2 patients led to reductions in personal and reactive anxiety (to 47 and 55 points respectively); in seven patients, the magnitude of the decrease was similar to that in group 1, while the other seven patients showed insignificant changes. The MPT test gave significant reductions in scale 2, which can be interpreted as some decrease in depressive tendency.

Analysis of the subjective evaluations of the results of "brain music" therapy by group 2 patients and physicians showed that these diverged in seven patients (patients reported very good effects and physicians reported small effects). In the other seven patients, assessments by physicians and patients were in accord (most of these evaluations were "intermediate" or "poor").

After courses of treatment, group 2 generally showed no other significant changes, apart from some increase in the □ range power. However, seven patients with subjectively good responses to treatment showed reductions in the power of slow rhythms in both hemispheres. The right hemisphere in patients of this group did not show restoration of primary assessment functions for nonverbal or verbal tasks.

In general, sleep structure in patients of group 2 did not change significantly. Seven patients with subjectively good responses to treatment had significant increases in the duration of sleep, and reductions in the time taken to go to sleep and the number of movements during sleep.

Our study revealed the positive influence of this method of therapy on patients with insomnia not only by subjective point of view of a patient, but also takings into account the results of objective investigations. The psychological mechanisms of this positive effect consisted of a reduction in the levels of depression and anxiety, and the neurophysiological basis was an increase in the activity of the somnogenic systems of the brain, along with normalization of interhemisphere interactions and hemisphere functions (especially affecting the right hemisphere in terms of primary assessment of nonverbal and verbal tasks).

An important factor supporting these results was the fact that a double-blind approach was used. Two tendencies were discerned in the group of patients presented with music derived from other patients: some patients (50%) obtained subjective and objective positive effects, while the remainder (50%) showed a clear placebo effect, with a positive subjective response after the first session of listening (without objective verification), with loss of this effect by the end of the treatment course. All these points indicate that the "brain music" program has a high placebo effect (50%), which is greater than the level usually seen [7]. This suggests a high psychotherapeutic potential for this program, which is in itself a positive aspect.

Thus, the "brain music" program can be regarded as a highly effective, nonpharmacological approach to the treatment of insomnia (compared with the positive effects of contemporary somnogenic medications), as indicated by the results of a wide range of investigative methods, including electrophysiological and psychological methods. It is very important to note that while this program has significant therapeutic potential, there is no risk of producing side effects or complications. Further studies will allow a widening of the settings for use of program, with its significant potential for the therapy of anxiety and depressive disturbances.

REFERENCES

1. N. A. Vlasov, A. M. Vein, and Yu. A. Aleksandrovskii. The Control of Sleep [in Russian], Moscow (1983), p. 231.
2. Ya. I. Levin and A. R. Artemenko. Zh. Nevrol. Psikhiatr., **96,** No. 3, 107-112 (1996).
3. Ya. I. Levin and A. M. Vein. Rossiiskii. Med. Zh., No. 3, 16-19 (1996).
4. O. Benoit. Neurophysiol. Clin., **21,** 245-265, (1991).
5. ICSD — International Classification of Sleep Disorders. Diagnostic Coding Manual. Diagnostic Classification Steering Committee, M. T. Thorpy (ed.), (1990), p. 396.
6. P. Lemoine. Hypnotiques, Editions Techniques, Encycl. Med. Chir., Vol. 9, Paris, France (1994).
7. P. Lemoine. Le Mystère du Placebo, O. Jacob (ed.), Paris (1996), p. 238.
8. J. Marks and A. N. Nicholson. Br. Med. J., 288, 261, (1984).
9. A. Rechtchaffen and A. Kales. A Manual of Standardized Terminology, Techniques and Scoring for Sleep Stages of Human Subjects. Bethesda, Washington D.C. Government Printing Office (1968), p. 235.

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“ Music of the Brain ”® – The NEW METHOD OF TREATMENT OF INSOMNIA, ANXIETY, DEPRESSION.

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As WHO reported, sleep disturbances, anxiety and depression occur in 64 per cent of population. At present, the undoubted leaders in treatment of these disorders are the pharmacological methods, which, however, usually initiate such problems as *drug addiction, dependence* (all these drugs are psychotropic ones) and the necessity to *increase dosage* of the drug in cases of long-term use; allergy, gastrointestinal side effects; *withdrawal syndrome*. Add the strong prejudice of people against these drugs, and we understand why the development of new non-pharmacological methods for treatment of patients with such disorders is important.

The program “Music of the Brain”® (MB) was created on the basis of the algorithm for transformation of electroencephalogram (EEG) into music invented by Levine I.I. (1991). Gavrilov D.G. created the software in media of WINDOWS for IBM-compatible personal computers (BRAIN SOUND COMPILER, Copyright 1992-1999).

The following scheme for **registration, processing and transformation of EEG into music** was applied in the treatment of patients: 1) EEG registration by means of device for correction of functional state of a subject, 2) Putting EEG into IBM-compatible personal computer by means of plate of analogue-to-digit converter of EEG; EEG registration by means of four monopolar leads: frontal (right and left) and central (right and left), 3) visual analysis of all the sectors of selected parts of EEG and removal of artifact sectors (artifacts due to locomotion, electrodes, etc.) by means of software BRAIN SOUND COMPILER, 4) transformation of edited segments of EEG into music, 5) application of the sound map for reproducing the music; piano is used for all the leads. As a result, relaxation and activation versions of the music are produced, and then recorded to audiocassette, which is listened to by the patient under the individual rationale.

The unique of the “Music of the Brain” is in: 1) its’ individuality – the influence upon a person is realized by music obtained by transformation of this person’s brain bioelectrical activity, 2) the possibility to change the functional state of one of the cerebral hemispheres via isolated influence upon it, 3) the absence of necessity of teaching a person the method and training him constantly in mastering it, 4) the possibility to use MB under any circumstances: from everyday life to special medical and industrial practice, 5) the absence of necessity in special devices (except a tape recorder) in case the individual audiocassette has been already recorded.

The total of 1500 healthy subjects and patients with various neurological and psychiatric disorders has been studied by means of this program since 1993. Now, the greatest experience of MB using is gained in treatment of insomnia, depression, panic attacks and other anxiety conditions, as well is in improving adaptation of healthy subjects.

To test the efficiency of MB in mentioned above groups of patients (the major groups in which the patients listened to their own music), the double blind, placebo-controlled studies have been carried out. As a placebo we used the music of the other patient (placebo-group). Before and after 14-days of treatment, 250 patients and healthy volunteers have undergone clinical studies, questionnaire and psychological testing (MMPI for evaluation of the urgent psychic state and the personality features; Spilberger test for evaluation of personal and reactive anxiety levels, Beck's test for evaluation of depression level), and neurophysiological testing (spectral analysis of EEG in relaxed wakefulness during verbal and non-verbal tests for estimation of interhemispheric interrelations; polysomnography for sleep structure analysis).

The decrease in frequency and severity of panic attacks, improvement of mood and improvement of sleep quality were shown for the patients of the major groups after the course of listening to MB (only the statistically significant changes are discussed here and below). Psychological testing revealed decrease in levels of anxiety and depression. Results of neurophysiological studies demonstrated not only recuperation of rhythmic pattern of EEG, but also normalization in interhemispheric interrelations (e.g., recuperation of the function of right hemisphere – the initial analysis of input information). Polysomnography showed the increase in total duration of sleep, increase in delta-sleep and REM duration, decrease in movement activity and wakefulness during sleep. The treatment was evaluated as high efficient both by patients and doctors (Table 1).

Table 1. The comparison of patients' and doctors' subjective evaluation of results of treatment with MB

EFFECT			
	"excellent"	"good"	"middling"
patient	43,2%	45,5%	11,3%
doctor	38,6%	45,5%	15,9%

In placebo-groups, 50% of patients had the typical effect of placebo with the maximum improvement during first days of treatment followed by diminishing effect.

No side effects or complications of MB have been observed.

Our study revealed the beneficial effect of MB on patients not only from the point of view of the patients' subjective sensations, but according to the results of objective testing. The psychological mechanism of this beneficial effect is the decrease of the levels of depression and anxiety. The neurophysiological basis of the effect is enhancement of the activity of somnogenic brain systems, and normalization of interhemispheric interrelations and functions of hemispheres. Absence of side effects and complications along with high efficiency and stable improvement, as well as possibility to use this method in combination with the other pharmacological and non-pharmacological methods brings "Music of the Brain" to one of the leading places in treatment of the whole number of rather common disorders.

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ETUDE DES EFFETS DE LA "MUSIQUE DU CERVEAU" (MC) CHEZ LES SUJETS SAINS ET LES INSOMNIAQUES.

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Les traitements pharmacologiques de l'insomnie ont montré leur inefficacité à long terme voire leur toxicité sur le sommeil. Parmi les techniques alternatives la méthode dite « Musique du Cerveau » (MC), transforme les ondes cérébrales en mélodie dont l'écoute permettrait d'améliorer le sommeil des insomniaques.
Première étude en cross-over, nous avons testé la méthode pendant trois semaines chez dix sujets sains. **Tests utilisés**: qualité subjective du sommeil (questionnaire de Levine, satisfaction globale) et de l'humeur (questionnaire de Beck). **Déroulement :** Semaine 1: baseline ; Semaine 2 : les sujets écoutaient leur propre musique ; Semaine 3: musique placebo (leur propre musique construite à partir d'un autre algorithme). L'écoute se déroulait le soir avant l'endormissement pour la partie relaxante (5-10 mn) et le matin juste avant le lever pour la partie activatrice (1-3 mn). **Statistiques:** test t de Student. **Résultats:** MC a induit une amélioration de la qualité globale du sommeil chez l'ensemble des sujets sains. Dans cette étude préliminaire aucune différence n'a été trouvée entre les effets de la musique propre du sujet et ceux de la musique placebo.
Deuxième étude: 54 patients insomniaques (DSM IV) chroniques, âgés de 18 à 60 ans ont donné leur; tests électrophysiologiques (EEG de veille, surcharges verbales et non verbales, polysomnographie), psychologiques (MMPI, questionnaires de Beck, d'anxiété et du sommeil), effectués avant et après 2 semains de traitement. Statistiques: tests non-paramétriques. 40 patients (groupe 1) ont eu leur propre musique et 14 patients (groupe 2) la musique placebo (MC d'un autre patient). Résultats, MC a amélioré le sommeil de l'ensemble des patients du groupe 1; tous les patients ont préféré leur musique du cerveau. La base psychologique de cette influence est la diminution de la dépression et de l'angoisse. Du point de vue neurophysiologique on trouve à la base des mécanismes cérébraux de cet effet le renforcement simultané de l'action des systémes somniphères de REM et non-REM, aussi que le changement des relations interhémisphériques.

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"Brain Music" for treatment of insomnia and anxiety

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Introduction: The close relationship between insomnia and anxiety is well established. Anxious patients have difficulties maintaining sleep, they spend less time in deep sleep and their sleep is more fragmented than that of normals. Traditional approaches have emphasized pharmacological treatment of insomnia. Benzodiazepines have become the most widely prescribed of all pharmaceuticals. Concern has been expressed however about their potential to cause dependency associated with self-dosing management. A non-pharmacological method – "brain music" has been recently developed for treatment of some psychosomatic symptoms[1]. This method allows establishing the most effective rhythmic and tonal parameters creating meditative conditions in patients by influencing the bioelectrical brain activity in the process of music therapy depending on the individual EEG. Subsequently EEG patterns are converted into unique music recorded on a personalized compact disc with listening instructions catered to each individual. Brain music because of its more favorable side-effect profile may represent a possible alternative for therapeutic management of insomnia and anxiety. The purpose of the present study was to assess the effectiveness of brain music for treatment of insomnia in anxious patients using objective actigraphic measures and psychometric testing.
Methods: Eighteen volunteers who had complained of symptoms of insomnia of at least two years duration and who had scored above 50 on the Zung Self Rating Anxiety Scale were recruited for participation in the study. Patients were divided into two groups on a double-blind randomized basis. Experimental group I comprised ten insomniacs (7 females and 3 males, aged 41.6.0±5.8) who were provided with their authentic "brain music". Placebo group II consisted of eight patients (5 females and 3 males, aged 42.8±7.8) who received compact discs with brain music of a different subject. The duration of the treatment, which entailed listening to the music on a daily basis, was four weeks. Athens Insomnia Scale and actigraphy were used for assessment of subjective and objective quality of sleep. Forty eight-hour actigraphic recordings were performed before and after 4 weeks of brain music. Average sleep onset latency (SOL), total sleep time (TST), and amount of intervening wakefulness were determined. Affective status of the patients was controlled by using the CES-Depression Scale. Participants from both groups had slightly elevated scores (19.6±3.8 and 20.1±5.4 respectively; $p>.05$). Statistical analysis was performed using the independent samples' t-test in the SPSS statistical software package with significance set at $p<.05$. Bonferroni correction was used for multiple variable analysis.
Results: Both authentic and placebo brain music reduced anxiety scores with more pronounced effects observed in the experimental group (58.1±2.8 vs.31±4.6 and 60±5.6 vs. 46.5 ±6.1 respectively, $p<.01$). There was a dramatic improvement in sleep quality as judged by the Athens Insomnia Scale ($p<.001$). However there was no significant difference between the positive effects of authentic and placebo brain music on subjective quality of sleep. Interestingly some actigraphic parameters characterizing insomnia in anxious patients were found to be significantly improved only in the experimental group of patients who were using authentic brain music. Amount of intervening wakefulness was significantly less following brain music treatment ($p=.02$). The patients had a significant increase in TST ($p=.004$). SOL remained unchanged before and after brain music treatment ($p>.05$).
Conclusion: In this study a 4 week regimen of brain music therapy was shown to be of value in reducing symptoms of anxiety and insomnia as evidenced by psychometric testing. Objective actigraphic measures of insomnia have been improved in the group of anxious insomniacs treated with endogenously generated brain music. Brain music is a useful alternative to pharmaceutical therapy for treating these conditions.

Reference:

1. Levin Y. Neuroscience and Behavioral Physiology 1998; 28: 330-335.

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Increases In Evening- And Night-Time Melatonin Levels Following Itr.iin Music Therapy For Anxiety-Associated Insomnia

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Introduction: A variety of studies reported psychophysiological effects of music. Different types of music may induce different neuroendocrine changes. For instance meditative music has been found to decrease levels of cortisol and adrenalin. Recently, acute increases in nocturnal melatonin production were reported following mindfulness meditation. Chronic insomniacs are known to have suppressed nocturnal outputs of melatonin. Stress and anxiety mediation is multifactorial and strongly influenced by GABAergic and dopaminergic neurotransmission. Melatonin as a CNS depressant with anxiolytic, mild hypnotic and anticonvulsant actions may also be involved in these effects. The purpose of this study was to investigate whether a specific type of music - "brain music therapy", a new non-pharmacological method for treatment of insomnia, could affect endogenous melatonin levels in patients with chronic insomnia and heightened anxiety traits.
Methods: Eleven volunteers (7 females and 4 males, aged 43.1 ±4.2) 'who had complained of long-term insomnia and who had scored above r50 on the Zung Self Rating Anxiety Scale were recruited for participation in the study. Their response to treatment with endogenously generated brain music was evaluated in an open pre- and post-treatment design. The duration of the treatment, which entailed listening to the sic on a daily basis, was two weeks. Severity of sleep disruption was assessed using Athens Insomnia Scale. Dim Light Melatonin Onset test (DLMO) was performed on the nights before and after treatment. Saliva samples were collected every hour from 20:00h to 02:00h under dim hi (less than 5O lux). In order to collect the saliva samples, the subjects had to chew on a cotton roll for approximately 2 minutes, then transfer the roll directly from mouth into the open end of the filter tube, avoiding touching the cotton roll with their fingers. Melatonin was assessed by Enzyme Linked Immunosorbent Assay (ELISA). Analysis of variance using the General Linear Model Procedure was employed to detect statistically significant differences in melatonin levels. Further analysis included Tukey post hoc paired comparisons and the non-parametric Mann-Whitney's U-test was used for the psychometric data.
Results: Brain music therapy reduced anxiety scores (62±5.2 vs. 42.5±4.3, p<0.01). There was a significant improvement in sleep quality as judged by the Athens Insomnia Scale (p<.001). Eight out eleven insomniacs had extremely low absolute values of endogenous melatonin secretion in all samples (between 1.1 and 9.2 pg/ml) on a before treatment night. No discernible DLMO could be detected. Three patients had delayed DLMO occurred at 01:00h. The point-by-point comparisons between melatonin concentrations on the pre- and post-treatment occasions showed significant increases at 21:00 (p<0.01), 22:00h (p<0.001), 01:00h (p<0.001) and 02:00 (p<0.002).
Conclusions: In this study a two-week regimen of brain music therapy was shown to increase endogenous melatonin production. Whether brain music alters hepatic

metabolism of melatonin or there is a direct involvement of pineal physiology remains to be clarified.