

Study on the impact of audio-visual stimulation (AVS) on cognitive performance, psycho-vegetative tension, general mental state and sleep

- Summary -

1. Introduction

Principal purpose of the study is to find out by means of neuropsychological tests and psychopathological rating procedures, whether and into to what extent a daily application of the AVS with the Laxman of Neurotronics GmbH, over a period of three weeks, leads to an improvement of cognitive performance, a reduction of psycho-vegetative tension and anxiety, an improvement of general mental state and sleep.

The tests were carried out with 20 test persons before and after the three-week application phase and evaluated afterwards.

In a preceding first investigation a positive trend could already be pointed out concerning the improvement in the aforementioned items. The following items were evaluated with 11 test persons before and after an AVS application with the Laxman: general mood, vitality, relaxation, concentration ability, anxiety, nervousness, depression. The test persons indicated improvements in all items, the improvement in relaxation was significant.

Stress, fears, and sleep disturbances, as well as concentration and attention deficits, are wide-spread problems in our society. They often lead to psychotherapeutical and medicamentous treatments. It is to be examined whether and into what extent the AVS represents an alternative treatment method resp. can support a primary treatment.

In particular, it is to be found out whether the AVS resp. the "Laxman" can be an answer to the stresses that accompany the rising complexity of our society. This includes the treatment and/or prevention of burnout as well as an up-to-date stress management. At the same time it is to be examined whether the AVS can parallelly lead to an improvement in cognitive performance, i.e. attention, concentration, and memory, in order to be able to provide an alternative method for complexity management for high performers.

2. Methods

The audio-visual stimulation device "Laxman" of the company Neurotronics GmbH was used for the investigation. The Laxman is a device which sends audio-visual impulses

by means of color Ganzfeld glasses and earphones, and for this purpose uses varied audio contents.

Before and after an application phase of several weeks, neuropsychological tests and psychopathological rating procedures were carried out, which measure memory, attention and concentration performance, the psychomotoric speed, as well as the psycho-vegetative tension, anxiety, quality of life and sleep.

During the application phase a 20-minute application with an alpha session was carried out daily on six days per week. The study was conducted over three weeks.

2.1 Study Participants

Altogether 20 healthy test persons participated in the study (10 women, 10 men). The average age was 51 years. All test persons were interviewed about their medical history. Only study participants were recruited who showed no indication of preceding transient consciousness disturbances, synkopes or other evidence of epileptic seizures. The anamnesis was carried out by a neurologically and psychiatrically experienced physician.

In order to form a group of test persons as naturalistic as possible and exclude possible factors of influence, e.g. persons were excluded who successfully use daily relaxation techniques such as autogenous training or progressive muscle relaxation, as well as persons who regularly get psychiatric medication. Likewise excluded were test persons with serious internal or neurological psychiatric illnesses.

The tests carried out can be divided into two main groups: psychometric rating procedures and neuropsychological tests. The individual tests are briefly described in the following.

2.2 Psychometric Rating Procedures

The *State Trait Anxiety Inventory* (STAI) is a psychometric procedure for measuring anxiety. The two scales of the STAI with 20 items each serve to measure anxiety as a state (State Anxiety) and anxiety as trait (Trait Anxiety).

The *General Health Questionnaire* (GHQ-14) is a procedure to measure the general psychological health. The procedure is based on a self evaluation of the condition in the past week.

The *Perceived Stress Scale* (PSS) is a common questionnaire to measure generally perceived stress. Statements concerning requirements, joy, concerns, and internal strain are evaluated on a four-stage frequency scale.

The *Munich Quality of Life Dimensions List* (MLDL) is a full standardized procedure for the self evaluation of adults concerning the cognitive assessment of elementary components of the quality of life. The questionnaire consists of 20 elementary components of life which have to be evaluated on a scale from 0-10 concerning their satisfaction, importance, desire to be changed, as well as the belief of being able to bring about the change in the respective field.

2.3 Neuropsychological Tests

The *Concentration Endurance Test (d2 Test)* is a universal test to measure the attention and concentration performance, which has been standardized and validated in psychological diagnostics for many years. On a test sheet there are 14 lines, each with 47 marks made up of combinations of the characters „d“, „p“, and „q“, and one, two, three, or four lines. Each "d" that has two lines is to be crossed out from the random order. After 20 seconds the test person is asked to switch to the next line.

The concentration performance value (KL value), which is used in the evaluation, measures the overall performance. It is formed by the amount of characters crossed out correctly (d with two lines) minus the mistakes (type F2). Thus, the evaluation takes into account the psychomotoric speed as well as the quality of the performance. The KL value is falsification-resistant, normally distributed and highly reliable.

The *Verbal Learning and Memory Test (VLMT)* is a test for learning serial word lists in five test runs with subsequent distraction and renewed delayed call. The test material consists of two word lists (A and B) comprised of 15 semantically independent words each. There are two parallel test forms in order to exclude a recognition factor in the after test. By means of the VLMT different parameters of the declarative verbal memory such as the supraspan, the learning and encoding efficiency can be measured.

The *Digit span backward* is a subtest of the Wechsler Memory Scale, which measures the capacity of the working memory. It concerns the short term storage of information. For this test the test person is first given a row of digits consisting of two digits which have to be repeated backwards. After each successful test run the number of digits in the row is increased until the correct reproduction does not succeed any longer.

The *Digit Symbol Test* is part of the Wechsler Intelligence Scale and measures the general cognitive processing speed. In the test sheet, digits from 1 to 9 are to be connected with a certain symbol with the help of an allocation pattern.

The *Trail Making Test (TMTA)* is a specific test procedure to assess the general cognitive speed as well as the attention. In this procedure the numbers of 1 to 25 are randomly distributed on a sheet of paper. The task is to connect them as fast as possible with a pencil. The test value is the time needed for the correct connection of the numbers.

3. Results

3.1 Cognition

As shown in Table 1, there was an improvement in all examined fields. The improvement in concentration and attention was particularly obvious (D2, Digit Span).

Table 1

Test	Field	Pre Value	Post Value	Improvement
D2	concentration/ attention/speed	155,16	180,79	14,2 %
TMTA	cognitive speed (time in seconds)	33,21	24,37	26,6 %
Wordlist VLMT	memory	48,05	54,6	12,0 %
Digit Symbol	psychomotoric speed/ working memory	55,67	61,37	9,3 %
Digit Span	concentration/ working memory	5,2	6,05	14,1 %

3.2 Psychometric Rating Procedures

Compared to the neuropsychological tests the conclusions of the psychometric rating resulted from the subjective experience of the test persons. An improvement could be determined in all examined psychometric dimensions. Predominant was a reduction of the individual stress feeling (by 21.6 per cent) as well as an improvement in the relaxation ability (by 21.5 per cent). Altogether the test persons indicated an improvement of the general psychological health by 27 per cent.

The first three rating procedures (PSS, STAI, GHQ) use „negative“ questions, i.e. a smaller value represents an improvement. The MLDL, including its subtests, uses „positive“ questions, which means a higher value represents an improvement.

Table 2

Scale	Dimension	Wert prä	Wert post	Verbesserung
PSS	Stress	23,85	18,7	21,6 %
STAI (State)	anxiety	39,95	34,05	14,8 %
GHQ	psychological health	14,05	10,2	27,4 %
MLDL	personal well-being	5,9	7,1	16,9 %
	relaxation ability	5,65	7,2	21,5 %
	total (item 1-20)	131,65	143,45	8,2 %

4. Discussion

The study at hand is currently the most comprehensive investigation of the effect of audiovisual stimulation on cognitive and psychometric fields. Despite the effort towards a standardized execution, certain motivational, daily-temporal, and projektive factors of influence cannot be excluded, as with all studies on the psychological situation. Although the absence of a control group limits the statistical power, a high degree of objectivity is ensured by the use of tests and rating procedures that have been validated for many years.

The consistent results concerning the improvement of concentration and attention (D2 and Digit Span) allow a valid interpretation, whereas the increase in cognitive speed by 26.6 per cent in the TMTA can be partially explained by a possible exercise effect. The improvement of the memory functions might be a secondary effect of the increase in concentration ability.

The fact that there was an increase in the general psychological health by 27 per cent, whereas the general life situation improved only by 8 per cent, is an indication of the problem of social desirability when filling out psychometric questionnaires.

5. Forecast

The version at hand is a first short evaluation of a multiplicity of data. These will be further edited for a publication. In this context the further sub scales and their correlations will be evaluated, as well as the sleep questionnaires to find out about the possible influence of an improved sleep quality on the test results.

Despite certain limitations concerning the explanatory power of the findings, the study at hand shows a clear tendency to an increased stress tolerance and relaxation ability connected with an improvement of the concentration and attention performance. To what extent a larger number of test persons of matched age groups in relation to a control group will confirm these improvements, is subject to further investigations. Concerning the medical use of the AVS we plan the publication of data from clinical post marketing surveillance studies. By request the complete data records of the test results can be made available as file.

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