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Review Article

Negative Symptoms and Neurofeedback Therapy

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Summary

This study compares two case histories. Both subjects showed negative symptoms of schizophrenia. The negative symptomatology is shown in the incoherent thought and speech processes of a person. In this study the effectiveness of neurofeedback therapy is analyzed. The aim of this therapy was to increase the cognitive coherence. This was measured with speech samples and a conditional-consecutive algorithm. Significant effects were shown in both subjects. These effects were based on inter-individually different processes.

Introduction

Incoherence is an essential feature of the negative symptoms of schizophrenia [1,2]. Language samples can be used to identify the extent of incoherence. The affected subjects have difficulty formulating connections between episodes. They speak either very abstractly or over-concretely. Final relations or conditional and consecutive relations are only marginally available.

An episode consists of a sequence of conditions – "intention and behavior" or "event and – behavior" or "event sequences". Contexts also result from conditional-consecutive relations, but between episodes. In people with negative symptoms, these contexts dissolve within the episodes and/or between episodes.

According to Hoffmann, et al [2], the sentences of a text are coherent if they can be arranged hierarchically. The hierarchy results from the following rule: "If X is true, then Y must be assumed". Y is thus hierarchically higher. This concept corresponds to the "framework" of a context [3]. The framework of a context is formed by those features, without which the course of the episodes would be incomprehensible. Trabasso & Sperry [4] examine this characteristic with a contrafactual criterion. Each sentence of a context is confronted with the question: "if event A had not occurred, would event B have not occurred either? An event A is thus necessary for an event B if the latter would not have occurred without A.

Deviations from this rule are indicators of incoherence. Incoherence exists [2] under the following circumstances:

1. If there are no common terms and anaphorical references between the sentences.
2. When common terms but no anaphoric references are used.
3. If no "bridging" is formulated, according to which two sentences could be connected by "because" or "but,
4. If the transitivity rule is violated (A presupposes B; and B presupposes C; but A does not presuppose C).

Coherence requires the priorities and preferences of an individual. Coherence thus presupposes the individual differentiation of relevant and irrelevant characteristics. Priorities influence selective perception and attention. They inhibit irrelevant features in the context of simultaneous and competing stimuli and thus favor relevant features. This process in turn requires a temporal interval. In this interval, discriminations between the different stimuli and coordination with memory systems take place.

"The brain generates its own temporal structure, which is largely organized by oscillations" [5]. These intervals of attention are reflected in the β - frequency band. The question of this study is therefore: can neuropsychological interventions of the β - frequency cause higher values of coherence in patients with negative symptoms of schizophrenia.

Therapeutic process

In a neurofeedback process, brain activity is recorded by EEG. These protocols are fed back to the subject on a computer. The subject can see their EEG parameters in the form of diagrams. Through this feedback patients learn to control their cerebral activity. In this study, a total of about 20 sessions took place. One session lasted 30 minutes. The sessions took place daily.

Subjects

Two subjects participated in this study.

- Subject B.Z. was 45 years old. She had been suffering from the negative symptoms of schizophrenia for 15 years. She had been hospitalized 15 times. At present she was not employed.

- Subject K.T. was 30 years old. He had been suffering from residual schizophrenia for seven years. He had been hospitalized three times. At present, he was unable to continue his studies.

Measurement instruments

1. the General Functional Level GAF [6]. This instrument was prescribed before and after the therapeutic intervention.

2. language variables:

Based on the approaches of Burke et al, [3] and Omanson [7] free speech protocols were evaluated. These speech protocols were recorded after each therapeutic session.

- Coherent = central were those sentences that contained the main subject 's actions and were simultaneously linked to another sentence by an "if - then - relation".
- Not assigned to coherence = supportive or marginal were descriptions of the main character, but without being linked to another sentence by an "if - then - relation".
- Incoherent = distractive were sentences that referred to secondary subject and were not linked to another sentence by an "if - then - relation".

3rd EEG parameter: Determined at each therapeutic session...

- Mean β (>15 Hz)
- Mean α (8 - 13 Hz)
- Mean θ (4 - 8 Hz)

Mean β represents the attention component relevant for stimulus identification. Irrelevant stimulus characteristics are inhibited. Mean α represents the attention component relevant for stimulus categorization. Irrelevant stimuli are inhibited. Mean θ represents increased rest, relaxation and sleep disposition.

Questions and research assumptions

1. is there an interdependence between the EEG parameters of attention during the therapeutic process? Significant correlations are assumed between Mean α, Mean β and Mean θ.
2. is there an interdependence between the parameters of the linguistic protocols? We assume significant negative correlations between central and marginal and central and distractive.
3. is there an interdependence between the EEG parameters of attention and the linguistic parameters? We assume significant correlations between mean α, mean β on the one hand and central on the other.
4. is there an interdependence between the EEG parameters of attention and the linguistic parameters at different times?

Can a given standard of attention regulation influence the later processes of coherence formation? Cross correlations between the mean α or mean β and central are assumed.

Results

The assumption of an improvement of the global functional level by neurofeedback therapy could be confirmed for both subjects. The Reliable Change Index (RCI) was calculated [8].

For subject B.Z. the pre- and post-measurements are on the GAF scale: For subject K.T. the pre- and post-measurements on the GAF scale are: GAF (pre) = 55 and GAF (post) = 65: GAF (pre) = 51 and GAF (post) = 61. The assessment of the reliability of the GAF is based on the study by Woldoff [9]. This results in a significant difference RCI=1.96; (p =.05).

1. In B.Z. there were no significant correlations between the EEG parameters. In K.T. the correlations were rMean α / β = .975 (p=.000), r Mean α / θ = .986 (p=.000), r Mean β / θ = .986 (p =.000). K.T. indirectly generates a current state of relaxed alertness.
2. 2. for B.Z. the correlations were rcentral/marginal =. -550 (p=.012) and rmarginal/distractive =. -642 (p =.002). For K.T. the correlation was rcentral/marginal =. -757 (p =.000). For both subjects, the more central and coherent aspects were focused, the less marginal and distractive aspects were focused.
3. for example, the correlation r Mean α was Mean9/central =.605 (p =.005). For K.T., the correlation r Mean θ/ central=.487 (p =.030). Both subjects achieved the same result. The underlying EEG-controlled attention processes were different.
4. significant cross-correlations were shown for B. Z. rlag2: central/ Mean β =. -646; rlag3: central/ Mean β =.534; rlag2: marginal/ Mean β =.495; rlag3: marginal/ Mean β =. -491. The autocorrelation was rlag1=. -518. The coherence is reduced after two sessions by the β- vigilance; its probability is increased after three sessions by the β- vigilance. The marginal incoherence is increased after two sessions of Mean β and reduced again after three sessions of Mean β. Mean β reduces itself one session unit later. K.T. showed significant cross correlations rlag3: central/ Mean β =.534 and rlag3: Mean β / central =. -771 High vigilance and coherence influence simultaneously and antagonistically.

Interpretation

Both subjects showed similar effects: a change in the general level of function and a higher probability of coherence. The underlying processes were different:

For example, did not adapt ad hoc to the current therapeutic situation. The attention-related regulation of coherence oscillated between the second and third session. In the first interval, the coherent aspects were reduced; in the second

interval, the coherence-creating aspects were focused. This mechanism is a habituation.

In K.T. the cognitive processes of coherence corresponded ad hoc with attention. The correlations between the EEG parameters point to an antagonistic balance or inner balance. High vigilance favours coherence after three sessions; but coherence also reduces the high β vigilance after three sessions - and thus simultaneously. This mechanism is an adaptation and approximation.

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