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Trance states during a mind-body intervention monitored by BIS

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Original Research [12 000 words]

Conflict of Interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Author Contributions

N.Z.: Data provision, literature search, data analysis and statistics, preparation of the manuscript. M. B.: V.J.: E.H.: preparation of figures, tables and manuscript, correction of manuscript.

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Starting out from the Moshe Feldenkrais' approach that includes Awareness Through Movement (ATM) and Functional Integration (FI) for the development of new patterns, the Martin Busch approach encourages experiments with variations of a movement instead of repeated practicing/exercising/training complex movement patterns. Directing attention through a movement suggestion that triggers different possible actions leads to the exploration of different variations (see also the “Introduction” in the text given as supplemental material). To achieve this, language must be as precise and open as possible. Precise in the description of What, open to individual interpretation of the How.

The instructions used here with the present audio file includes pressing one foot and the opposite elbow against the floor (task 1), movement of the eyes separately or together with the head from side to side (task 2), breathing with the hands uncrossed or crossed on upper or lower ribs (task 3), and eye movements together with the imagination of a diagonal between shoulder and opposite hip (task 4). The letter task includes the inexecutable suggestion of eyes moving forwards and backwards separately in the head.

Movements are performed in the rhythm of the breath, since breathing is also a movement (diaphragm, ribs), and controlled both consciously and unconsciously is a bridge to the unconsciousness. Moreover, this clock generator allows for individual and condition-adjusted pacing of the movements, in contrast to exercises, where breathing follows the movements. Even whether a movement goes with breathing out or in makes a difference. The patient is encouraged to observe “how you do what you do”, and again after variations of the movements. Thereby, the central nervous system receives new information, and the subsequent breaks give the brain the opportunity to compare the new information with its previous experiences, integrate new information and confirm what it already knows to optimize processes instead of practising complex patterns.

For calculations, the phases of the MBI were subdivided to result in time periods of approximately equal length (1.5-2 minutes). The deepest phase with regard to Bis was determined for every individual participant.

2.4 Statistical analyses

Variables were tested for normal distribution using the Kolmogorov-Smirnov-Lilliefors Test and visually. Accordingly, we present normally distributed variables with mean ± standard deviation (SD) and use a paired or unpaired Student´s t-test, as appropriate. Univariate ANOVA was performed including the 17 phases of the MBI. To assess potential contributing factors, multifactorial analyses of variance were conducted. The dependent variables were either “total intervention”, “all breaks”, “task 4b” (overall deepest phase), “deepest phase” (individual deepest phase), and “deepest minute”. As independent variables we used age group (15-30, 31-50, 51-80 years), gender, suggestibility group (low =0-1, medium =2-3, high =4-5, according to the HGSHS-5) and daytime group. Linear regression analysis was performed with regard to the same dependent variables and the ungrouped independent variables: age, HGSHS-5 score and time of day. A $p < 0.05$ was considered statistically significant for all tests. All analyses were performed with IBM SPSS Statistics, Version 27.

4. Discussion

4.1 Bispectral Index during mind-body intervention

The results of this study show that objectively measurable changes in the EEG occur during the mind-body intervention tested (see Fig.3). Throughout the intervention the BIS-values were significantly lower than in the awake state (see Tab.3 and Fig.4).

The extend of the BIS-reduction was comparable to that observed during hypnosis induction in the course of suggestibility testing (see Fig.2). It is noteworthy that the latter trance induction is not just a certain type of hypnosis induction but represents a standardized, worldwide used induction preceding the test for Harvard Group Scale of Hypnotic Susceptibility (HGSHS). Both interventions lead to a decrease in BIS to about 85. This corresponds to results of own preceding studies on HGSHS (Zech 23) or other types of hypnosis induction (publication in preparation) with BIS-monitoring. The variation within the test subjects was similar for BIS values during HGSHS-test and MB-intervention (compare Fig.2 and 3), namely

about 6%. This also confirms previous results from BIS studies on trance (Zech23).

While in the test for HGSHS, BIS is continuously decreasing during hypnotic induction and increasing during the subsequent tasks (see Fig.2), the course of BIS is varying during the MB-intervention (see Fig.3). There are rapid and slow changes. Overall, the trend is declining over the 30-minutes experiment with a R^2 of 0.545. This resembles the steady decline in BIS during the 15min induction phase of HGSHS testing and compatible with increasing trance depth.

Moreover, patterns of more rapid BIS changes can be identified, for instance a drop in BIS with every break. While during the exercises test participants are busy with movements, during the breaks they undertake reflections about their body position and relationships between different body parts. Such a shift in focus inward is known to be trance-inducing (Peter 2024). In addition, the breaks are accompanied by relaxation and tranquillity promoting a trance state. Drops in BIS possibly referring to trance deepening can be identified also during the exercises (see tasks 1-4 in Fig.3). Their origin remains unclear except for task 4, where in the second half participant are asked to move their eyeballs forwards and backwards. This represents an impossible task leading to confusion, which is a potent trance inducer (Erickson 64, Fusco20).

The search for possible factors with impact on the observed effect of the mind-body intervention on BIS did not yield any significant results, for none of the selected BIS target parameters, namely “total intervention”, “overall deepest phase” (task 4b), “individual deepest phase”, “all breaks”, and “deepest minute”. Age, gender, hypnotic suggestibility (HGSHS), and time of day seem to have no influence on the observed changes in electrical brain activity. This is remarkable for the HGSHS, where a stronger reaction could be expected for “high suggestibles” (Bongartz 1984, Peter 2024). However, this is consistent with the low to missing impact of suggestibility grouping on hypnotic effects in clinical settings (Montgomery 2011), and the lack of a correlation to BIS changes observed with hypnotic inductions (Zech 2023). A dependency of hypnotic induction on the time of day with a higher

suggestibility in the evening is generally assumed, but not proven. An ultradian rhythm of susceptibility to trance and hypnotic phenomena have been described (Rossi 1982), but is individually timed and thus escaped the present study. We also did not observe a higher susceptibility in females or a decrease with age as has been described for hypnotic susceptibility (Page and Green, 2007). These discrepancies indicate differences to hypnotic trance and phenomena despite the similarities in BIS.

4.2 Bispectral index and trance

Changes in consciousness are based on brain processes which are reflected in electrical activity. The advantage of consideration of the EEG is the fast, almost online monitoring of brain activity, the non-invasive measurement, and its feasibility allowing continuous data collection in numerous persons. The monitoring of the bispectral index (BIS) as a processed EEG in contrast to sophisticated analysis of power spectra offers simple values ranging between 100 and 0 and give clinicians objective information about the depth of sedation. The patient is considered awake for values over 90. General anesthesia comprises values ranging of 40 to 60, while deep sedation is within 60 to 70, and 70 to 90 represents light to moderate sedation. Although developed to monitor anesthetic depth, BIS is not strictly specific for anesthetics and sedatives, but also affected by other chemicals like muscle relaxants or alcohol (Gerstman15). It is also affected by physical (e.g. hypovolemia or, hypothermia) or metabolic (e.g. hypoglycemia) conditions (Dahaba 05). Moreover, changes in BIS do not exclusively reflect drug-induced effects on brain such as anesthesia and pharmacological sedation, but also non-pharmacological effects. Physiological sleep, for instance, has an effect on BIS and allows to distinguish the different sleep phases (Tung 02, Nieuwenhuijs 02). Moreover, applications of BIS monitoring outside the scope of the operating room and general ansethesia to “grade” other EEG conditions are considered (Dahaba 2019). For instance, bispectral electroencephalogram monitoring has been used to assess neurologic status in unsedated, critically ill patients (Gilbert 2001). Effects on BIS have also been demonstrated with methods of non-pharmacological relaxation and sedation, such as

acupressure of the extra 1 acupoint (Fassoulaki 07) or mindfulness meditation (Turer 23).

Hypnotic trance is caused and accompanied by electrophysiological processes that can be observed in the EEG (Hinterberger 11, Wolf 22). Accordingly, also changes in BIS have been described (Dunham21). In our previous study on BIS during the standardized hypnotic induction preceding suggestibility testing with the HGSHS, the electrophysiological measurements and the subjective score of hypnotic depth showed a similar course (Zech 23). The present experimental study supports the hypothesis that during a movement-based mind-body intervention EEG-changes are induced equivalent to a hypnotic trance induction.

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Tables

	Explanation	Time (min:sec)
Introduction		00:00
Break 0	Bodyscan	03:55
Task 1	Ellbow/Foot	05:30
Break 1		10:10
Task 2	Eyes/Head	11:45
Break 2		15:44
Task 3	Breathing	17:36
Break 3		22:44
Task 4	Eyes diagonal	24:00
Break 4		28:20
Exit	Eyes open, Reorientation	29:48
End		30:07

Table 1: MB-Intervention

Characteristics		
Total, n (%)		54 (100)
Age, years median (interquartile range)		36 (22-53)
mean (±SD)		38 (±16)
Age groups, n (%)	15-30 years	21 (40.2)
	31-50 years	17 (32.7)
	51-80 years	14 (26.9)
Gender, n (%)	female	32 (59.3)
	male	22 (40.7)
Suggestibility groups according to HGSHS-5 (2-3)	low (0-1)	39 (75%)
	medium	7 (13.5)
	high (4-5)	6 (11.5)

Table 2: Baseline characteristics of patients

(n=54)	BIS Awake	BIS total intervention	BIS deepest phase
Suggestibility Test (31.5min)	97.41 ±0.26	89.62 ±6.04	86.68 ±6,55*

MB Intervention (30.1min)	97.50 ±0.23	90.10 ±5.06	88.61 ±7.51**
		p= 0.152	p= 0.603

Table 3: Bispectral Index during Suggestibility Test and Mind-Body Intervention

The average BIS value during the total HGSHS-test and the total MB-Intervention was determined for each of 54 participants. Shown are the mean of 54 participants and the mean of the corresponding SDs. p was tested according to paired Student´s t-test. *: In HGSHS the deepest phase (90 sec after 17 min) is the end of the hypnotic induction. **: In the MB-intervention the deepest phase is the second half of task 4 (T4b).

Figures

Figure 1: Measurement Set-Up

Study participant with BIS-Monitoring during MB-Intervention

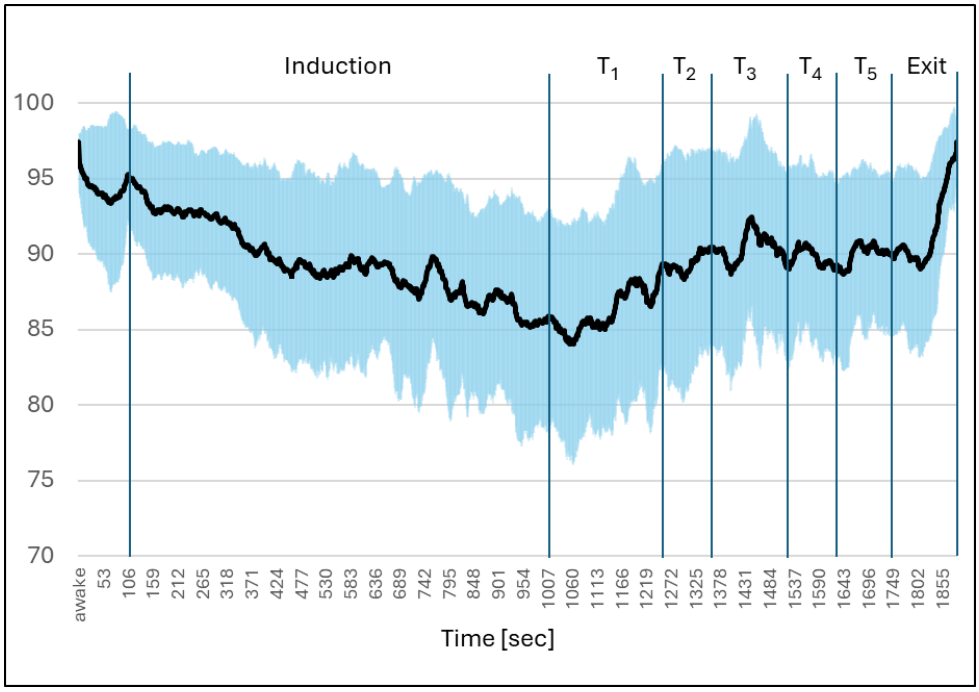

Figure 2: Bispectral Index during Suggestibility Test (HGSHS-5)
T= tasks 1-5

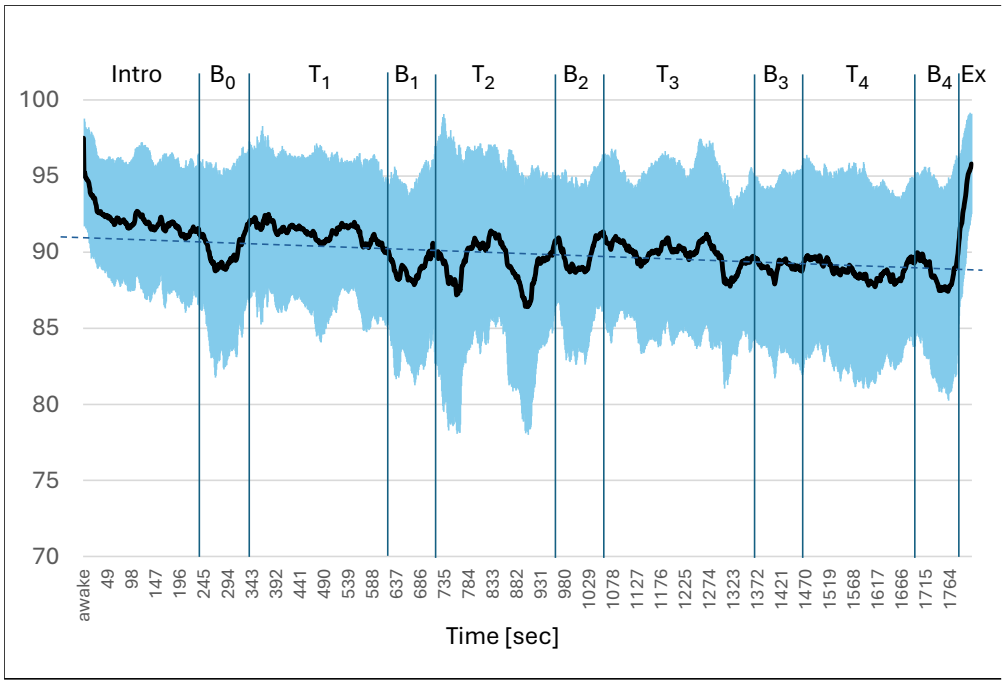

Figure 3: Bispectral Index during Mind-Body Intervention

Intro= introduction, B= breaks 0-4, T= tasks 1-4, Ex=exit
dotted blue line: linear regression of 1min-intervals y= 91.43-0.11*x, R^2= 0.545, $p<0.001$

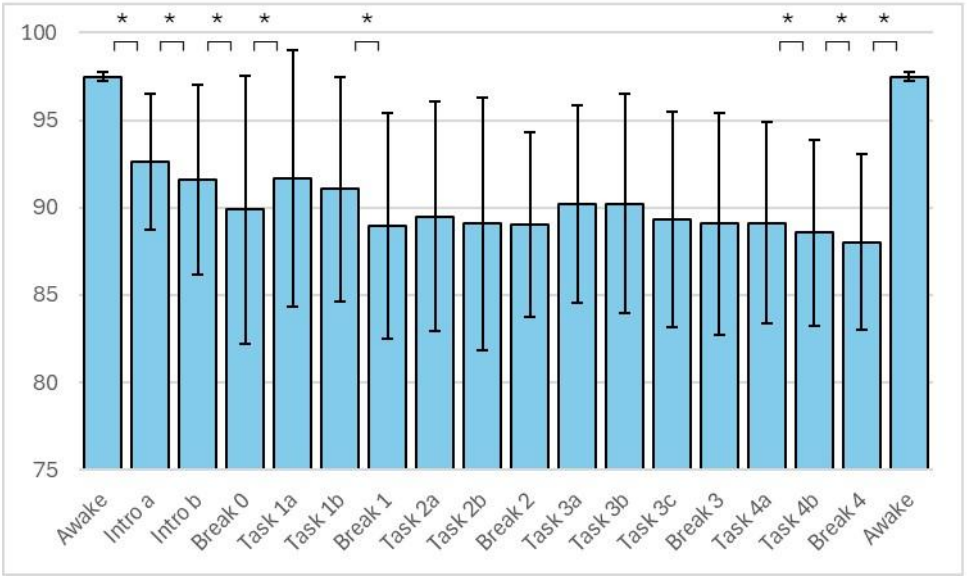

Figure 4: Phases of the MB Intervention
Introduction and tasks were divided up so that they resulted in phases of approximately equal length (1.5-2 minutes). *= $p < 0.05$