

# Investigation of psycho-physiological interactions between patient and therapist during a psychodynamic therapy and their relation to speech using in terms of entropy analysis using a neural network approach

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## Abstract

In the present contribution we investigate in an exemplary single-case study the behavior of psycho-physiological variables in psychotherapy sessions. The values are measured continuously during a single session at the same time for both patient and therapist. The analysis of the data is done using an artificial neural network approach for non-linear principal component analysis and faithful data representation/visualization and compression required for subsequent process analysis. The used network (growing self-organizing map, GSOM) thereby uses a kernel smoothing for improved data density estimation. In this way, we are able to generate an entropy model of psycho-physiological variability detecting emotionally instable phases during the therapy process. We relate our finding to results obtained by speech analysis of the therapy sessions according to the cycle model invented by Mergenthaler. Thus, we get preliminary suggestions how psycho-physiological reactions are related to the therapeutic process.

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*Keywords:* Psycho-physiological process; Entropy analysis; Neural network approach; Patient/therapist interaction

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## 1. Introduction

New perspectives in diagnosis play an important role also in modern psychotherapy (Mundt, 2001). Thereby, it may be complicated to judge adequately the current mental state during therapy (Jacob, 2003). In particular, the ‘measurable elicitation’ of emotional descriptors, affective handling interpretation or evaluation of interactions between patient and therapist are well known-difficult tasks (Krause, 2000; Krause & Merten, 1999; Dreher, Mengele, & Krause, 2001).

In the present preliminary study, the complex psycho-physiological interaction between patient and therapist during a single psychodynamic therapy is investigated. The therapy was evaluated as a successful one, verified by a catamnestic study 2 years after therapeutical treatment.

The main focus of this investigation is in handling of the real therapy situation during data measurement, which is in contrast to conventional single-stimulus/response-approach; in this widely applied scenario, usually, psycho-physiological data are measured during an isolated test in a fixed environment to eliminate and/or reduce artefacts and noise in data. A well-defined single stimulus is given to the probationer and the response of the considered parameters is derived (Kolb & Whilshaw, 1996). The difference of pre- and post-values immediately gives an indicator for the strength of the reaction for the given stimulus.

Common psycho-physiological parameters, simply to measure, are heart rate, respiratory frequency, blood pressure, skin conductivity, muscular tension, etc. (Kandel, Schwarz, & Jessel, 1995; Marwitz & Stemmler, 1998). In this attempt scheme, a well-defined stimulus is presented to the probationer and the psycho-physiological reaction of the parameters is determined. Disturbing factors of the measurement (like, for example, artifacts through movement or/and speech) are eliminated by the experimental design widely on that occasion in the advance. As it was shown in several publications, the psycho-physiological reaction on emotional stimuli or stimulus patterns can be determined in this way (Kandel et al., 1995; Kolb & Whilshaw, 1996).

The situation represents itself however contrary to the single-stimulus/response situation during psychotherapy sessions. Obviously, a therapy session highly influences the psychophysiology of patient due to emotional excitations. Therapy sessions are characterized by multiplicity of complex emotional stimuli that can appear moreover in interaction and overlap. The complex emotional arousal resultant leads to complex physiological reactions and reaction patterns. Hence, the effect of single emotional stimuli cannot be viewed in isolation. A study of respective biochemical parameters, blood pressure and heart frequency was published for a single therapy session in Kollenbaum et al. (1995). Thereby, the parameters were obtained after the session, which can course the reported (only) weak correlations. An online measurement of psycho-physiological parameters should be more precise. Moreover, the consideration of a single isolated session does not give information about changes during the whole therapy process and, hence, only can be taken as a flashlight of the actual state during therapy. A continuous setting during the whole therapy leads to the possibility to analyze changes in therapeutical and emotional behavior.

In the online scenario, however, the immediate psycho-physiological reaction is influenced by a multiplicity of other processes, like speaking, gesture, general movements and other, necessary therapy-related, attractions, etc. These disturbing factors are called

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