Neural Correlates of Trance State

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Background

Dissociative experiences are mostly studied as a risk factor for dissociative pathology. However nonpathological dissociation is quite common in the general population (de Ruiter et al., 2006). Spirituality and religiousness have been shown to be highly prevalent in patients with schizophrenia and dissociative symptoms (Mohr et al., 2010). However, the variety of methodological issues and discrepancies among the studies developed so far make it difficult to articulate a comprehensive framework for brain activity and cognitive mechanisms in pathological and non-pathological dissociation.

Study aims

The present study aims to determine whether the dissociation presented in trance state is associated with specific alterations in brain activity that differ from those during resting state and imagery.

Sample

8 experts in trance were recruited from a religious group (3 males; mean age 48.8; SD 7.95)

A battery of neuropsychological tests: Wechsler Memory and verbal fluency test (RWT), working memory task (digit span forward and backward, WMS-R), multiple-choice vocabulary test (MWTB), attention test (TMT-A and TMT-B) and Edinburgh Inventory of Handedness. Besides the neuropsychological tests all participants were clinically assessed using the Structured Clinical Interview for DSM-IV (SCID German version), the Global Assessment Scale and PANSS (Positive and Negative Syndrome Scale) (table 1).

Table 1 – Description of the participants

Participants	sex	age	level education*	MWTB	TMT-A	TMT-B	GAS	PANSS
1	female	52	10	31	21	48	90	30
2	female	54	13	33	24	59	80	38
3	female	53	14	32	22	39	80	34
4	female	57	13	26	28	36	90	34
5	female	49	10	27	35	100	90	35
6	male	52	13	34	18	41	90	34
7	male	33	13	**	26	47	85	33
8	male	41	13	31	17	27	80	34

* number of years.
** the participant is a non German native speaker. Therefore the test was suppressed as it is based on German language skills.

Method

In a block design, the participants performed four tasks: 1- trance (participants were instructed to indicate when they were ready to get into trance by button press); 2- mathematical equation (a sequence of mathematical equations to wash out possible cognitive alterations caused by trance state); 3- imagination (participants were instructed to simulate by imagination in a non-trance state the same perceptual experiences they had during trance; it had the same procedures as in trance); 4- resting (participants were instructed to relax). Each block was repeated 3 times, always under the same order (figure 1). The participants had eyes closed during trance, imagination and resting.

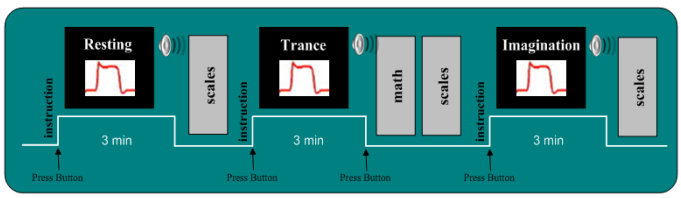

Fig. 1 Blocks

fMRI

- Siemens Trio 3 Tesla scanner with a circular polarized phase array head coil;

Functional parameters: IG = 0.30 mm; MS = 64 x 64; FOV = 240 x 240 mm; TR = 2.0 s; TE = 28 ms; FA = 77°; 34 slices (thickness: 3.5 mm, gap: 10 %) with a full coverage of the brain (voxel size 3.5 mm x 3.5 mm x 3.5 mm)

Anatomical localization (T1-weighted 3D FFE sequence) parameters: TR = 1.9 ms; TE = 2.5 ms; NS = 176 (sagittal); TI=900ms; IG = 0 mm; FOV = 256 x 256 mm; voxel size = 1 x 1 x 1 mm.

- Data analysis was performed using SPM8; Significant cluster activations at $p < .05$ (Monte Carlo correction).

Results

Behavioral data

In relation to the deepness of the trance state and vividness of imagery, there was no significant difference in relation to the first session (fig. 2). However, for the last two sessions, it seems that the participants felt the trance state more intense and might have had difficulties in transposing it to the imagination task (short interview after the experiment).

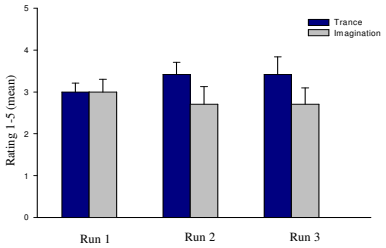

Fig. 2 Self-developed scales

The results of PANAS and ESR indicate homogeneity within each task and among sessions. No significant differences were found (fig. 3 and 4).

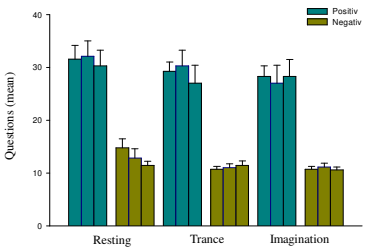

Fig. 3 PANAS for the 3 runs (Positive and Negative Affective Scale)

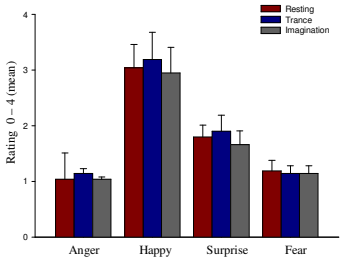

Fig. 4 ESR (Emotion Self-Rating) (Schneider et al., 2006)

fMRI data

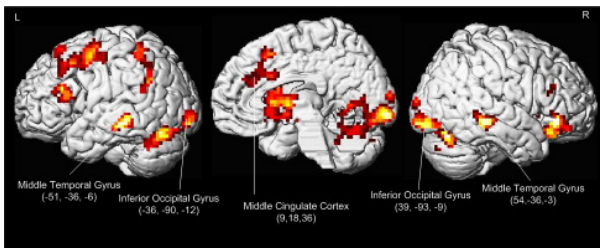

Fig. 5 Trance > Baseline (Resting)

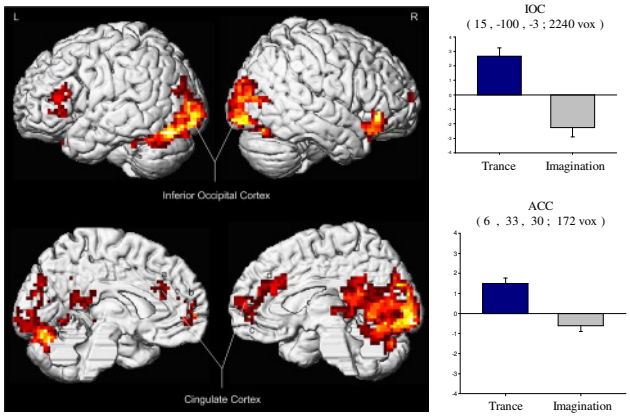

Fig 6. Trance > Imagination

Conclusion

• Dissociation is typically defined as the lack of normal integration of thoughts, feelings, and experiences into consciousness and memory (Giesbrecht et al., 2008). In qualitative terms, our subjects reported varying types of "spiritual contact" and reported feeling inspired during trance and/or being in a semi-conscious state: phrases came to them as if dictated as well as being "out of their bodies" in contact with "spirits" (human shape) and had no control over the content "elaborated by the spirit". Although the participants studied had reported apparent delusions, auditory hallucinations, personality changes and other dissociative behaviors during trance state they did not present mental disorders;

• The middle temporal gyrus, which contains the auditory cortex, was activated during trance versus baseline. The middle temporal gyrus is also involved in language comprehension and is a key area related to auditory hallucination in psychotic patients (Kindermann et al., 2004);

• We also found increased activation in prefrontal areas in trance versus imagination as well as in trance versus baseline contrasts. Imaging studies of meditation have generally found increased frontal lobe activity (Wang et al. 2011; Davanger et al., 2010), which is similar to what we observed in our data. Although meditative states do not necessarily involve dissociation and the phenomenological expressions are different compared to trance, a recent study suggested that meditation practices improve the efficiency of brain functioning (Kozasa et al., 2012) so that trance experts might be able to manage in a different way their attentional resources.

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