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## The results of cognitive training in schizophrenic patients

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## Summary

Some schizophrenic patients are characterized by cognitive deficits. These deficits are independent of the duration of the illness and seem remarkably stable after the onset of the illness. There is no progressive deterioration into a defect state. The degree to which a patient has cognitive deficits is related to outcome. Those patients with most serious cognitive disturbances have the poorest prognosis. If clinicians could rehabilitate cognitive function, this might result in a better outcome too. So, from a clinical point of view, rehabilitation training of cognitive function is highly relevant.

Some negative symptoms such as slowness are very stable over the years, while other negative symptoms such as poverty of speech and flattening of affect can improve by an adequate psychosocial (ward) climate. We presume the same to be true for cognitive deficits. Some will be persistent and associated with the biological vulnerability of the patient, while others are open to rehabilitation.

To understand cognitive failure in schizophrenia, a general working model on information processing is put forward in chapter two. In this framework computational stages of information transformation are combined with energetical mechanisms. When we consider information processing as a function of time then information is transformed in several stages from senses onto muscles. Each stage has its own characteristics. At some stages there is a variable need of processing capacity. Energetical mechanisms then allocate processing resources to the computational processor. Information processing can be automatic or controlled. Automatic processes are triggered by known and invariant stimuli. Several automatic processes can take place at the same time. These processes show hardly any performance decrements after a long time on the task. They make use of computational mechanisms without the need for conscious attention-controlled resources. Examples of automatic processes are cycling, swimming, dancing the foxtrot, etc. Controlled processes are slow. Information is processed step by step and mental effort allocates the processing resources that are needed to meet the task demands. Examples are having a conversation, drawing up a shopping list, taking decisions, playing chess, etc. In schizophrenia controlled processes are disrupted most. Although there is computational failure, energetical deficits characterize schizophrenia most.

Three energetical mechanisms are distinguished: arousal, activation and effort. Arousal is the phasic physiological response to input. Processing resources are allocated by arousal at each novel stimulus to the perceptual processor. Too low a level of arousal will result in underprocessing of stimuli. Over-arousal results in sustained information transfer but hurts memory function and often results in superficial processing. Activation is the tonic physiological readiness to respond. Under-activation results in delayed or irregular responding, while

over-activation results in impulsive responding and the production of highly stereotyped motor sequences. Effort is needed to up- or down-regulate the level of arousal and activation to fit the task demands. In more controlled processing, effort is related to task difficulty and includes conscious processing, reasoning and decision-making.

In chapter three the information processing research on schizophrenia is reviewed. Chronic schizophrenics were found to be overaroused, while acute patients were under-aroused. The effects of overarousal are a tunnel-like perception, decreased discrimination of relevant and irrelevant stimuli and decreased memory function. In the residual stage we see a lack of effort and activation. These energetical failures are partly the result of disability and partly they seem to be coping strategies. If allocation of resources does not result in improved performance, a way to avoid negative feelings is to diminish effort and activation (give in all attempts).

Attention deficits have always been at the core of the schizophrenia concept. These deficits, together with deficits in perception, seem to be of a computational and energetical nature. Deficits in memory are of an energetical nature. The allocation of resources in the stage of acquisition is insufficient. Patients do not make use of memory aids, rehearsal, visualizing, and categorizing. The status of perseverating or the absence of learning by error is still unclear. Some evidence is found for computational deficits such as the inability to benefit from training, while others found that reinforcement improved performance, which points to the involvement of energetical mechanisms too.

If deficits are found in schizophrenic patients these are remarkably stable. There is no progressive decline in neuropsychological functioning in schizophrenia. Neuropsychological test performance is related to symptoms. The association of cognitive deficits to symptoms is still not completely clear. Negative symptoms seem to be related to impairments in speed of information processing, lack of responding and disturbed conceptual thinking. Delusions and hallucinations seem to be unrelated to cortical cognitive dysfunction. Intellect is best preserved in these patients and the psychotic disorder seems to be located in deeper temporal structures that are important in the monitoring of own behaviour. Thought disorder, inadequate affect, and bizarre behaviour are associated with insufficient suppression of inadequate responses and substantial cognitive deficits.

In chapter four we review cognitive rehabilitation research. In general the results made us cautiously optimistic. Some cognitive functions can be improved by cognitive training. As delusions and hallucinations were not

related to cognitive functioning. There is some improved cognitive function.

The review taught us that a strategy than do energetically two ways: through the teaching a prosthetic skill. It has been successful in improving but not seem to generalize. As indicated in computational evaluation of facial emotion of automatic skill-based based conscious procedure prosthetic way.

Energetical failure benefits Learning by instructions strategies: a mnemonic actively organizing stimulus function. The self-instruction plans and behaviour, and

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The results are presented training while the attention 1) matching two photographs emotion; 3) social comprehension pictures into a logical sequence long-term visuo-construction. So social comprehension. Although verbal memory the recency effect was absent. Training did not affect the found no improvements attention, selectivity, flexibility tasks did not benefit from resources.

related to cognitive function, these do not covary with improved cognitive functioning. There is some evidence that negative symptoms decrease with improved cognitive functioning.

The review taught us that computational deficits need a different rehabilitation strategy than do energetical deficits. Computational deficits can be trained in two ways: through the restoration of function by excessive exercise or by teaching a prosthetic skill to get around the disability. The first strategy has been successful in improving reaction time, but is time-consuming and does not seem to generalize to other tasks. The second strategy seems to be indicated in computational deficits in pre-attentive processes such as the evaluation of facial emotion and the apprehension of social situations. Failure of automatic skill-based perceptual processes cannot be remedied. So, rule-based conscious procedures are trained to compensate for the deficits in a prosthetic way.

Energetical failure benefits from instructions, feedback, and reinforcement. Learning by instructions is generally fast and cost-effective. We have used two strategies: a mnemonic and a self-instruction strategy. The first one includes actively organizing stimuli, rehearsing and visualizing to enhance memory function. The self-instructional strategy helps to establish a set, to self-edit plans and behaviour, and to inhibit inappropriate responses.

Chapter five deals with the methods applied in this study. The study evaluates cognitive rehabilitation training with chronic schizophrenic patients. The training group was compared with an attention-placebo group which was treated identically, with the exception of the cognitive exercises. The attention-placebo group had recreational activities instead, with the same trainer though. Both groups comprised 21 schizophrenic patients and were matched on age, sex, duration of the illness, neuroleptic medication and level of education.

The results are presented in chapter six. The training group benefited from training while the attention-placebo group did not on five cognitive measures: 1) matching two photographs of facial emotion; 2) verbal labelling of facial emotion; 3) social comprehension and reasoning as measured by arranging pictures into a logical story; 4) long-term auditory-verbal memory and; 5) long-term visuo-constructive memory.

So social comprehension and memory benefited from this type of training. Although verbal memory improved to normal standards in the training group, the recency effect was absent in both groups on pre- and on post-measures.

Training did not affect tasks that rely on fast processing of information. We found no improvements in simple attention tasks that measure sustained attention, selectivity, flexibility and capacity of attention. These single-strategy tasks did not benefit from compensatory control by extra allocation of resources.

Word fluency, mazes and symbol digit substitution did not benefit from our training either. Mazes tended to be solved faster and with fewer errors, but this did not reach statistical significance. Word fluency and symbol digit substitution were most successful at discriminating patients from normal controls and deficits were also quite persistent.

No fewer than 90% of the patients who were successful in training could be predicted by using discriminant function analysis. Low scores on picture arrangement and long-term verbal memory predicted success. The third predictor variable 'selectivity of attention' did not contribute much to the variance. We interpret this finding as evidence for the hypothesis that patients with predominantly psychomotor poverty or negative symptoms benefited from training. They learned to process information more elaborately than before.

We discussed our results in chapter seven. The training programme seems to be effective in energetic tasks. Relatively little training (6.5 hours spaced over 3 months) is necessary to restore functioning to outpatient or even normal levels. The supervisory control and elaborate processing that were reinstalled after training might also be the result of giving up a no longer adequate 'defensive' restricted processing strategy. The study has two major shortcomings. The absence of symptom measures to distinguish subgroups and the fact that we do not know to what extent each test loads on computational and on energetical mechanisms.

Since we evaluated a training programme, it is unclear what the therapeutic ingredients are and what is redundant. Is instruction only effective when combined with reinforcement? Is processing of external stimuli incompatible with hallucinations? Can pre-attentive structuring of the perceptual field be learned with operant conditioning without instructions? What are the results of cognitive rehabilitation at 1- and 3-year follow-up? These questions ask for further research. However, the most urgent issue which needs to be addressed is the question of computational versus energetical loadings of tests, since different rehabilitation strategies are needed. Only when we can adequately assess cognitive deficits, can we tailor cognitive therapy.

## Samenvatti

Schizofrene patiënten positieve symptomen symptomen kunnen i patiënten lijden er bij duurzamere negatieve afwezigheid van gedr gevoelsuitingen, enz. de handicap van deze partner, of burger. weerspiegeling van co alle kennende functies alle patiënten met schi schizofrene patiënten stoornissen zijn onafh stabiel na het doorbrek aftakeling naar een dementie. De mate wa voor de uitkomst van stoornissen hebben de stoornissen te vermind vanuit een klinisch uitermate relevant.

Sommige negatieve s terwijl andere negatiev kunnen verbeteren o veronderstellen dat he blijvend van aard zijn van de patiënt, terwi cognitieve training.

Om de cognitieve prob hoofdstuk twee een gepresenteerd. In dit verwerking gecombin informatieverwerking verschillende stadia kenmerkt zich door an Dit worden de compu reactie taak wordt alle een achtergrond. Daar