INTELLECTUAL FUNCTION TRAINING IN ADULTS WITH ACQUIRED BRAIN DAMAGE

An Occupational Therapy Method

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ABSTRACT. An occupational therapy method termed Intellectual Function Training (IFT) is presented for cognitive retraining of patients with brain damage. Comprehensive training material, comprising about 900 pages, is described. The method is used to remediate intellectual dysfunction and to give intellectual stimulation, particularly concerning the following abilities: visual perception ability, spatial ability, verbal ability, numerical ability, memory ability and logical ability. The material is used for systematic individualized, daily treatment over a period of 2-4 months. The way in which the material is used is based on neuro-psychological and pedagogical principles. Examples of training tasks and the training procedure are given.

Key words: cognition disorders; brain injuries; rehabilitation, convalescence disorders; rehabilitation; occupational therapy

Patients suffering from brain damage following cerebrovascular disease, trauma, infectious diseases and the like frequently exhibit symptoms of disturbed intellectual function, e.g. amnesia, agnosia, apraxia, acalculia, agraphia and aphasia. In many cases, these disturbances of intellectual functions give rise to greater handicap than the concurrent reduced physical function (1, 9, 35). Different types and degrees of disturbances of intellectual function have been described extensively (2, 22, 30, 47, 48, 54, 58), but methodology for their systematic treatment is sparsely covered in the literature of rehabilitation (36, 41).

Models for comprehensive treatment of individuals with brain damage have been described by Luria (26, 31, 32) and by Diller & Weinberg (6, 7, 8) and by others (15, 37, 44, 56). The remediation model of Luria, in particular, has been used by others (19, 40). These methods have enjoyed limited clinical use, because they do not include detailed practical instructions on how to carry out the treatment. In addition, no training material for clinical application is provided.

Methods for treating various intellectual dysfunctions, such as visual agnosia (18, 55) and amnesia (5, 13), have been published as individual case reports. Such case descriptions abound, but cannot generally be used for setting up a comprehensive programme of treatment. However, in the treatment of aphasia (4, 14, 16, 28, 29, 39, 43, 57) comprehensive methods and training material have been described and the effect of treatment has been reported. The same is true for the field of perceptual disturbances in children with reading and/or writing difficulties (3, 17, 34, 42, 52). These programmes are usually coordinated with training material of the pencil-and-paper type (12). The methods comprise relatively long individual training periods and are employed under the guidance of highly-specialized speech therapists, special teachers and/or neuropsychologists.

In occupational therapy there are few (published) practicable programmes for the specific training of intellectual functions and very little published training material. What there is, is primarily aimed at the treatment of visual and visuo-spatial agnosia (31, 46). Approaches and material allowing systematic training for different disturbances of intellectual function are lacking in Swedish occupational therapy.

The aim of the present work is to present a practicable, clinically applicable, occupational therapy method: Intellectual Function Training (IFT) for treatment of intellectual dysfunctions in adults with acquired brain damage. The training material was designed to cover several intellectual abilities and to be sufficiently comprehensive to be used for systematically planned treatment over a period of many months.

METHOD

Description of Training Material with Examples

The training material, which is arranged in a loose-leaf system, comprises 900 pages arranged in six sections, plus...
right card games, and is of the pencil-and-paper type. The tasks consist of stories with different types of questions, pictures, drawings and photographs, all describing everyday objects and situations. It is largely based on tests and standardized according to Thurstone’s Factorial Studies of Intelligence (50, 51) namely perceptual speed, spatial ability, reasoning ability, numerical ability, verbal understanding, verbal fluency and memory ability. The concepts of intellectual function have been investigated concerning their theoretical edifications (25) and the definitions of the factors (22, 23, 24, 60, 61, 62). It was found to be necessary to modify the definitions in order to adapt the factors to paper and pencil tasks. In the present work, the factors above have been modified to cover the following six factors of intellectual ability: visual perception ability (P), spatial ability (S), verbal ability consisting of verbal understanding and fluency (VW), numerical ability (N), memory ability (M) and logical ability (L). These six factors represent one section each of the training material. Each of these sections is again divided into subsections containing 5–50 pages, which are progressively more difficult and used for the training of a specific area of an intellectual function. For every subsection there are instructions for the occupational therapist. These instructions are in the form of a handbook. This handbook also describes the theoretical background of IP.

Visual Perception Ability (P)

Definition
The ability to recognize and discriminate between visual stimuli and to interpret these stimuli through association with earlier visual experiences (22). Specific examples of this type of ability would be, for instance, to identify a figure from a background, to synthesize the contents of a picture and to interpret the identity of an object which is seen from different directions.

This part of the training material is intended for the treatment of symptoms such as different kinds of visual agnosia and anopsia. The material consists of 88 pages and 64 playing cards comprising geometrics, photographs, drawings and pictures of objects in common everyday use. The patient is asked to solve a maze problem, to find one object among many, to analyse and to synthesise a picture and to interpret properties such as colour and shape. The training tasks are divided into the following subsections: eye–eye-hand coordination, figure–background perception (Fig. 1) and perceptual synthesis.

Eye–eye-hand coordination. The patient is asked to scan the surface of a page and to draw a line between numbered points in the correct order so as to be able to interpret what object the resulting picture represents.

Perceptual synthesis. Part of an object is shown in a picture and the patient is asked to say what object the picture represents.

Spatial Ability (S)

Definition
The ability to perceive the construction of an object in both two and three dimensions. Spatial ability is composed of four components (24): the ability to perceive a static figure in different positions, the ability to interpret and duplicate the movements between various parts of a figure, the ability to perceive the relationship between an object and a person’s own body shape, and the ability to interpret the person’s body as an object in space (45).

This part of the material is intended for the treatment of symptoms such as agnosia, alexia and agaphia. The material consists of 105 pages and 12 playing cards, including drawings of objects, people and puzzles. The patient is trained to understand the relationship of objects to other objects and the person’s body. Other tasks are aimed towards training the patient to assess the size of an object. The training tasks are divided into the following subsections: three-dimensional design, position in space (Fig. 2) and body awareness.

Examples
Three-dimensional design. The patient is shown a drawing of a block with 2-dimensional patterned sides, together with a picture of the finished product. The task is to determine which pattern is missing from one side. The patient is asked to determine which pattern is missing.

Fig. 2. Task in spatial ability (S) (Position in space and body awareness). The patient is asked to describe the position of the clothes in relation to his own body.

Body awareness. The patient is asked to analyse and describe body positions shown on photographs.

Verbal Ability (VW)

Definition
Verbal ability is composed of verbal understanding (V) and verbal fluency (W).

Examples
Verbal understanding is the ability of an individual to understand the semantics and meaning of words (V) and verbal fluency is the ability to imagine, process and say words without associating them with any particular object (W).

Logical Ability (L)

Definition
The ability to formulate a general rule or principle which one can use to objectively solve a problem (22). Added to this definition is the ability to plan, regulate and control one’s own activities (30). This part of the material is intended for the treatment of the symptoms which generally come about through frontal lobe damage. The material consists of 86 pages and 6 card games with a total of 519 cards and is made up of photographs and drawings.

The training tasks are divided into the following groups: sequence of events, classifying concepts and objects (Fig. 4), and problem solving.

Example
Sequence of events: The patient is asked to place pictures together in such a way that they represent a series of events. Problem solving: The patient is shown a row of postage stamps or flags in a certain combination. In a second row,
right cards, and is of the pencil-and-paper type. The tasks consist of stories with different types of questions, pictures, drawings and photographs, all describing everyday objects and events, and is also based on and classified according to Thurstone's Factorial Studies of Intelligence (50, 51) namely perceptual speed, spatial ability, reasoning ability, numerical ability, verbal understanding, verbal fluency and memory ability. The concepts of intellectual function have been investigated concerning their theoretical edifications (25) and the definitions of the factors (22, 23, 24, 40, 61, 62). It was found to be necessary to modify the definitions in order to adapt the factors to paper and pencil tasks. In the present work, the factors above have been modified to cover the following six factors of intellectual ability: visual perception ability (P), spatial ability (S), verbal ability consisting of verbal understanding and fluency (VW), numerical ability (N), memory ability (M) and logical ability (L). These six factors represent one section each of the training material. Each of these sections is again divided into subsections containing 5-50 pages, which are progressively more difficult and used for the training of a specific area of an intellectual function. For every subsection there are instructions for the occupational therapist. These instructions are in the form of a handbook. This handbook also describes the theoretical background of ITP.
one stamp or flag is missing. Four or five extra stamps or flags are shown in a third row. After studying the rows, the patient is asked to conclude which stamp or flag is missing from the second row. In another task, the patient is shown a picture of a everyday misfortune, for example a dropped shopping bag with groceries all over the road. The patient is asked to suggest different ways of correcting the situation.

DESCRIPTION OF THE TRAINING PROCEDURE

The occupational therapist begins with constructing a treatment programme (40). It is based on a personal interview, knowledge of the patient's medical history, social background and a qualitative analysis of an intellectual function assessment (IFP). Through an analysis of the answers, a pattern of the patient's intellectual functions and dysfunctions is distinguished. This pattern assists the occupational therapist in cooperation with the patient to determine the different treatment goals and their sequence in the treatment programme. The therapist chooses various tasks from the same relevant subsection of the training material and uses these during a training period of one to ten sessions. The selection of the subsections is made with an activity analysis of the tasks, where the therapist attempts which intellectual functions (33) are active or not when working through and solving the tasks. The activity analysis is also used to adapt the tasks to achieving the patient's primary treatment goal. During the training period the tasks are used to draw up strategies which are useful to the patient when solving the tasks. During the treatment, the patient's intact intellectual functions are utilized, which brings about an altered problem-solving method (39). The therapist assists the patient to develop and use these strategies by an instructive dialogue (10, 20, 38), feedback, non-verbal instructions and encouragement of the patient's thoughts and actions. The strategies are repeated until their usage becomes incorporated. Once a strategy is incorporated in the patient's behaviour the treatment process is repeated with an additional treatment goal. It is essential that the therapist develops an individual training programme for each patient and achieves this by using different combinations of the subsections of the training material.

IFP is commenced at the earliest six weeks after the appearance of brain damage and consists of a treatment period of 36-60 min per day, five days a week for 3-5 months. The training is performed in a special room at the Occupational Therapy Department, usually individually but occasionally in groups. A prerequisite for the treatment is that the patient actively and consciously cooperates with the occupational therapist conducting the treatment.

CASE REPORT

A 56-year-old male lift fitter (L. H.) incurred head trauma with contusion of the right frontal lobe and subdural haematoma on the right side. The right frontal lobe was resected during an emergency operation and a computer tomography showed additional bleeding at the base of the left frontal lobe. Legisation consciousness six days later the patient exhibited slight hemiparesis on the right side. On admission to the rehabilitation clinic, he could walk with assistance and no longer exhibited symptoms of the paresis. An IFP was carried out. During the qualitative analysis, the pattern of answers revealed intellectual dysfunctions through the following behaviour:

The patient's attention was distracted by all incoming stimuli. The patient had difficulty decoding a task into its components and evolving a plan which would assist him to reach the conclusion of that task. The patient was consistently uncritical of his own judgements regarding the tasks performed. These dysfunctions made it extremely difficult to solve tasks requiring memory (M), spatial (S) and logical (L) abilities. Examples are given in Figs. 5 and 6. The patient had no difficulties solving the tasks which included verbal fluency (W) and verbal understanding (V).

The treatment programme was outlined and included three treatment goals. The primary treatment goal was to assist the patient to disregard irrelevant stimuli. To achieve this goal, tasks from the training material were used, e.g. sorting cards, drawing a simple figure, filling in one or two words in a sentence. These tasks were chosen from the Logical (L,1,2), Spatial (S, 9,9) and Verbal ability (V/W,8) subsections. The following strategies were used: the patient was encouraged to talk out loud, which made continuous feedback easier. The goal of the task was written down in front of the patient and the therapist encouraged concentration by prompting, e.g. "What are you doing?", "What are you going to do now?".

The secondary treatment goal was to assist the patient to evolve a plan when solving tasks. Training materials illustrating sequence of events and classification of objects were utilized, mainly from subsections Logical Ability (L) but also from other subsections with similar orientation. The patient and the occupational therapist began by discussing how to go about solving the tasks. A detailed plan was written. The patient followed the plan and noted down step by step until each task was solved. He then actively checked his answer together with the therapist.

The third treatment goal: Active memorising, was encouraged by the patient's structuring and classifying the various components of the training tasks in the Memory Ability (M) subsections. Strategies for recalling these tasks were given by the therapist using association and prompting techniques.

The degree of difficulty of all tasks performed increased gradually over the 4.5 months and 40 training periods which the training program encompassed.

At the second measurement time-point the patient had improved his ability by 34%. (The patient solved 35 of 75 items at the first assessment and 60 of 75 items at the second assessment.) However, no improvement in memory ability was noted. After six months, without further training, a third IFP was carried out, and the patient was then able to solve 52 of 75 items, which was a decrease of 6 items compared with the second IFP. After the second IFP the patient worked under job retraining with his previous employer. Two years after discharge from the rehabilitation clinic the patient has completed an electrician's course and is back with his employer working full-time as an electrician.

DISCUSSION

The training method presented here has been developed for use in occupational therapy. It differs from other, similar methods in the volume and the relatively simple design of the training material. Because it is arranged in a loose-leaf system, the material is easily handled, allowing the individual therapist to vary the training according to different treatment goals.

A modification of Thurstone's multitactor factor (30, 51) was chosen for classification of the tasks.
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1 IFP is an abbreviation of the equivalent Swedish term (Intellektuell Funktionsprövning). IFP will be presented as a supplement to this article.

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A modification of Thurstone’s multifactor theory (30, 51) was chosen for classification of the tasks.
These proved to be suitable, since it was relatively easy to create pencil-and-paper tasks based on the modified definitions of these intellectual abilities. The main criteria of the training material is its relationship to the patient's daily life and the fact that all the pictures and stories contain well-known concepts.

Each task is intended to exercise one specific ability, but these tasks may also be used to train other intellectual abilities. The way in which a training task is utilized is dependent on the occupational therapist's analysis of which strategies the patients will need to complete the tasks. For certain other intellectual abilities, such as audio-perceptive and sensory-motor ability and most forms of praxis ability, no training tasks were developed, since these require other equipment than paper-and-pencil tasks.

Occupational therapy material training the pencil-and-paper type is available traditionally at most rehabilitation clinics. As distinct from the IFT material, their use is non-specific and there is a lack of instructions on how the patient is to be guided towards satisfactory completion of the tasks.

There are only a few published occupational therapy methods training materials which can be used for the training of intellectual functions in patients with acquired brain damage. Siev & Frischhut's manual (46) contains recommendations for testing and examples of training visual perception ability, spatial ability and praxis ability. This manual does not contain training material. On the other hand, the "Perceptual Training Material" (11) by Feldt et al. contains examples of training material that is also available commercially. This material consists chiefly of sorting boxes, puzzles, etc., not pencil-and-paper tasks. The "Perceptual Training Manual" contains practical instructions and advice for training apraxia, spatial neglect, spatial relationship, body awareness and visual agnosia, but lacks material for training visual and memory ability.

IFT is suitable for integration with conventional occupational therapy, for example ADL, such as housework, and functional training in various techniques such as games, woodwork and so on.

The selection of patients suitable for the training method is made on the basis of an IFT. Patients exhibiting difficulty in completing items of IFT are offered training. In the first instance, patients of working age with brain damage resulting from cerebrovascular lesions, head trauma and infectious diseases have proved suitable candidates for the training. Patients with progressive diseases are excluded. Patients without ADL dysfunctions and only mild intellectual dysfunctions generally do not benefit from the IFT training material. Obstacles to participation in training are patients with symptoms such as acoustic-vestibular aphasia or global aphasia which is so extensive that instructions cannot be given. Other forms of dysphasia do not normally present any obstacle.

Psychological factors associated with, e.g., crisis reactions to the disease suffered, may also limit the individual's ability to benefit from the training. Above all, it is hard to persuade patients towards training if they deny or rationalise their modified intellectual function ability. These patients often begin training but later show in different ways that they are unmotivated.

The financial resources for intellectual function training are judged to be moderate, despite the fact that the treatment is individual and continues for several months. The resources required are comparable with those of a speech therapist treating a dysphasia patient. It is recommended that the method be employed as a complement to and a further development of, existing occupational therapy methods for the treatment of intellectual dysfunctions arising from acquired brain damage.

The evaluation of the IFT method will be presented in a future article.

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The Intellectual Function Training Material is available in Swedish from Psychologiförlaget AB, Box 463, 12041 Hagstorp.

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ABSTRACT. Intellectual Function Training (IFT) is an occupational therapy method for remediating cognitive functions in patients with acquired brain damage and has been presented in a previous paper. It has been evaluated by comparing a group of trained patients (n=12) using the IFT method with a control group (n=13) which underwent conventional rehabilitation. The trained group received IFT for 40 min each day, 5 days a week for about three months. Age, education and neurological status did not differ between the groups. The measurement methods of evaluation were Intellectual Function Assessment (IFA) and three psychometric test batteries. At the beginning of the study there was no significant difference in any subset between the two groups. After the training period there was a significant difference of at least p<0.05 between the trained and the control group in the IFA battery, except for the Long-term Memory subset. The improvement for the trained group was evident six months later at the time of the follow-up measurement, clearly indicating a significant difference between the groups. In one psychometric subset a significant difference of p<0.01 was found. Within the experimental group over the study time there was a slight increase in performance which was not as evident in the psychometric subsets p<0.05-p<0.001. The positive effect of IFT is considered to be specific for the type of task in which the patients were trained, while evidence of the effect on general intellectual function is inconclusive. The results of the evaluation suggest that IFT is a valuable occupational therapy method in the rehabilitation of patients with acquired brain damage.

Key words: cognition disorders; brain injuries; rehabilitation; occupational therapy

An occupational therapy programme, Intellectual Function Training (IFT), has been developed for remediation of intellectual dysfunctions in patients with acquired brain damage and is presented in detail in an earlier paper (6). Over a period of 2-3 months the patient, under the guidance of an occupational therapist, works through the IFT method, which consists of a large number of pen-and-paper tasks. The literature of occupational therapy, re habilitation medicine and neuropsychological literature contains few evaluation studies. What studies there are of neuropsychological remediation character (1, 8) have proved that patients taking part in remediation programmes improve their cognitive ability compared to control patients. To the present authors’ knowledge, there are no evaluation studies on the effect of occupational therapy training of intellectual functions in CVA patients.

The aim of the present study was to compare the training effects in a group following the IFT method with those in a control group of patients undergoing conventional rehabilitation.

METHOD

The participants in the present study were selected from patients with acquired brain damage and in general cerebrovascular disease (CVA), who had been referred to three rehabilitation clinics. The population of this study (n=31) fulfilled the following three inclusion criteria during the period 1978/06-1981/12: age 20-45 years, first assessment of the study completed between two and six months after the first onset of the disorder and that the patient had no previous history of brain damage.

These patients who, on neurological examination, exhibited signs of intellectual dysfunction (agnosia, aphasia, apraxia, akathisia, amnesia and symptoms of frontal lobe damage) were referred for an interview with an occupational therapist. If the O.T. judged the patient to be motivated and able to take part in the IFT programme, an intellectual function assessment (IFA) was carried out. Where a qualitative and a quantitative analysis of IFT showed that the patient had difficulties in solving the items of IFT, also he became a participant in the present study. The study involved 31 patients who were divided into two groups. The experimental group (n=16) comprised patients who were referred to the rehabilitation clinic at Danderyd hospital,