

## 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 neuropsychological and pedagogical principles. Examples of training tasks and the training procedure are given.

**Key words:** cognition disorders; brain injuries, rehabilitation; cerebrovascular 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 handicaps than the concurrent reduced physical function (1, 9, 35). Different types and degrees of disturbances of intellectual function have been described extensively (2, 27, 30, 47, 49, 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, 48). 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 dysfunc-

tions, 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 (11, 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 practical, 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

## WHAT IS THERE IN THE PICTURE?

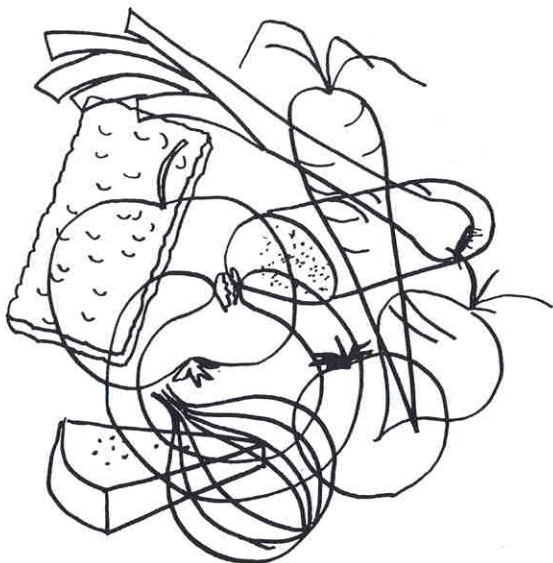


Fig. 1. Task in visual perception ability (P) (Figure-background perception). The patient is asked to distinguish one object from the background. The patient uses a pencil or other aid to follow the contours of the object.

eight 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 events. It is loosely 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, 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 IFT,

its implementation and the most common symptoms of brain damage.

### 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 (12). Specific examples of this type of ability would be, for instance, to separate a figure from a background, to synthesize the contents of a picture and to interpret the invariability 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 mazes, 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 analyze and to synthesize a picture and to interpret properties such as colour and shape.

The training tasks are divided into the following subsections: eye- and eye-hand coordination, figure-background perception (Fig. 1) and perceptual synthesis.

#### Examples

*Eye- and 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 sphere, 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 design and dressing apraxia, visuo-spatial agnosia, and hemi-inattention. The training material consists of 165 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 words that describe these. 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 block in which the pattern is missing from one side. The patient is asked to determine which pattern is missing.



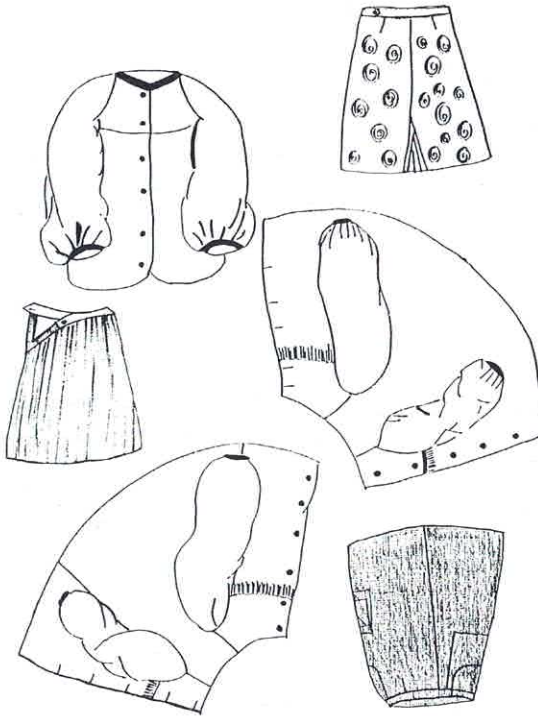


Fig. 2. Task in spatial ability (S) (Position in space and body awareness). The patient is asked to describe the position of the clothes in relation to his own body.

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

### Verbal Ability (VW)

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

#### Definition

Verbal understanding is the ability of an individual to understand the subtleties and meaning of words (61) and verbal fluency is the ability to imagine, process and say words without associating them with any particular object (62). In addition to this is the ability to communicate by talking, writing, listening and reading.

This part of the material is intended for the treatment of symptoms such as aphasia, alexia and agraphia. The material consists of 361 pages and 254 playing cards. The tasks have been constructed using photographs, drawings and text. The patient is asked to match a word or a sentence with a picture, or to describe a picture in his own words. The patient may also be asked to read or listen to a story.

The training tasks are divided into the following subsections: verbal understanding and verbal fluency (Fig. 3).

#### Example

**Verbal understanding.** The patient is asked to listen to or read descriptions and to say what object they refer to.

### Numerical Ability (N)

#### Definition

The ability to solve numerical problems using the four fundamental rules of arithmetic, i.e. addition, subtraction, multiplication and division (60).

This part of the material is intended for treatment of acalculia. The material comprises 140 pages with the addition of material normally used in school instruction. The tasks consist of figures and words describing quantity and measurement systems.

The training tasks are divided into the following subsections: perception of quantity, arithmetical problems expressed in words and figures, and systems of measurement.

### Memory Ability (M)

#### Definition

Memory ability is composed of two parts (53): short-term memory (Mk), that is, the ability to briefly register incoming information and long-term memory (Ml) that is the ability to retain information which can be recalled and/or recognized later on (21). In the present work short-term memory is defined as the ability to recall an event 0–10 min after it has happened and long-term memory is the ability to recall an event after 3 hours or more (53).

This part of the training material is intended for the treatment of amnesia. The material comprises 369 pages and consists of pictures of objects and stories, advertisements, figures and drawings.

The training tasks are divided into two specific material subsections: learning through visual perception and learning through auditory perception.

#### Examples

**Learning through auditory perception:** A short passage is read and the patient answers questions on it.

**Learning through visual perception:** A collage of objects is shown and the patient subsequently states what objects were in the picture (following various principles of selection).

### 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 follow frontal lobe damage. The material consists of 80 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,

## WORK



Fig. 3. Task in verbal ability (V, W) (Verbal fluency). The patient is asked to describe, using the words given, the event the picture illustrates.

WORKSHOP	MEN	STAND
TALKING	LAMPS	SWITCHED OFF
CUPBOARDS	SHELVES	LABELS
FILES	FLEXES	TOOLS
NEWSPAPERS	WRITE	RADIO
SWITCHED ON	BLACK	SIT
MEND	TV SETS	BROKEN

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 an 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).<sup>1</sup> 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 subsection is made with an activity analysis of the tasks, where the therapist ascertains 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 (59). 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 reiterated 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.

IFT is commenced at the earliest six weeks after the appearance of brain damage and consists of a treatment period of 30–60 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.

<sup>1</sup> IFP is an abbreviation of the equivalent Swedish term (Intellektuell Funktionsprövning). IFP will be presented as a supplement to this article.



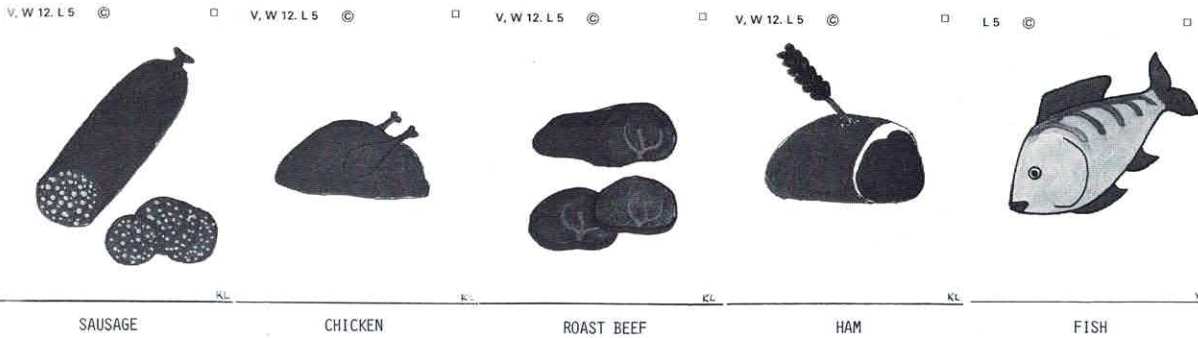


Fig. 4. Task in logical ability (L) (Classifying concepts and objects). The patient is asked to sort cards in such a way

that four cards together can form a common concept. The fifth card is a reject.

### CASE REPORT

A 36-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. Regaining 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 behavior:

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:6, 9) and Verbal ability (VW: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, mostly from subsection 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 memorizing, 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.

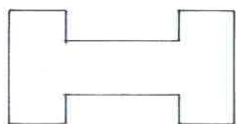
At the second measurement time-point the patient had improved his ability by 34%. (The patient solved 35 of 75 items at the first assessment and 60 of 75 items at the second assessment.) However, no improvement in memory ability was noted. After six months, without further training, a third IFP was carried out, and the patient was then able to solve 52 of 75 items, which was a decrease of 6 of items compared with the second IFP. After the second IFP the patient underwent 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

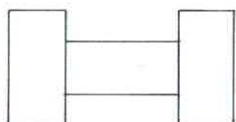
The training method presented here has been developed for use in occupational therapy. It differs from other, similar methods in the volume and the relatively simple design of the training material. Because it is arranged in a loose-leaf system, the material is easily handled, allowing the individual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

A modification of Thurstone's multifactor theory (50, 51) was chosen for classification of the tasks.

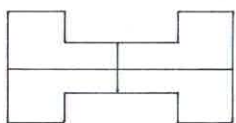
DIVIDE INTO FOUR EQUAL PARTS.



THE TASK



THE PATIENT'S  
SOLUTION



A CORRECT  
SOLUTION

Fig. 5. Case L. H. Example of an incorrect answer in IFP. The patient divided the figure into three instead of four identical parts and did not critically consider his solution.

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.

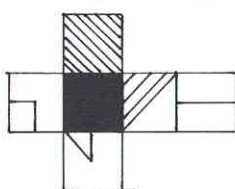
Each task is intended to exercise one specific ability, but these tasks may also be used to train other intellectual abilities. The way in which a training task is utilized is dependent on the occupational therapist's analysis of which strategies the patients will need to complete the tasks.

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.

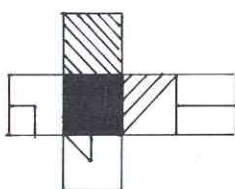
Occupational therapy training material of the pencil-and-paper type is available traditionally at most rehabilitation clinics. As distinct from the IFT material, their use is non-specific and there is a lack of instructions on how the patient is to be guided towards satisfactory completion of the tasks.

There are only a few published occupational therapy methods training materials which can be

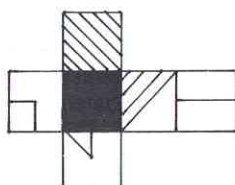
WHAT WILL THE PATTERN ON THE BLANK SIDE BE,  
IF YOU COMPARE THE BOX WITH THE FLAT MODEL?



THE TASK



THE PATIENT'S  
SOLUTION



A CORRECT  
SOLUTION



Fig. 6. Case L. H. Example of an incorrect answer in IFP. The patient did not critically compare the design drawing and the projection and therefore he filled in a pattern at random.

used for the training of intellectual functions in patients with acquired brain damage. Siev & Frieschat'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 apraxis, spatial neglect, spatial relationship, body awareness and visual agnosia, but lacks material for training logical 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 IFP. Patients exhibiting difficulty in completing items of IFP 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 IFP training material. Obstacles to participation in training are patients with symptoms such as acoustic-gnostic 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 predispose 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.

#### ACKNOWLEDGEMENT

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The Intellectual Function Training Material is available in Swedish from Psykologiförlaget AB, Box 461, 12604 Hägersten.

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