Neuroreha today

What is task-oriented training?

Renata Horst

AT A GLANCE
What is task-oriented training? There is little consensus on this question in the literature. In this discussion article, an expert in neurorehabilitation explains this term from her perspective and uses case examples to show how she proceeds in practice. In her experience, it makes sense to set structural goals within activities.

Relearning everyday activities

In recent years, a paradigm shift has taken place in neurological rehabilitation. Modern technical developments have provided access to new theories about motor learning and the associated neuronal processes and structural changes (plasticity). Even years after central injuries or the onset of a neurodegenerative disease, everyday activities can be relearned and optimized (Fig. 1).

What is learning and how do people learn?

Humans are problem-solving beings and are shaped by experience. Gravity in particular is a challenge for him. In the course of evolution, it has learned to rise up against this in order to interact with its environment. Learning is accompanied by long-lasting plastic changes in the synaptic connections in the central nervous system and representations in the cortex. This reorganization is primarily activity-dependent and is influenced by sub-different sensory and cognitive experiences.

It has been proven that it is not repeated use, but rather repeated experience with problem solutions that require the use of affected body parts that leads to plastic changes.

Adkins et al. (1) describe that plasticity depends on the requirements of the task and not on the extent of motor activity. Consequently, it cannot be expected that therapeutic measures that lead to an improvement in joint mobility and muscle strength will automatically enable everyday activities.

Kleim and Jones (2) even extend the concept of plasticity and describe it as a mechanism by which the brain deciphers experiences and learns new behaviors. It can even be a hindrance to learning a certain everyday activity if the therapy is aimed at is to train a structure in such a way that it masters another task (3).

What role does the therapist play in learning?

One of the most important tasks of the therapist is to make the therapy situation so

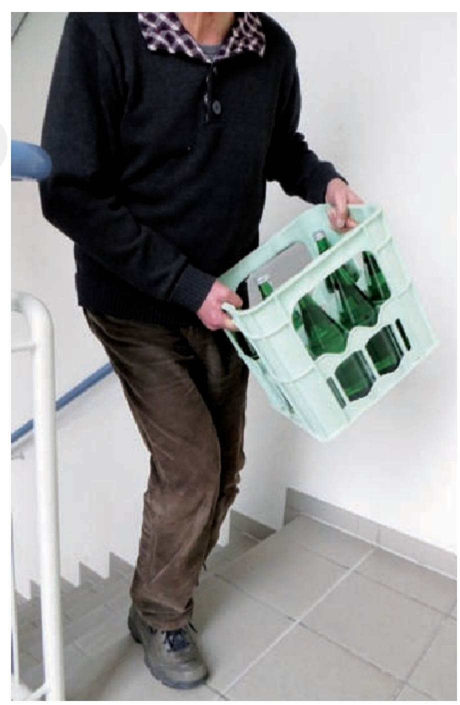


Fig. 1_"You have to have a sense of achievement! You can't get up otherwise. Otherwise you get depressed." Mr. I., a patient four years after a stroke, initially had a shoulder subluxation and no arm or hand function; today, he can carry a box of water with both hands, push open and pull shut a door with his affected limb and dress and undress independently

that learning can take place. This means creating the motive for the learner to want and need to set themselves in motion in order to solve their problem. The therapist must find tasks that are important for the individual in their everyday life, for example overcoming obstacles when walking without falling.

When performing all tasks, it is essential for the individual to maintain their balance. In this sense, the therapist must "create problems" that require attention to solve.

How do you encourage attention? The learner's attention can be encouraged with interesting tasks that are relevant to the individual.

become. An important task for the therapist is to support their client in searching for and selecting information that may be relevant to solving their motor problem. He also encourages the client to reflect on the chosen strategies so that he can find out which are suitable and which are not. Ultimately, the therapist fulfills the

The task is to enable learners to experience success so that they enjoy repeating the strategies they have used.

What is task-oriented training?

Unfortunately, there is little agreement on this term in the literature.

Shumway-Cook and Woollacott write that task-oriented training (task-oriented approach) can include measures that focus on body structure and function as well as those that are trained at the activity level.

The exercises themselves can be practiced both in subcomponents and as a whole (4). Carr and Shepherd (5, 6) describe that - although tasks should generally be practiced as a whole - it can be useful in the early phase after a stroke to break the task down into subcomponents in order to train these in isolation. They also describe that the patient gets an "idea" of the movement through the therapist's guidance.

The Ottawa Panel for Continuing Education in Neurological Rehabilitation has described evidence-based guidelines for clinical practice that include interventions in which activities of daily living are first broken down into subcomponents and practiced (7). Only after the client has practiced the partial movement

If the patient has mastered the movement, he trains it together with other subcomponents. This classification is not consistent with current evidence (8). Above all, it does not take into account the essential factor of task-specific training, which should be geared towards the acquisition of skill (9).

Walking is practiced as a whole. A recent Cochrane Review on electro-mechanically assisted gait training after stroke shows that this type of training can be effective in improving walking ability - in combination with physiotherapy (11). Electromechanically assisted gait training in combination with physiotherapy appears to be particularly helpful for patients who are unable to walk in the first two months after a stroke. However, it is still unclear how often and for how long the training should take place and how long the effects last. The description of treadmill or robot-assisted gait training as task-oriented training is a misinterpretation (12).

Repetitive exercises in such a

Context (closed loop task) cannot meet the cognitive demands of walking in a variable environment (13). It can be assumed that it is precisely this criticism that has contributed to the increasing use of device-supported training in modern rehabilitation facilities today.

Joint functions, mobility improvement, muscle functions and strengthening influence body structures and bodily functions. However, this does not automatically result in the ability to perform everyday activities!

Technical procedures for gait training

It has been shown that it is more effective to train walking as a whole rather than in partial components (weight shift to the supporting leg, single-leg stance exercises, free-leg functions) (10). It is often argued in the literature that gait training on a treadmill is effective because the

The new system is offered in combination with costly computer-controlled virtual environmental situations.

Technical procedures for training the upper limb

There are also technically highly developed procedures for the upper extremity in which arm movements are supported by equipment and computer-controlled

CASE STUDY 1:
STABILITY IS ACHIEVED BY ACTIVATING FLEXURAL SYNERGY

Problem / Leading symptom_A post-stroke patient has difficulty stabilizing her supporting leg when walking due to a lack of knee control. In the mid-stance phase, the knee does not extend sufficiently and medializes (Fig. 2).

Therapeutic hypothesis 1_It is assumed that the quadriceps muscle is too weak to bring the knee into extension in the mid stance leg phase (17).

Therapy strategy 1_To solve the problem, Carr and Shepherd suggest first training the quadriceps muscle in a sitting position in the so-called "open system" against the distal resistance of the therapist (6). The position of the foot, which is biomechanically necessary for knee extension, is not initially taken into account in this exercise. The patient should then try to pull her kneecap up voluntarily both when sitting and standing. These exercises - both sitting and standing - train the quadriceps muscle concentrically.

Points of criticism of this hypothesis_The quadriceps muscle is not primarily responsible for bringing the knee into extension in the mid stance phase. Its "task" is to prevent excessive knee flexion after the knee has been pulled into extension by the dorsal structures. It is a reactive "fall preventer" and therefore works eccentrically in the mid stance phase. The primary activity of the peroneal muscles and the intrinsic foot muscles creates the biomechanical prerequisite for the tibialis anterior muscle to transport the tibia over the forefoot. Next, the pelvis rotates dorsally on the femoral head due to the concentric activity of the hip extensors and external rotators and straightens itself on the femoral head. The ischiocrural muscles work eccentrically in the popliteal fossa together with the gastrocnemius muscle. Their active extension pulls the knee into approximate extension. Only at the end does the quadriceps muscle take over its fall-preventing function.

Therapeutic hypothesis 2_It is assumed that the planar flexors (especially the peroneal muscles), the intrinsic foot muscles and the pelvitrochanteric muscles are too weak to provide the necessary stability for hip extension. ,

Therapy strategy 2_With the biomechanical background knowledge described above, the knee extension function is trained using the activity of climbing stairs (Fig. 3).

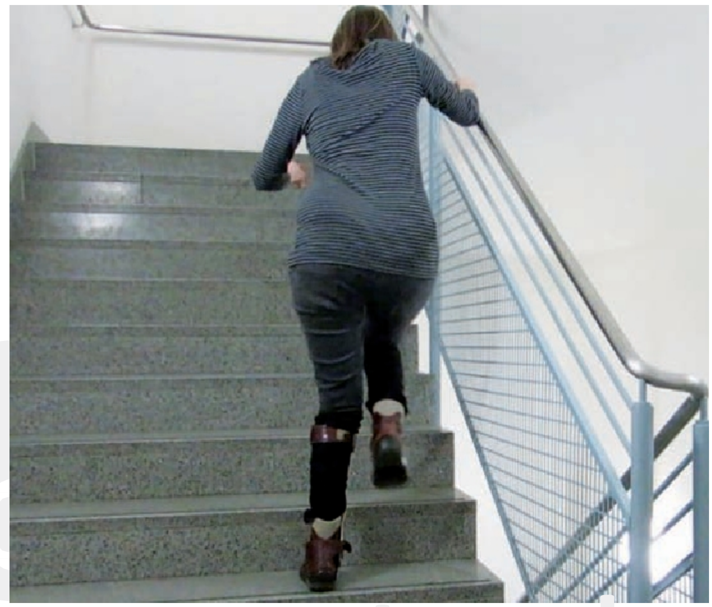


Fig. 2_A patient after a stroke cannot stabilize her left affected knee when climbing stairs; controlled knee extension is not possible due to the weakness of her hip and foot muscles

Fig. 3_Pressure on the tuber ischiadicum ventrally provides proprioceptive feedback to the brain so that the activity of the ischiocrural muscles can be controlled more easily; with the left hand, the therapist applies pressure in the direction of the ball of the big toe so that the forefoot can be stabilized

CASE STUDY 2:
STABILITY IS ACHIEVED BY HYPEREXTENSION OF THE KNEE AND PLANTAR FLEXION IN THE OSG

Problem Leading *symptom*_A 54-year-old post-stroke patient cannot move his body weight forward over his forefoot.

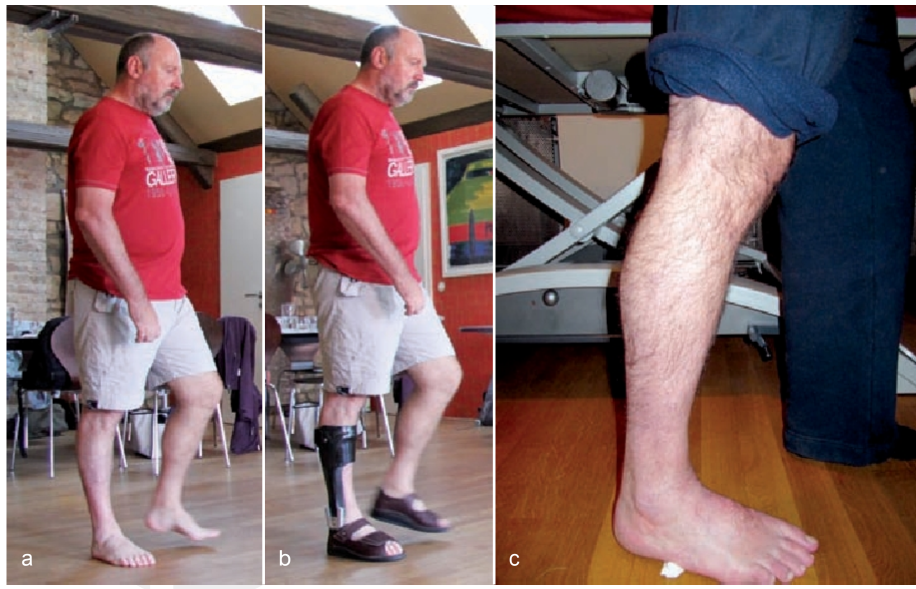
In order to achieve sufficient stability in the affected leg, the patient locks his upper ankle joint in plantar flexion and his knee in hyperextension (genu recurvatum) (Fig. 4a).

Treatment strategy 1_The patient was fitted with a Neuro-Swing orthosis, which enables mobility of the upper ankle joint in dorsiflexion thanks to the laterally attached screw. Despite this, he is unable to move his center of gravity forward over his forefoot.

He lacks the necessary fixed point in the forefoot for this. The splint provides him with

no solution. (Fig. 4b).

Therapy strategy 2_The stability of the forefoot is only achieved by creating the correct biomechanical situation. A small amount of information on the sole of the foot by placing a simple cotton tampon under the cuboid bone helps to create the correct biomechanical situation.



Ankle joint fixed in plantar flexion
b_after fitting with a Neuro-Swing orthosis, he cannot bring his upper ankle joint into dorsiflexion despite the hinge; he lacks the necessary activity of the peroneal muscles to stabilize the forefoot.
c_a small elevation of his cuboid bone with a cotton tampon provides sufficient information to activate his intrinsic foot muscles so that he no longer has to claw his toe flexors to create stability

contact with the ball of the big toe. This gives the brain an "idea" of how the peroneal muscles have to work to achieve this position. This allows the patient to relax his toe flexors and succeed in moving his tibia forward. This makes hip extension possible so that the knee can be extended in a controlled manner (Fig. 4c). A permanent improvement in controlled knee extension in the mid stance phase could be achieved by combining the Neuro-Swing orthosis with sensorimotor insoles.

feedback can be combined. For example, the person concerned tries to take virtual eggs from a virtual basket and fry them in a virtual pan.

to "whip up". If he misses, he wipes the hob clean - virtually, of course. The motivation in the simulated situation may be an argument in favor of this type of training. The body functions of elbow flexion and extension as well as shoulder flexion and extension can also be trained.

vation, abduction and rotations are trained without a doubt. Body structures are also addressed. But is this really task-oriented training? The cognitive strain is much higher than when passively moving the limb or repetitively moving the individual joints, as the exerciser has a goal. The muscle synergies and joint movements that they train are

However, they are not comparable with the real action. In addition, these exercises are performed with the affected limb in a sitting position - this may not be the action that the patient used for the corresponding task before their injury. In addition, these exercises not only allow unfavorable evasive movements of the shoulder, but actually call them up.

his supporting leg against gravity; he stabilizes himself by fixing his hips in flexion, adduction, internal rotation and knee flexion

The dexterity required to perform these everyday activities is not trained with these technical procedures. This is training at the level of body structure and function, which may even have an unfavorable effect on shoulder stability. Bimanual activities, which require the use of the second hand, offer an opportunity to train arm functions in a meaningful way.

"Constraint-induced Movement Therapy (CIMT)

"Constraint-induced Movement Therapy" is a restriction-induced movement therapy developed by Edward Taub (14). The aim

The aim of this therapy method is to restore the learned non-use of the affected part of the body after central lesions by forcing the patient to use it in everyday life. CIMT is a special type of task-oriented training because the proven functional improvements may not be due to the restriction of the better limb, but are rather the result of several hours of daily training (15).

How do people compensate?

If humans are too weak to stand up against gravity, they fall back on phylogenetically older patterns to create stability (see case studies 1 and 2). Either

it retracts into flexion or it generates tonic muscle activity of the extensor muscles (16).

Compensation strategies involve either concentric activity of the knee and hip flexors or concentric activity of the knee extensors.

Learn to act instead of being treated!

What "ingredients" are needed f o r task-oriented training?

The brain only knows activities and organizes motor and cognitive programs to solve problems. It therefore makes sense to develop structural goals within activities instead of training them in isolation in preparation for them (18). It is therefore about more than just guidance ("manual guidan- ce") (4, 5). Information from the periphe-

The learning process must be specific so that the right things can be learned. Important principles:

- Tasks must be challenging in order to arouse the interest and attention of the learner (9).
- Tasks must be continuously steered and optimally adapted. They should be neither too simple nor repetitive (9).
- But they must not be too difficult either, because then unwanted mistakes creep in and the learner becomes frustrated.
- Tasks must be interesting enough to require the active participation of the learner. This is particularly important because active voluntary movements have been proven to be more effective for learning than passive ones.
sive movements (19).

Another case study

A 22-year-old man diagnosed with infantile cerebral palsy (ICP) due to a lack of oxygen at birth presented for treatment in June 2010. He could only walk short distances with great difficulty. He walked with severely flexed hips and knees. His back was in a severe lumbar curve (Fig. 5). He dragged his feet and was unable to flex his hips and knees sufficiently to initiate his free leg.

Hypotheses

Initially, hypertonus of the back extensors, adductors and plantar flexors was suspected, as well as weakness of the hip flexors and foot lifters. The patient held his right elbow in flexion and his hand was in volar flexion with flexed fingers.

Fig. 6_Findings, treatment and outcome in a patient with infantile cerebral palsy a_In the findings, the patient tries to lift one leg
b_before therapy, he cannot extend his hips and knees and complains of pain in his lumbar spine
c_in the vertical body position, the therapist determines that the ICP patient's hip and knee flexors are neither shortened nor hypertonic, but that his extensor synergy is too weak
d_the ICP patient turns from the lateral position onto his back; the therapist fixes his lower leg by applying longitudinal traction to his adductors; the effect of gravity is used to promote the eccentric activity o f these muscles
e_the patient comes from the prone position to the quadruped position; to do this, he bends his left leg; this activity requires and promotes the elasticity of his left hip adductors; the extensibility of his right toe flexors and back extensors is also promoted and he succeeds in activating the extensor synergy of his right leg and supporting himself up with his left arm
f_While sitting slowly, the patient tries to extend his hands towards his feet; the therapist stabilizes his left hip by applying pressure in the trochanteric fossa so that his hip external rotators are activated; with her right hand she pulls his left ribcage ventrally and uses the influence of gravity to eccentrically activate the dorsal extensors
g_after therapy, the patient is able to actively lift his leg h_back position after therapy

Findings

To assess the findings, the therapist must precisely analyze which body structures are too weak, too stiff or too shortened. Above all, the structural findings should also be objectified at the activity level.

On examination, the patient was barely able to lift his right leg in particular. (Fig. 6a). To determine whether As his hip and knee flexors were contracted, he assumed the supine position. He was initially unable to extend his legs. This position also revealed severe lumbar lordosis accompanied by pain in the lower lumbar region. (Fig. 6b). The patient needed 14 seconds for the timed up-and-go test.

In addition, joint mobility was also measured in the "lateral movement" activity.

climbing stairs". Since the patient was able to extend the hip and knee joints in this situation with strong support activity of his right arm and neck extension as well as the support of his therapist, it could be assumed that his hip flexors and adductors as well as his knee flexors and back extensors were neither hypertonic nor shortened (Fig. 6c).

New hypothesis

The patient's extensor synergy was merely too weak to lift him up against gravity. It was assumed that he stiffened up for the continuation of the movement in order to stabilize himself. The stiffness of his back extensor prevented him from lifting his leg to initiate the play leg.

Therapy planning

For gait training, it is increasingly believed that safe walking is the primary goal, even if symmetry is not restored (12). Especially if the patient relies on compensatory strategies

is reliant on the body to maintain its stability, the objective must be defined at the body structure level.

the. Secondary prophylactic measures must be considered in order to prevent contractures and further muscle atrophy and the associated joint damage. For ICP patients, this means that the elasticity of their hip flexors, adductors, toe flexors and back extensors must be promoted (Fig. 6d- f). This is best achieved by activating these muscles ex- cessively - especially as this also enables active straightening against gravity. In addition, the elasticity of the elbow flexors and wrist flexors must be promoted so that the patient can support themselves better.

PRACTICAL MESSAGE

- Repeated experiences with problem solutions lead to plastic changes in the central nervous system.
- Practice real tasks with your neurological patients in as natural an environment as possible.
- Establish a correct biomechanical situation in order to prevent strategies that are harmful to the body's structures.
- Recommend aids to your patients that enable independent training under correct biomechanical conditions.
- Apparatus-based training can be a supplement to training in the natural environment - it is important to take biomechanical conditions into account.
- Biofeedback and virtual environments as well as playful aspects that give the exercise a competitive character can have a motivating effect.
- Being emotionally involved is the basic prerequisite for learning!

Result

Following these measures, the patient was able to raise his right leg.

than before (Fig. 6g). He was also able to extend his legs in the supine position without pain (Fig. 6h). He only needed 8 seconds for the timed up-and-go test after the therapy.

Further course

After these positive therapy experiences, the patient decided to stop the Botox treatment used to detonate various muscles and to exercise actively on a regular basis. When he presented himself again two years later, he was able to walk up and down the stairs effortlessly with no aging.

climb without the need for a handrail.

tigen. He even came running towards me on a busy road!

FIGURES

All photos in this article by Renata Horst

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LITERATURE

Sources (1) to (19) and further reading at:
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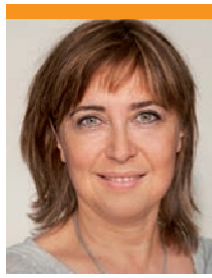

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Imprint

pt_Journal for physiotherapists
ISSN 1614-0397 - www.physiotherapeuten.de

Official organ of the German Association for Physiotherapy (ZVK) e.V.

Redaktion_Chefredaktion_Frank Aschoff [fa] (responsible), address as publisher, fon 0 89_1 26 07-2 56, fax 0 89_1 26 07-1 11, aschoff@pflaum.de - **Re- daktion_Tanja** Bossmann [tb], Martina Grosch [mg], Jörg Stanko [js] - **Redak- tionsnetzwerk_Jasmin** Clegg [jc], Julia Kretschmann [jk], Doreen Richter [dr], Annette Weiß [aw] - Kontakt_pt.redaktion@pflaum.de

Anzeigen_Anzeigenleitung_Christine Seiler (responsible), address as publisher, fon 089_1 26 07-2 95, fax 0 89_1 26 07-2 03, seiler@pflaum.de - The current advertising rate list is no. 56 dated 1.1.2014 - pt_Zeitschrift für Physio- therapeuten is IVW-approved.

Vertrieb_Vertriebsleitung_Cornelia Kondora - **Customer** Service_InTime Media Services, phone 0 89_8 58 53-83 1, pflaumverlag@intime-media- services.de - pt_Zeitschrift für Physiotherapeuten is published monthly by subscription (in the middle of each month) - Subscription **prices_Annual** domestic **subscription** 103.80 euros, annual international subscription 118.20 euros - Retail price 9.25 euros; all prices are valid from January 1, 2012 including postage and shipping. PT pupils and students will receive a 50% discount on presentation of a current certificate - **cancellation_at the latest** two months before the end of the delivery year in writing to the publisher. No subsequent delivery or refund in the event of no-shows through no fault of their own.

Produktion_Gestaltung_Science Communication - Dr. Petra Lutterbüse & Bettina Pfluger GbR, Freiburg - **Satz, Druck_Firmengruppe** APPL, sellier druck GmbH, Angerstraße 54, 85354 Freising, Germany

Publisher_Richard Pflaum Verlag GmbH & Co. KG
Postal address_P.**O. Box** 190737, 80607 Munich
Parcel address_Lazarettstraße 4, 80636 Munich
phone 089_1 26 07-0, fax 089_1 26 07-202
www.pflaum.de
Publishing director_Michael Dietl, e-mail: dietl@pflaum.de
Komplementär_PFB Verwaltungs-GmbH
Kommanditistin_Edith Laubner, publisher **Managing director_Edith** Laubner, e-mail: laubner@pflaum.de
Commerzbank (BLZ 700 800 00)
Account no. 442 100 000
Postbank Munich (BLZ 700 100 80)
Account no. 282 55-802
VAT ID No. DE 1 30 255 449

Deutsche Fachpresse

PFLAUM Verlag