

D I N N O S

Diversity Innovation Support Scheme

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Diversity Innovation Support Scheme

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Cognitive training web - based app (ISS individual training component)

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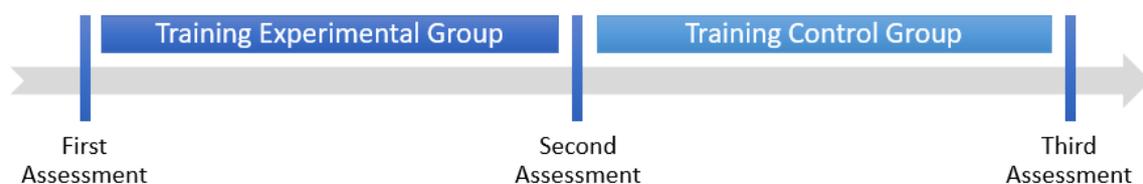


Scope of this document

Within the scope of DINNOS, an Innovation Support Scheme (ISS) was developed. The ISS will be implemented in 300 small- and middle-sized companies to enable a comprehensive and well-founded evaluation. As part of the ISS, DINNOS offers a cognitive training in cooperation with CogniFit (<https://www.cognifit.com/#>) to 900 employees of the participating companies. Cognitive skills, such as memory and attention, form an important basis for creative thinking and the development of innovations. Since these cognitive abilities can decrease with age, DINNOS aims to conduct a web-based training counteracting this decline. This document provides an overview of the theoretical background, procedures and content of this training component.

DINNOS

The Innovation Support Scheme, developed within the scope of DINNOS, involves the training of cognitive abilities for employees of participating companies aged 45 years and older. 450 employees from 150 companies each in the experimental and waiting-list control group will participate in this training to evaluate its effect on creativity and innovation. Participants will be asked to complete questionnaires and take part in objective assessments of their cognitive abilities targeting, among others, attention, memory and creativity at three points in time. After the baseline measurements, three participants of every company in the experimental group will be introduced to the training app through a short webinar. They will be asked to use the application four times a week for at least 15 minutes over a period of 8 weeks. After this period, both groups will complete the second assessment of their cognitive abilities, followed by the intervention for participants of companies in the waiting-list control group. Subsequently, both groups will again take place in the assessment of their cognitive abilities. These repeated measurements for both groups are necessary to account for confounding influences, such as time-related changes or external factors outside of the experimental treatment. This design is considered a gold standard for evaluating the effectiveness of treatments and allows a sophisticated assessment of the individual training component of the ISS.

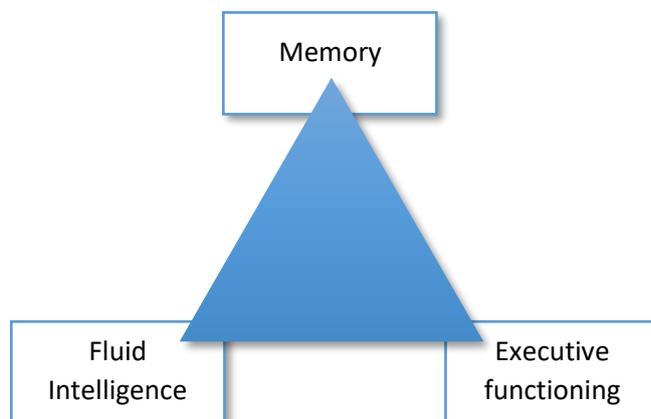


D2.1 Cognitive Training (ISS Individual Training Component)

Cognitive abilities as a basis for creativity and innovation

An increased age comes along with a decline of cognitive abilities and flexibility, for instance shown in reduced memory capacities or shorter attention spans^{1,2}. Such cognitive abilities provide the base for creativity and innovative ideas³ through logical reasoning, that combines different pieces of information, and explorative thinking, which creates new and unusual connections between those. Due to the age-induced alterations of our cognitive abilities, older employees may have difficulties to keep up with fast-paced changes and innovations. Additionally, different perspectives and approaches between younger and older employees can lead to a higher complexity of social interactions⁴. A cognitive training for older employees can help to maintain cognitive abilities and reduce the discrepancy between different age groups^{5,6}. Employees have to regularly participate in the training to benefit from it. Besides an enhanced personal development, the training enables a more effective adoption of innovative procedures such as generating ideas and developing novel products.

The assessment of cognitive abilities



For the assessment of cognitive abilities an online-based test battery developed by the University of Wuppertal will be used. These test covers three areas: Memory, Fluid Intelligence and Executive Functioning.

The area of memory focuses on short- and medium-term reminiscence. This forms the basis for many other cognitive processes, as several stimuli often have to be held in memory and processed simultaneously.

Fluid intelligence represents both convergent and divergent thinking. Convergent thinking describes stringent thinking processes (conclusions) based on the rules of logic, which aim to find the right



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solution of a task or problem at hand. Divergent thinking describes explorative and creative thought processes, which are intended to create new unusual associations and novel starting points for task and problem solving.

Under the area of executive functioning, superordinate control functions are summarized, which decisively influence the thinking processes described above. The central components focused on in this test are attention, inhibition and concentration. In interaction, these abilities serve to process presented stimuli as quickly as possible under the given task.

CogniFit

The cognitive training will be offered in cooperation with CogniFit. CogniFit is a healthcare company, founded in 1999 by Professor Shlomo Breznitz and oriented to assess and improve cognitive health. All of their exploration and brain function stimulation tools are scientifically validated. They are present in more than 15 languages, and work and collaborate with hospitals, universities, foundations, and investigation centers around the world.

The neuroscientific program is led by an international team of scientists, neurologists, and psychologists that investigate and combine the latest discoveries about the brain with advanced algorithms making simple tasks in the form of games. This professional neuropsychological exploration and cognitive stimulation program is based on scientific methodology and is able to measure, train, and monitor concrete cognitive abilities and their relationships with neurological pathologies.

The technical development is made up of a complete computerized battery of tasks that allows for the assessment of over 22 fundamental cognitive functions, clearly defined and subjected to objective measurement controls that provide standardized age and demographic criteria based on the results of thousands of subjects. These abilities are validated in multiple investigations. Through the cognitive data received by the exploration and the normalization of the results by age and country, CogniFit understands the particular cognitive condition of each individual and can offer a personalized brain training program. These skills have been validated in a number of studies.

Further information about CogniFit and their trainings program can be found on the following website (<https://www.cognifit.com/>).



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D2.1 Cognitive Training (ISS Individual Training Component)

Underlying algorithm

CogniFit offers individualized trainings based on their patented ITS™ (Individualized Training System) technology. In particular, CogniFit makes small measurements during each training session so that the system can tailor the type of activity and difficulty to the user's specific needs. Hence, the program will propose activities to the user that have a greater impact on so far less developed skills without leaving aside the rest of the cognitive abilities. This procedure enables a maximized training impact for all participants.

Trained skills

With their games and exercises CogniFit trains a broad range of different cognitive skills. These can be summarized under the five categories attention, perception, memory, reasoning, and coordination.

- Attentional control can be divided into multiple sub-processes such as focused attention on one specific object/task, divided attention on multiple objects/tasks as well as inhibition where initial reactions have to be overridden or suppressed.
- Perceptual skills encompass, among others, the visual encoding in two and three-dimensional spaces, scanning of multiple items and recognition of visual objects.
- The memory capacity includes various sub-processes such as short-term memory and working memory.
- Exercises and games related to reasoning are targeting the processing speed, planning as well as shifting between different tasks.
- The category coordination includes the hand-eye coordination along with the response time.

These skills largely cover our cognitive abilities and are used extensively in our daily lives. Hence, the training of these skills can lead to a great benefit at work and in our personal lives.



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Games and exercises

In the following, a sample of different exercises is described to provide an impression of the online training. Each game is designed in a way that it trains several interconnected skills effectively and at the same time motivates participants through gamification. The following table provides an overview about the skills addressed by the selected exercises.

Exercises and Games	Bee Balloon	Cross-roads	Cube Foundry	Fuel a car	Math Twins	Star Architect	Tennis Bomb	Traffic Manager
Attentional Control								
Focus Attention	X					X		
Divided Attention		X		X				X
Perceptual Skills								
Spatial Perception			X			X		
Visual Perception							X	X
Visual Scanning				X				
Memory								
Working memory								X
Reasoning								
Planning			X		X			
Estimation		X						
Processing Speed					X			
Task Shifting	X							
Coordination								
Hand-Eye Coordination	X		X				X	
Response Time		X		X			X	



Bee Balloon

In the training game “Bee Balloon” participants have to guide a bee to burst balloons by passing the cursor over them while avoiding the bombs and red zones. The bee will follow the cursor which makes the balloons blow up. If participants do not notice the presence of a red zone or bomb and hit it, they lose a life. As participants progress through the levels the game will become more and more challenging. For example, in advanced levels the forbidden zones or objects can move. By practicing the game participants train their hand-eye coordination, focus attention and shifting, which will help to be more effective in tasks that require manual precision or quick reactions to unexpected or changing situations.

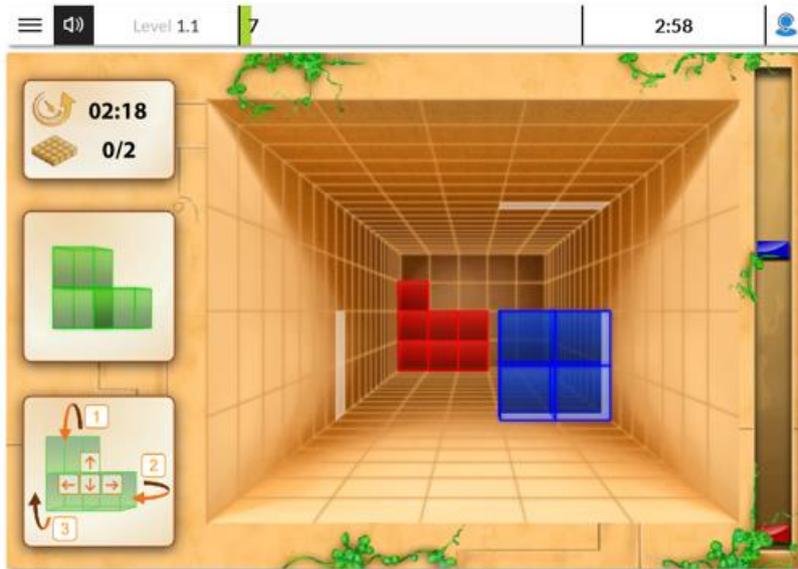


Crossroads



In this game the participants see a field with square stones, between which several coloured balls roll around. The aim is to keep the balls from colliding with one another by putting rocks in the intersections where they might hit. Users have to divide their attention to be aware of all of the balls in the field at the same time. As the level increases there will be more and more obstacles that participants need to be aware of. By progressing through the levels, participants will train their abilities of divided attention, estimation and response time, which are important in everyday situations such as driving or working.



Cube Foundry

In this game participants see a square wall divided into several smaller squares. Some of those squares are already covered by 3D figures in different colours. The aim is to cover the whole wall with 3D figures, avoiding accumulation. For this, participants receive further 3D figures, which they have to place in the appropriate positions to complete the wall. The figures can be turned or moved by pressing the arrow keys (seen in the bottom left of the picture). As soon as a wall is completed, those pieces will disappear and participants continue to complete the next wall. The game “Cube Foundry” aims to train hand-eye coordination, planning skills and spatial perception. This will improve performance for example in manual precision activities or helps with achieving goals more effectively by planning ahead.

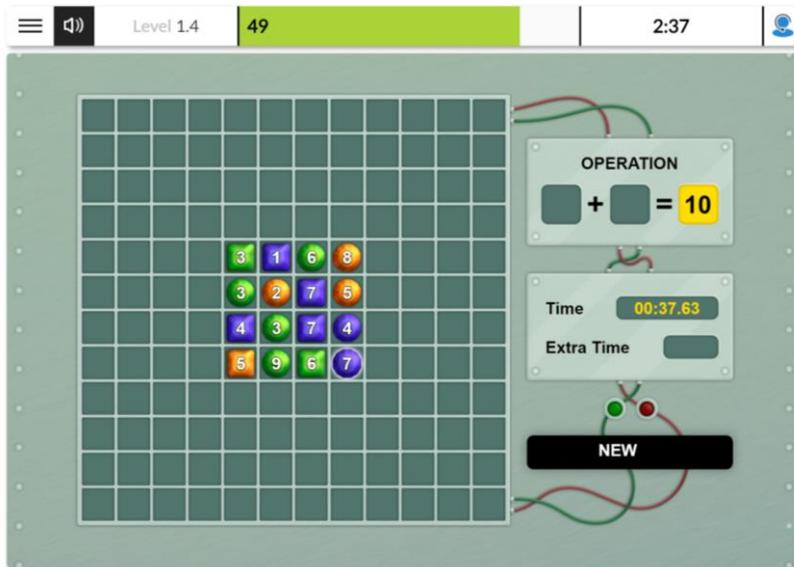


Fuel a Car

“Fuel a Car” requires the participants to supply the cars on the screen with correct fuel or liquid. When a car is supplied, participants have to lift the barrier so that the cars can drive on without causing traffic jams. There are several cars on the screen at the same time demanding different types of service. There is a limited amount of time for each car, so users have to identify the colour of each car and the specific need. Participants have to mentally organize this information, set priorities and attend to them quickly. Among other things, playing the game stimulates divided attention, response time, updating skills and visual scanning. These abilities help to constantly update and adapt the behaviour to new circumstances in the everyday life.



Math Twins



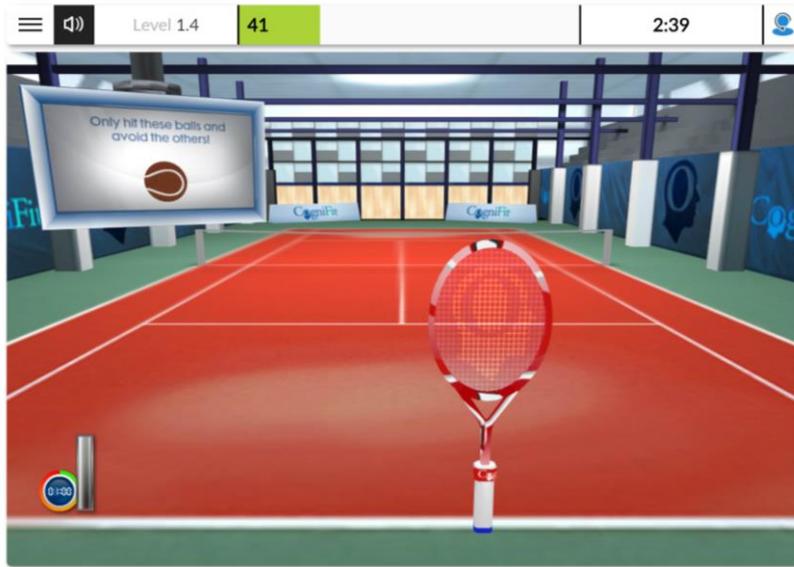
The goal of this game is to join two numbers that add up to the required number (seen in the right of the picture), keeping in mind that there must be an open path between the two numbers. Participants have to find all possible combinations of numbers before the time runs out. As the level increases, the order of the numbers will change and the cognitive demands will be greater. By playing this game participants improve their skills in planning, processing speed and visual scanning which for example helps to be more efficient in anticipating the correct way to achieve a specific goal.



Star Architect

Participants are shown a 3D-model which they have to replicate using the cubes on the screen. The cubes can be moved by using the arrow keys. For this, participants have to understand the target model and detect the position of each fragment. Playing this game will improve focus attention, spatial and visual perception which will help to be more efficient in everyday tasks, for example, when searching for a house number.

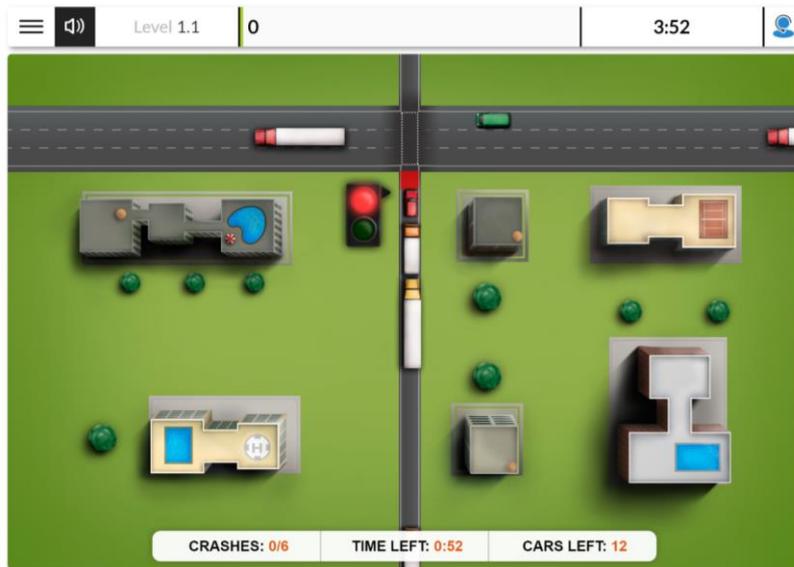


Tennis Bomb

In this game participants can see a tennis court in which balls in different colours will appear. The aim of the game is to hit the correct tennis balls (as shown on the top left of the screen) and avoid the others by moving the racket right and left with the mouse. For this, participants have to identify the colour of each ball and calculate the distance and speed of the balls trying to position the cursor in time. This will improve the hand-eye coordination, response time and visual perception which will help to be faster in responding to a given situation or stimulus in everyday life.



Traffic Manager



In this game participants are shown an intersection. Users have to respectively allow or prevent the vehicles from crossing through the intersection using the stoplight (by clicking on the green or red light). Participants can stop the cars driving on the vertical street only to avoid crashes. For this they have to calculate the speed of the cars in both directions keeping them from crashing. As the level increases participants have to process different sources of information and coordinate multiple stoplights at the same time. This game improves divided attention, visual perception and working memory which can help to execute a number of different daily activities in a more efficient way.



Conclusion

The web-based training developed and offered by CogniFit can be used to effectively train several cognitive skills such as attention, memory and processing speed. It represents an important part of the ISS that is implemented within the scope of DINNOS. This gamified training can especially counteract the decline of cognitive abilities with increasing age. Hence, employees aged at least 45 years can benefit from this training for their personal growth and, in turn, engage more effectively in innovative procedures such as generating ideas and developing novel products. The change in cognitive abilities will be measured over time with a test battery developed by the University of Wuppertal. This procedure allows a comprehensive evaluation of the cognitive training as individual training component of the ISS.



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