

## *Neuropsychological assessment*

### 神經心理學評估

Participants were administered a neuropsychological test battery including the following cognitive tests: MMSE, Ray Auditory Verbal Learning Test (RAVLT), a Greek version of the “FAS” verbal fluency test, Rey-Osterrieth Complex Figure Test (ROCFT), Rivermead Behavioral Memory Test (RBMT), Test of Everyday Attention (TEA) items 1, 4, & 6, and Trail Making Test part B. It also included the following functional scales: Functional Rating Scale for Symptoms of Dementia (FRSSD), Functional Cognitive Assessment Scale (FUCAS), and Clinical Dementia Rating (CDR). Furthermore, the battery included the following measures of depression, anxiety, and neuropsychiatric symptoms: Beck Anxiety Inventory (BAI), Beck Depression Inventory (BDI), Geriatric Depression Scale (BDS), and the Perceived Stress Scale (PSS). The battery was used to gather qualitative and quantitative data on all participants and help the neurologist provide an accurate diagnosis. MMSE, RAVLT, ROCFT, and RBMT were used to assess cognitive functioning and aid diagnosis, FUCAS and FRSSD for assessment of activities of daily living (ADL), and GDS was used to determine the presence of depressive symptoms. The rest of the tests were included to provide qualitative data and examine the correlations between VSM performance and performance in tests assessing specific cognitive domains.

參與者進行一系列的神經心理測試，包括以下認知測試：MMSE，Ray聽覺語言學習測試（RAVLT），希臘版“FAS”語言流暢測試，Rey-Osterrieth複合體圖測試（ROCFT），Rivermead行為記憶測試（RBMT），日常注意力測試（TEA）項目1,4和6以及：路徑描繪測試B部分。它還包括以下的功能規模：癡呆症狀（FRSSD）的功能評定量表，功能認知評估量表（FUCAS）和臨床癡呆評估（CDR）。另外，此測試還包括以下判斷抑鬱，焦慮和神經精神症狀的基準：貝克焦慮量表（BAI），貝克抑鬱量表（BDI），老年抑鬱量表（BDS）和感知壓力量表（PSS）。這個測試用於收集所有參與者的定性和定量數據，並幫助神經病學家提供準確的診斷。MMSE，RAVLT，ROCFT和RBMT用於評估認知功能和輔助診斷，FUCAS和FRSSD評估日常生活活動（ADL），GDS用於確定抑鬱症狀的存在。包括其餘測試以提供定性數據，並檢查評估特定認知領域的測試中VSM性能與性能之間的相關性。

## *Virtual reality cognitive training application*

### 虛擬現實認知訓練應用

The virtual super market (VSM) application has been developed by the Information Technologies Institute in collaboration with the Greek Association of Alzheimer’s Disease and Related Disorders (GAADR). It is a simple VR cognitive training program with a low degree of immersion, based on the state of the art in the field of VR applications for cognitive assessment. It runs on any tablet device with Android® operating system, whereas PC and web-based versions also exist. The application has been described in detail in a previous study [15].

虛擬超市（VSM）應用由信息技術開發研究所與希臘阿爾茨海默病和相關疾病協會合作（GAADR）。這是一個簡單的VR認知訓練計劃，具有較低的浸透度，基於VR應用領域的技

術水平進行認知評估。它可以在任何使用Android®操作系統的平板電腦上運行，而PC和與Web有關的版本也存在。在以前的研究[15]中已經詳細描述了此應用。

The VSM is designed to mimic one of the most common activities of daily living, daily shopping in a super market. It features a short demographics questionnaire followed by instructions before the user can engage in the virtual experience. A shopping list is provided to the user who is allowed to navigate freely, buy the products he or she is instructed to buy, and proceed to pay at the till, by entering the correct amount. The application is aimed at training a multitude of cognitive processes namely visual and verbal memory, executive function, attention, and spatial navigation with the emphasis placed on executive function. The need of simultaneous activation of different cognitive processes makes the program challenging enough to correspond to the ability of the target population while reducing ceiling effects. Randomization of the shopping list in each trial allows the application to maintain its difficulty level and limit learning effects.

虛擬超市旨在模仿日常生活中最常見的活動之一，每天在超市中購物。在測試者尚未接觸體驗虛擬超市，它的特徵是具有一個附有說明的簡短人口統計問卷。提供購物清單測試者被允許可以自由瀏覽，購買他或她被指示購買的產品，用正確的金額持續支付。該應用旨在培養大量的認知過程，即視覺和口頭記憶，執行功能，注意力和空間導航，重點放在執行功能上。同時激活不同認知過程的需要使程序具有足夠的挑戰，以適應目標人群的能力，同時減少天花板效應。在每次試驗中隨機購物清單允許應用程序保持其難度級別並限制學習效果。

In this study, a modified version of the VSM exercise, the VSM remote assessment routine (VSMRAR), was used. VSM-RAR is an automated administration protocol which includes 5 administrations of the VSM exercise in each of the available difficulty levels, starting at level 1 and progressing up to (and including) level 4, for a total of 20 administrations of the exercise. These administrations are preceded by 5 familiarization administrations at difficulty level 1. The score of familiarization administrations is not calculated, as their main aim is to allow the user to get accustomed to the exercise before his or her performance is assessed. The large number of familiarization administrations in combination with the fact that participants had also participated in the previous VSM study (and were familiar with the exercise) ensured that there would be limited variation in performance due to lack of familiarization or misunderstanding of instructions.

在本研究中，使用VSM練習的修改版本，VSM遠程評估程序（VSMRAR）。VSM-RAR是一個自動化管理協議，其中包括VSM練習的5個主管部門，其中每一個可使用的難度級別，從1級開始，並進展到（並包括）4級，總共進行20次練習。這些管理是由5個在難度一級的熟練行政部門進行。熟練管理部門並不計算分數，因為他們的主要目的是讓測試者在他或她的表現被評估之前熟悉練習。大量有經驗的行政部門結合與參與者也加入了先前的VSM研究（並熟悉該練習）的事實，確保有效的限制由於缺乏熟練或誤解指令而導致的實行變化。

### *Administration of the cognitive training exercise*

#### *管理認知訓練*

Participants were given a 10-inch tablet PC with custom software that launched the VSM-RAR application on startup, which they could keep at their home for one month. They were instructed to self-administer the cognitive exercise at least once a day and they were informed that they were allowed to administer the exercise as many times as they wanted; however, they were advised not to administer the exercise more than 5 times each day as this could lead to fatigue. They were informed that the exercise featured a program of increasing difficulty which would raise the difficulty level after 5 administrations in each difficulty level. More specifically they were informed that the program featured 5 training administrations at difficulty level 1 followed by 5 administrations in each of the 4 difficulty levels. After the completion of the program, the difficulty settings were unlocked and the participants were able to select the difficulty level they wanted. One training administration was conducted at a day center of the GAARDR under the supervision of a psychologist while subsequent administrations were carried out in the participants' homes.

參與者被給了一個10英寸的平板電腦與自定義軟件啟動VSM-RAR應用程序啟動，他們可以將它放在家里一個月。他們被指示每天至少一次自我管理認知練習，並被告知允許他們多次按照自己的意願進行練習;不過，他們建議每天不要超過5次，因為這可能導致疲勞過度。他們被告知，這項工作的特點是難度加大的方案，這將提高每個難度級別5次行政後的難度。更具體地說，他們被告知，該計劃的特點是在難度一級有5個管理訓練，隨之而來的是4個難度級別中的5個管理訓練。程序完成後，難度設置被解鎖，參與者能夠選擇他們想要的難度級別。一個管理訓練在心理學家們的監督下在希臘阿爾茨海默病和相關疾病協會的日間護理中心進行而隨後的管理是在參與者家中執行。