D4.2 – Normative document for DIMEMO

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1. EXECUTIVE SUMMARY

VRMIND-DIMEMO (Nesplora Suite from now on) is a neuropsychological test for memory function in people from 16 to 90 years old. It is a test designed to evaluate the main memory processes to support the diagnosis and severity of any clinical condition which course memory impairment. This assessment is carried out through the performance of the person within a virtual furniture store. The proper assessment of memory function is a crucial issue in many conditions as different types of dementia, the natural ageing process, acquired brain injury, substance abuse disorder, adult ADHD, multiple sclerosis, psychotic disorders or anxiety and mood disorders.

This product is going to be launched to the market on 2019. For the commercialization of Nesplora Suite we wanted to offer a scientific tool. That is why we have developed a normative study to a large extent by ourselves, but also with the help of some external collaborators. This way, the results obtained from the test, are automatically compared with the average of the person's reference group, where both age and sex are taken into account.

This deliverable describes in sections 3 and 4 the objectives and the process of development of the normative study in the Spanish population and the collaborators that are taking part in equivalent studies in other countries. In section 5, the results of these studies are shown, although most of these collaborators are still collecting the data that will be analyzed. Finally, the main conclusions are drawn up in section 6.

2. RELATION WITH OTHER WPS AND DELIVERABLES

This deliverable is related with "D2.2 – GEAR version DIMEMO", since this deliverable details the Nesplora Suite tool. It is also related with D5.7, D5.8 and D5.9 that will explain in the future the clinical studies with Nesplora Suite.

3. OBJECTIVES OF THE NORMATIVE STUDY

The main objective of the normative study is to establish a normal curve in the execution of the Nesplora Suite test with the aim to represent the population

in which we are going to use the measurement and from which we will extract the rules that will be used in the diagnosis.

Once we have the norms, we can evaluate each subject and know if this subject is within the rule or not, and in its case in which parameters differs and how much. These parameters indicate the distance to the rule and, depending on them the clinician can suspect a concrete pathology.

Although the main normative study is carried out in the country of origin where the test is carried out, it is also advisable to carry out small contrasting normative studies in those countries where it is intended to be marketed. The main reason is that one of the ways to start commercializing on these countries is through the collaborators who carry out these studies. Likewise, potential clients in that country feel more confident when buying if there are previous studies carried out with this test in their own socio-cultural environment. For this reason, a normative study has been carried out not only in Spain but also in other countries as detailed in the following section.

4. METHODOLOGY OF THE NORMATIVE STUDY

We are currently carrying out normative studies in Spain, Greece, Mexico, Colombia and USA. In each one of these places the methodology carried out has been different, so that is why the results are presented in different sections. But in general one of the most important things is to recruit a heterogeneous sample, in terms of age, socioeconomic level, etc, which represents the general sample.

In general, the inclusion criteria for all the studies have been the following:

- Voluntarily participation
- Sign of the informed consent
- Older than 16 years
- Not blind or deaf people
- No mental illness

As a requirement to be able to administer the test to the people who compose the present study, both the participants and their parents or legal guardians (in the case of minors) had to sign an informed consent. The

personal data was anonymised. The only personal data collected for these analyzes were basic sociodemographic data (sex, age and educational level).

3.1 Methodology of the Spanish normative study

Most of the evaluations for the normative study in Spain have been carried out by Nesplora. In total we have invited to be evaluated 440 people. However, not all the data were valid, since in some cases on the first day of the evaluations the transmission of the data failed after the end of the test, aspect that was later solved, in other cases people could not complete one of the two tests (they were invited to perform the Ice Cream and Suite tests at the same time) for reasons of time, etc. So finally we have data from 398 people evaluated by Nesplora with the following sociodemographic characteristics.

Table 1. Sociodemographic characteristics of the Spanish sample recruited by Nesplora

N	Age range	% Male - $ Female	Location
398	16-84	52.76% Female 47.24% Male	San Sebastián, Bilbao and Madrid

The minimum number of people to be evaluated has been set together with the psychometricians of the Catholic University of Murcia (UCAM). We were advised to evaluate 400 people whose sociodemographic characteristics were representative of the general Spanish population, to be sure that with this number of evaluations we could conclude the normative study of the tools. In order to design the target population to be evaluated ensuring the representation of the sample we are considering 3 criteria: age, gender and education level. Previously to the data collection, we have established the sample goal for each age, gender and education level group according to the Instituto Nacional de Estadística (National Institute of Statistics) sociodemographic data of Spanish population in 2016.

To collect the sample, we have relied on the services of the company Sevicampo Estudios de Mercado S.L., who recruit the sample according to the sociodemographic information provided by Nesplora. The company has been

also responsible to schedule participants' appointments in the different evaluation locations.

The test administration has been carried by Nesplora's personnel with expertise on the administration of the test. The data collection took place in three different cities: Donostia-San Sebastian, Bilbao and Madrid in order to provide some geographical variability to the sample.

Also, part of the sample of the normative study has been collected by an independent collaborator from the Oviedo's University. The sample goal established to this institution has been 40 participants from 16 to 24 years old. In order to do that, the evaluators on this institution have been trained in the use of Nesplora Suite and other complementary measures.

So far this collaborator has evaluated 34 people, of whom 15 are women and 19 are men. As far as the academic education they are currently studying: 21 of them are studying baccalaureate, 11 of them are studying degree of psychology and 2 of them are studying a postgraduate course.

So, at a national level, the tests administered by both ourselves and the collaborators are going to be 438, of which 398 have been administered by Nesplora and 40 have been administered by the collaborators. This number is slightly higher than the number established by psychometricians to consider that the ideal sample has been reached for the normative study.

At the same time that Nesplora Suite has been administered, each participant has been administered a questionnaire asking for their sociodemographic data, such as educational level, profession, bilingualism, etc. These data allow us to carry out studies whose purpose is to obtain more knowledge of basic processes such as memory function.

3.2   Methodology of the Mexican sample

The Mexican sample is being recruited by the clinician Dr. Lincoln Antonio at Technological University of Tabasco (UTTAB) at Mexico D.F. Its vision is to contribute with social responsibility to the development of the region based on the application of an educational model of competencies, emphasizing the use of technological tools, innovation and the pursuit of a comprehensive and professional training of human capital, as well as a strategic relationship with the productive and social sectors, through linkages and services. The commitment of this collaborator is to recruit 100 participants over the age of

16. The aim of this study is to test the differences between Mexican and Spanish population in order to validate the Spanish normative study of Nesplora Suite in Mexican population. Validation of the norms provides guaranties to fairly use this tool relying on the norms collected in Spain.

Dr. Lincoln Antonio collects sample for Nesplora Suite's normative study collecting also sociodemographic data of the participants. In addition, Nesplora Ice Cream is been also administered in order to analyze convergent validity between some test variables, providing also data for the clinical studies of Nesplora Suite.

Up to now, this collaborator has not started with the collection of the sample but the deadline for this task is June 30th 2019. The collaboration agreement with this collaborator can be found in Annex 4.

3.3   Methodology of the Greek sample

The Greek sample is being recruited by Dr. Argiro Vatakis at Panteion University of Social and Political Sciences, and she's a member of the Embodied Language Processing Group at the Cognitive Systems Research Institute in Athens, Greece and director of the Multisensory and Temporal Processing Laboratory (MultiTimeLab). This collaborator has already participated with us in the normative study of the Nesplora Aquarium tool and is very interested in continuing with other types of studies in the future. The commitment of this collaborator is to recruit 100 participants over the age of 16. Dr. Argiro Vatakis collects sample for Nesplora Suite's normative study collecting also sociodemographic data of the participants. In addition, Nesplora Ice Cream is been also administered in order to analyze convergent validity between some test variables, providing also data for the clinical studies of Nesplora Suite.

The aim of this study is to test the differences between Greek and Spanish population in order to validate the Spanish normative study of Nesplora Suite in Greek population. Validation of the norms provides guaranties to fairly use this tool relying on the norms collected in Spain.

After receiving the data at the end of March, we will perform Mann-Whitney U test in order to analyse differences between Greek and Spanish groups. Results will be disseminated in congress publications. The collaboration agreement with this collaborator can be found in Annex 5.

3.4   Methodology of the Colombian sample

The Colombian sample is been recruited by the neuropsychology clinic Neuraxis in Ibagué. The commitment of this collaborator is to recruit 60 participants (30 of them without cognitive impairment) over the age of 60. As part of the study, the center collects sociodemographic information of the participants as well as the performance in Nesplora Ice Cream. The clinic Neuraxis is collecting also a sample of patients with Mild Cognitive Impairment. Up to now, they have not started yet with the data collection. The collaboration agreement with this collaborator can be found in Annex 6.

3.5   Methodology of the North American sample

The North American sample is been recruited by Dr John Nietfeld at the North Carolina State University. The commitment of this collaborator is to recruit 100 participants over the age of 16. As part of the study, the center collects sociodemographic information of the participants as well as the performance in Nesplora Suite. So far they have not been able to start collecting the sample due to the distribution of classes during the school year. The collaboration agreement with this collaborator can be found in Annex 7.

5. RESULTS

First of all, it is important to mention that Nesplora Suite produces more than 200 variables with the information generated in the evaluation. From all these variables, a total of 36 have been selected for the clinical report. This selection has been based on clinical criteria and ease of interpretation. The remaining variables may be used in the future either to produce other types of reports or to supplement the existing clinical report. Therefore, the results shown in this section correspond to those of the 36 variables that appear in the report. In the following table the final variables used by the clinical report and their corresponding abbreviation can be seen in the following table:

Variables	Description	Measurement unit
task01_PE01_correct_n	Total furniture correctly pressed in the order 1 (round 1), of the Task 1	n
task01_PE02_correct_n	Total furniture correctly pressed in the order 2 (round 1), of the Task 1	n
task01_PE03_correct_n	Total furniture correctly pressed in the order 3 (round 1), of the Task 1	n
task01_PE04_correct_n	Total furniture correctly pressed in the order 4 (round 1), of the Task 1	n
task01_PE05_correct_n	Total furniture correctly pressed in the order 5 (round 1), of the Task 1	n
task01_PE06_correct_n	Total furniture correctly pressed in the order 6 (round 2), of the Task 1	n
task01_PE07_correct_n	Total furniture correctly pressed in the order 7 (round 2), of the Task 1	n
task01_PE08_correct_n	Total furniture correctly pressed in the order 8 (round 2), of the Task 1	n
task01_PE09_correct_n	Total furniture correctly pressed in the order 9 (round 2), of the Task 1	n
task01_PE10_correct_n	Total furniture correctly pressed in the order 10 (round 2), of the Task 1	n
task01_PE11_correct_n	Total furniture correctly pressed in the order 11 (round 3), of the Task 1	n
task01_PE12_correct_n	Total furniture correctly pressed in the order 12 (round 3), of the Task 1	n

task01_PE13_correct_n	Total furniture correctly pressed in the order 13 (round 3), of the Task 1	n
task01_PE14_correct_n	Total furniture correctly pressed in the order 14 (round 3), of the Task 1	n
task01_PE15_correct_n	Total furniture correctly pressed in the order 15 (round 3), of the Task 1	n
task01_time	Total time needed for Task 1	ms
task02_FAM01_correct_n	Family pressed correctly in round 1, task 2	n
task02_FAM02_correct_n	Family pressed correctly in round 2, task 2	n
task02_FAM03_correct_n	Family pressed correctly in round 3, task 2	n
task02_FAM04_correct_n	Family pressed correctly in round 4, task 2	n
task02_FAM05_correct_n	Family pressed correctly in round 5, task 2	n
task02_fam_correct_n	Total number of family pressed correctly	n
task02_fam_incorrect_n	Total number of family pressed incorrectly	n
task03_PE01_correct_n	Total furniture correctly pressed in the order 1 of the Task 3	n
task03_PE02_correct_n	Total furniture correctly pressed in the order 2 of the Task 3	n
task03_PE03_correct_n	Total furniture correctly pressed in the order 3 of the Task 3	n
task03_PE04_correct_n	Total furniture correctly pressed in the order 4 of the Task 3	n
task03_PE05_correct_n	Total furniture correctly pressed in the order 5 of the Task 3	

task03_time	Total time needed for Task 3	ms
task05_PE01_correct_n	Total furniture correctly pressed in the order 1 of the Task 5	n
task05_PE02_correct_n	Total furniture correctly pressed in the order 2 of the Task 5	n
task05_PE03_correct_n	Total furniture correctly pressed in the order 3 of the Task 5	n
task05_PE04_correct_n	Total furniture correctly pressed in the order 4 of the Task 5	n
task05_PE05_correct_n	Total furniture correctly pressed in the order 5 of the Task 5	n
task05_time	Total time needed for Task 5	ms
task07_correct_n	Total furniture correctly pressed in Task 7	n

N= number; ms= milliseconds

5.1.   Results of the Spanish normative study

In this section we present the results of the evaluations carried out in Spain by the team of Nesplora. To obtain the scales, we have had the help of psychometricians from the Catholic University of Murcia (UCAM) and the company Damatech. People between the ages of 16 and 84 have been evaluated and it has been observed, after carrying out a cluster, that there are three groups for the scales according to age. No differences between men and women have been found in the variables analysed. The extraction of these groups and the differences by sex are compatible with the previous findings of the literature.

Thus, in this section the characteristics of the variables for the total sample, the normative groups obtained and the homoscedasticity and normality analysis will be presented. Secondly, the differences according to sex and age that have been found in the normative sample are shown. To finish, the reliability that the scales of the Nesplora Suite test have shown will be explained.

Description of the sample:

The objective of the normative study of Nesplora Suite was to identify the different groups existing in the sample based on the scores obtained in the execution of this test, while establishing the normality curve for each one of them. To carry out this normative study, the data of 398 subjects has been initially analyzed and three age groups have been identified, in order to obtain the scales.

In order to collect a sample as representative as possible of the population, the educational level was recorded to get a sample provided in each group according to the sociodemographic data of the National Institute of Statistic of Spain (INE) of 2016. The participants that make up the total sample, in addition, were from different Spanish geographical areas such as Bilbao, San Sebastian and Madrid in order to introduce some geographical variability to the sample.

5.1.1 Characteristics of the variables of the total sample:

It is necessary to verify the **homoscedasticity** assumption for the study of the differences by sex of the sample. That is, it is sought that the different groups obtained present the same variance. For the study of homoscedasticity the Levene test was used. The Levene statistic follows a Snedecor F distribution. In table 1 (annex I), the results of differences by age are shown, where BP is the value of the statistic, DF the degrees of freedom of the numerator and the denominator, respectively and p the value of the probability associated with BP. The variables for which it is necessary to reject the null hypothesis (α = .05) of equality of variances between the group of men and women are marked with an asterisk.

For the study of the **normality** of the variables, the Shapiro-Wilk statistic was used. The results obtained for the total sample can be seen in table 2, 3, 4 and 5 (annex I). Those variables whose distribution can be considered normal (α = .05) are marked with an asterisk.

5.1.2 Study of differences according to age and sex of the normative group:

Before beginning with the evaluation of the different variables, it is essential to carry out a study of interindividual differences. Depending on the results obtained, it will be necessary to decide the number of different scales that will be necessary to perform.

A Kmeans cluster analysis has been carried in order to establish the age groups according to the performance in the main variables of the task. Cluster's centroids for each variable are presented in table 1 (annex II):

According to cluster analysis, 3 different age groups have been established: group 1 from 16 to 40 years old, group 2 from 41 to 67 years old, group 3 from 68 to 84 years old. No gender differences have been found in these age groups.

The differences between age groups are analyzed for the total sample (n = 398) using the non-parametric "U" test of Chi-Squared and the results are presented in the table 2 (annex II). The variables in which the differences are statistically significant (confidence level = 95%) can be seen in this table. As can be observed in the tables, there are differences between age groups of the entire sample in most of the variables analyzed.

These analyzes are carried out with the complete normative sample collected up to the moment of publication (n = 398), with ages between 16 and 84 years, to check in which groups the sample is distributed according to age and determine the scales.

After these analyzes, 3 age groups are obtained. The first age group ranges from 16 to 40 years, the second from 41 to 67 years, the third from 68 to 84 years.

The final sample of the first age group was 150 participants, 77 women and 73 men, aged between 16 and 40 years, with an average of 32.11 years.

With regard to the second age group, the sample was 199 participants, 107 women and 92 men, aged between 41 and 67 years, with an average of 52.61 years.

In the third age group, the sample consisted of 49 participants, 26 women and 23 men, with age between 68 to 84 years, with an average of 73.56 years.

5.1.3 Discussion

With the results obtained from the application of the test to the normative group, the following analyzes were carried out:

- A Kolmogorov-Smirnov test to check the normality of the distributions of the scores on the different scales.
- A test of F to test the equality of variances.

The results obtained, at the 95% Confidence Level (α <0.05), show that in the majority of cases the homoscedasticity assumption is not fulfilled. Neither is the normality of the distributions met to be able to carry out parametric tests for the study of the differences of the means by groups.

For the study of the differences of the means between the different groups, in the 36 variables studied the following tests were carried out:

- The "U" of Mann-Whitney for the study of the differences between sexes in the complete sample collected until now (n = 398).
- Kruskal-Wallis test for the study of age differences.

The results obtained (α <0.05) show:

- Statistically significant differences between the three age ranges identified in the sample.

According to the groups (psychologists, neurologists, psychiatrists, etc.) and potential users of the tests, the results were measured on percentile scales and T scores. In order to facilitate the interpretation and comparison of results, it was decided that Scores T were normalized.

5.1.4 Reliability study of the scales

The Nesplora Suite test presents certain special characteristics that, in some aspects, bring it closer to an "adaptive" type test, since the presentation time between stimuli, the appearance of distractors, their frequency, etc. they depend on the sequence of responses given by the person. In many aspects it could be said that the subject, in fact, may be responding to a "different" test. This, which considerably improves the ecological validity of the test and its real efficiency, makes it difficult; however, to estimate the reliability of all the measured scales, at least in what is traditionally understood as the reliability coefficient of a test. This is the reason why it is only possible to estimate classical reliability in the scales shown below. However, if these are reliable, in turn, they also guarantee the reliability of the rest of the aspects considered.

It should also be clarified that aspects such as standard deviations, reaction times, etc. which can be very useful for the diagnosis and classification of adults, do not support, strictly speaking, the concept of reliability coefficient.

Finally, the statistical analysis of the scales and alfa-Chrombach analysis have been carried out, and the results can be seen in the table 3 (annex III).

5.2. Results of the collaborators' studies

So far only the collaborator from Oviedo has sent data from his normative sample (which we still have to include in the analyses carried out). However, the collaborators from Mexico, Greece, Colombia and the USA have not yet started their studies, so their results cannot be shown here.

6. CONCLUSIONS AND FUTURE WORK

This deliverable describes the normative study of Nesplora Suite. We have done this study in a slightly different way than the Nesplora Aula and Nesplora Aquarium normative studies, which were the other two normative studies we had done to date. For this study, and guiding us by the psychometricians who have been different from the other psychometricians who have advised us for the previous studies, we have made a more precise estimate of the socio-demographic characteristics of the sample that we had to collect in order for it to be representative. We have set the necessary sample population at 400 people, which we have managed to surpass in 432 people and when our collaborators at the University of Oviedo finish passing us the sample will be surpassed in 38 people.

With these data, 3 age groups have been defined, with no differences in sex between these groups.

Thanks to these data collected, we have generated the execution curves against which the execution of each specific person performing the test can be compared, in order to know exactly where he or she is.

On the other hand, we have managed to close agreements with centres in 4 different countries representing the regions of Europe, USA and LATAM, to carry out small normative studies of contrast against which to compare the results obtained here. The ideal would have been to be able to start these studies earlier and already have results on them. But the delays that have occurred in the development of the Nesplora Suite tool, due to the change to an spherical photo instead of a 3D environment, some other problem that arose with the locutions in other languages of this tool, and especially the requirement of the ethics committees, has caused that these studies have not been able to begin yet. The ethical stumbling block has been the most important, since for that reason we have lost some of the interested collaborators, and because they cannot seriously start working on recruitment until they have at least sent the documentation to an ethical committee.

In any case, we will continue with the studies with these collaborators and with their publication and diffusion through different scientific means.

However, we consider that we have fulfilled the objective that we had with these studies because we have products that can be marketed today and although the results of normative studies from other countries arrive a little later, that does not delay us in our marketing.

ANNEX 1 – CHARACTERISTIC OF THE VARIABLES

Table 1: Homoscedasticity in variables of the complete sample

variable	BP	df	p_value
task01_PE01_correct_n	44.21	2	0.00
task01_PE02_correct_n	9.54	2	0.01
task01_PE03_correct_n	39.39	2	0.00
task01_PE04_correct_n	38.98	2	0.00
task01_PE05_correct_n	9.52	2	0.01
task01_PE06_correct_n	42.25	2	0.00
task01_PE07_correct_n	26.22	2	0.00
task01_PE08_correct_n	32.04	2	0.00
task01_PE09_correct_n	28.39	2	0.00
task01_PE10_correct_n	5.98	2	0.05
task01_PE11_correct_n	39.25	2	0.00
task01_PE12_correct_n	40.84	2	0.00
task01_PE13_correct_n	34.04	2	0.00
task01_PE14_correct_n	40.40	2	0.00
task01_PE15_correct_n	9.23	2	0.01

task01_time	63.27	2	0.00
task02_FAM01_correct_n	4.23	2	0.12
task02_FAM02_correct_n	6.52	2	0.04
task02_FAM03_correct_n	3.28	2	0.19
task02_FAM04_correct_n	3.56	2	0.17
task02_FAM05_correct_n	7.50	2	0.02
task02_fam_correct_n	1.17	2	0.56
task02_fam_incorrect_n	1.17	2	0.56
task03_PE01_correct_n	6.09	2	0.05
task03_PE02_correct_n	6.13	2	0.05
task03_PE03_correct_n	0.12	2	0.94
task03_PE04_correct_n	0.81	2	0.67
task03_PE05_correct_n	1.75	2	0.42
task03_time	49.68	2	0.00
task05_PE01_correct_n	1.72	2	0.42
task05_PE02_correct_n	5.46	2	0.07
task05_PE03_correct_n	1.90	2	0.39

task05_PE04_correct_n	4.03	2	0.13
task05_PE05_correct_n	0.57	2	0.75
task05_time	37.04	2	0.00
task07_correct_n	2.45	2	0.29

Table 2: Normality in variables (*Kolmogorov-Smirnov-Lilliefors*) from 16 to 40 years old

Variable	W	p_value
task01_PE01_correct_n	0.31	0.00
task01_PE02_correct_n	0.44	0.00
task01_PE03_correct_n	0.40	0.00
task01_PE04_correct_n	0.29	0.00
task01_PE05_correct_n	0.18	0.00
task01_PE06_correct_n	0.44	0.00
task01_PE07_correct_n	0.45	0.00
task01_PE08_correct_n	0.50	0.00
task01_PE09_correct_n	0.39	0.00
task01_PE10_correct_n	0.21	0.00

task01_PE11_correct_n	0.51	0.00
task01_PE12_correct_n	0.51	0.00
task01_PE13_correct_n	0.51	0.00
task01_PE14_correct_n	0.45	0.00
task01_PE15_correct_n	0.24	0.00
task01_time	0.12	0.00
task02_FAM01_correct_n	0.38	0.00
task02_FAM02_correct_n	0.29	0.00
task02_FAM03_correct_n	0.36	0.00
task02_FAM04_correct_n	0.42	0.00
task02_FAM05_correct_n	0.26	0.00
task02_fam_correct_n	0.18	0.00
task02_fam_incorrect_n	0.18	0.00
task03_PE01_correct_n	0.24	0.00
task03_PE02_correct_n	0.20	0.00
task03_PE03_correct_n	0.19	0.00
task03_PE04_correct_n	0.20	0.00

task03_PE05_correct_n	0.17	0.00
task03_time	0.09	0.01
task05_PE01_correct_n	0.18	0.00
task05_PE02_correct_n	0.19	0.00
task05_PE03_correct_n	0.18	0.00
task05_PE04_correct_n	0.18	0.00
task05_PE05_correct_n	0.15	0.00
task05_time	0.14	0.00
task07_correct_n	0.39	0.00

Table 3: Normality in variables (*Kolmogorov-Smirnov-Lilliefors*) from 41 to 67 years old

Variable	W	p_value
task01_PE01_correct_n	0.23	0.00
task01_PE02_correct_n	0.33	0.00
task01_PE03_correct_n	0.22	0.00
task01_PE04_correct_n	0.25	0.00
task01_PE05_correct_n	0.17	0.00

task01_PE06_correct_n	0.28	0.00
task01_PE07_correct_n	0.34	0.00
task01_PE08_correct_n	0.35	0.00
task01_PE09_correct_n	0.28	0.00
task01_PE10_correct_n	0.14	0.00
task01_PE11_correct_n	0.28	0.00
task01_PE12_correct_n	0.38	0.00
task01_PE13_correct_n	0.41	0.00
task01_PE14_correct_n	0.30	0.00
task01_PE15_correct_n	0.18	0.00
task01_time	0.15	0.00
task02_FAM01_correct_n	0.32	0.00
task02_FAM02_correct_n	0.23	0.00
task02_FAM03_correct_n	0.35	0.00
task02_FAM04_correct_n	0.36	0.00
task02_FAM05_correct_n	0.29	0.00
task02_fam_correct_n	0.14	0.00

task02_fam_incorrect_n	0.14	0.00
task03_PE01_correct_n	0.12	0.00
task03_PE02_correct_n	0.17	0.00
task03_PE03_correct_n	0.15	0.00
task03_PE04_correct_n	0.17	0.00
task03_PE05_correct_n	0.14	0.00
task03_time	0.10	0.00
task05_PE01_correct_n	0.15	0.00
task05_PE02_correct_n	0.21	0.00
task05_PE03_correct_n	0.18	0.00
task05_PE04_correct_n	0.19	0.00
task05_PE05_correct_n	0.16	0.00
task05_time	0.13	0.00
task07_correct_n	0.30	0.00

Table 4: Normality in variables (Kolmogorov-Smirnov-Lilliefors) from 68 to 84 years old

Variable	W	p_value
task01_PE01_correct_n	0.89	0.00

task01_PE02_correct_n	0.89	0.00
task01_PE03_correct_n	0.88	0.00
task01_PE04_correct_n	0.88	0.00
task01_PE05_correct_n	0.89	0.00
task01_PE06_correct_n	0.79	0.00
task01_PE07_correct_n	0.84	0.00
task01_PE08_correct_n	0.88	0.00
task01_PE09_correct_n	0.88	0.00
task01_PE10_correct_n	0.92	0.01
task01_PE11_correct_n	0.80	0.00
task01_PE12_correct_n	0.78	0.00
task01_PE13_correct_n	0.82	0.00
task01_PE14_correct_n	0.85	0.00
task01_PE15_correct_n	0.84	0.00
task01_time	0.96	0.25
task02_FAM01_correct_n	0.83	0.00
task02_FAM02_correct_n	0.87	0.00

task02_FAM03_correct_n	0.62	0.00
task02_FAM04_correct_n	0.79	0.00
task02_FAM05_correct_n	0.89	0.00
task02_fam_correct_n	0.93	0.02
task02_fam_incorrect_n	0.93	0.02
task03_PE01_correct_n	0.92	0.01
task03_PE02_correct_n	0.86	0.00
task03_PE03_correct_n	0.92	0.01
task03_PE04_correct_n	0.92	0.01
task03_PE05_correct_n	0.87	0.00
task03_time	0.92	0.01
task05_PE01_correct_n	0.93	0.03
task05_PE02_correct_n	0.81	0.00
task05_PE03_correct_n	0.92	0.01
task05_PE04_correct_n	0.91	0.00
task05_PE05_correct_n	0.77	0.00
task05_time	0.93	0.01

task07_correct_n	0.88	0.00

ANNEX 2 – STUDY OF DIFFERENCES ACCORDING TO AGE AND SEX

Table 1: Centroid values for the different cluster groups in the main variables of the task.

V1	V2	V3	V4	V5	V6	V7	V8	V9	V10	V11	V12	V13	V14	V15	V16	V17	V18	V19	V20	V21	V22	V23	V24	V25	V26	V27	28	V29	V30	V31	V32	V33	V34	V35	V36
0,43	0,35	0,40	0,42	0,33	0,42	0,40	0,40	0,42	0,45	0,37	0,30	0,31	0,36	0,50	-0,34	0,23	0,49	-0,30	0,48	0,46	0,65	-0,65	0,57	0,55	0,35	0,41	0,41	-0,14	0,52	0,52	0,33	0,46	0,31	-0,20	0,33
-2,05	-1,85	-2,40	-2,55	-1,81	-3,28	-2,98	-3,13	-3,06	-2,43	-3,13	-3,01	-2,99	-2,85	-2,18	0,35	-0,82	1,07	0,23	-0,79	-1,78	-1,57	1,57	-1,40	-1,28	-1,43	-1,24	-1,48	0,21	-1,50	-1,21	-1,01	-0,80	-1,26	0,37	-0,69
-0,31	-0,24	-0,25	-0,26	-0,21	-0,17	-0,19	-0,17	-0,20	-0,31	-0,13	-0,06	-0,07	-0,15	-0,38	0,38	-0,20	-0,48	0,34	-0,50	-0,38	-0,64	0,64	-0,55	-0,53	-0,29	-0,38	-0,35	0,15	-0,48	-0,51	-0,29	-0,48	-0,24	0,20	-0,33

V1: task01_PE01_correct_n; **V2**: task01_PE02_correct_n; **V3**: task01_PE03_correct_n; **V4**: task01_PE04_correct_n; **V5**: task01_PE05_correct_n; **V6**: task01_PE06_correct_n; **V7**: task01_PE07_correct_n; **V8**: task01_PE08_correct_n; **V9**: task01_PE09_correct_n; **V10**: task01_PE10_correct_n; **V11**: task01_PE11_correct_n; **V12**: task01_PE12_correct_n; **V13**: task01_PE13_correct_n; **V14**: task01_PE14_correct_n; **V15**: task01_PE15_correct_n; **V16**: task01_time; **V17**: task02_FAM01_correct_n; **V18**: task02_FAM02_correct_n; **V19**: task02_FAM03_correct_n; **V20**: task02_FAM04_correct_n; **V21**: task02_FAM05_correct_n; **V22**: task02_fam_correct_n; **V23**: task02_fam_incorrect_n; **V24**: task03_PE01_correct_n; **V25**: task03_PE02_correct_n; **V26**: task03_PE03_correct_n; **V27**: task03_PE04_correct_n; **V28**: task03_PE05_correct_n; **V29**: task03_time; **V30**: task05_PE01_correct_n; **V31**: task05_PE02_correct_n; **V31**: task05_PE02_correct_n; **V32**: task05_PE03_correct_n; **V33**: task05_PE04_correct_n; **V34**: task05_PE05_correct_n; **V35**: task05_time; **V36**: task07_correct_n

Table 2: Difference of means according to age Chi-Squared.

Variable	Chi-squared	df	p_value
task01_PE01_correct_n	44.61	2	0.00
task01_PE02_correct_n	50.41	2	0.00
task01_PE03_correct_n	66.68	2	0.00
task01_PE04_correct_n	33.27	2	0.00
task01_PE05_correct_n	18.35	2	0.00
task01_PE06_correct_n	60.87	2	0.00
task01_PE07_correct_n	47.78	2	0.00
task01_PE08_correct_n	65.51	2	0.00
task01_PE09_correct_n	46.83	2	0.00
task01_PE10_correct_n	50.75	2	0.00
task01_PE11_correct_n	66.16	2	0.00
task01_PE12_correct_n	38.39	2	0.00
task01_PE13_correct_n	46.15	2	0.00
task01_PE14_correct_n	35.91	2	0.00
task01_PE15_correct_n	66.53	2	0.00

task01_time	71.11	2	0.00
task02_FAM01_correct_n	14.06	2	0.00
task02_FAM02_correct_n	25.21	2	0.00
task02_FAM03_correct_n	2.57	2	0.28
task02_FAM04_correct_n	23.96	2	0.00
task02_FAM05_correct_n	27.83	2	0.00
task02_fam_correct_n	46.04	2	0.00
task02_fam_incorrect_n	46.04	2	0.00
task03_PE01_correct_n	57.73	2	0.00
task03_PE02_correct_n	37.47	2	0.00
task03_PE03_correct_n	34.64	2	0.00
task03_PE04_correct_n	22.56	2	0.00
task03_PE05_correct_n	40.59	2	0.00
task03_time	20.89	2	0.00
task05_PE01_correct_n	42.85	2	0.00
task05_PE02_correct_n	29.36	2	0.00
task05_PE03_correct_n	21.80	2	0.00

task05_PE04_correct_n	16.38	2	0.00
task05_PE05_correct_n	15.58	2	0.00
task05_time	26.63	2	0.00
task07_correct_n	28.87	2	0.00

ANNEX 3 – RELIABILITY STUDY OF THE SCALES

Table 1: Statistical analysis of the scales for the complete sample

Variable	Average	Variance	Standard Deviation	Cronbach Alpha
task01_PE01_correct_n	5.75	2.33	1.53	0.77
task01_PE02_correct_n	3.39	0.73	0.85	0.77
task01_PE03_correct_n	4.96	1.53	1.24	0.77
task01_PE04_correct_n	4.01	0.92	0.96	0.77
task01_PE05_correct_n	5.33	2.03	1.42	0.77
task01_PE06_correct_n	6.14	2.16	1.47	0.89
task01_PE07_correct_n	3.45	0.75	0.86	0.89
task01_PE08_correct_n	5.34	1.56	1.25	0.89
task01_PE09_correct_n	4.21	1.10	1.05	0.89
task01_PE10_correct_n	5.88	2.90	1.70	0.89
task01_PE11_correct_n	6.31	1.74	1.32	0.85
task01_PE12_correct_n	3.58	0.63	0.79	0.85
task01_PE13_correct_n	5.50	1.13	1.06	0.85
task01_PE14_correct_n	4.37	1.02	1.01	0.85
task01_PE15_correct_n	6.12	2.57	1.60	0.85
task01_time	262,676.99	17,391,850,614.63	131,878.17	0.65

task02_FAM01_correct_n	4.64	3.69	1.92	not necessary
task02_FAM02_correct_n	3.36	3.69	1.92	not necessary
task02_FAM03_correct_n	0.83	0.62	0.79	0.38
task02_FAM04_correct_n	0.93	1.10	1.05	0.38
task02_FAM05_correct_n	-0.49	0.25	0.50	0.38
task02_fam_correct_n	0.48	0.46	0.68	0.38
task02_fam_incorrect_n	2.06	0.77	0.88	0.38
task03_PE01_correct_n	4.06	3.69	1.92	0.76
task03_PE02_correct_n	2.12	1.48	1.22	0.76
task03_PE03_correct_n	3.61	2.59	1.61	0.76
task03_PE04_correct_n	2.42	1.42	1.19	0.76
task03_PE05_correct_n	5.20	2.60	1.61	0.76
task03_time	93,364.71	1,903,156,853.22	43,625.19	0.65
task05_PE01_correct_n	4.22	3.29	1.81	0.70
task05_PE02_correct_n	2.19	1.31	1.14	0.70
task05_PE03_correct_n	3.81	2.18	1.48	0.70
task05_PE04_correct_n	2.42	1.48	1.22	0.70

task05_PE05_correct_n	5.30	1.88	1.37	0.70
task05_time	93,272.10	1,543,505, 734.04	39,287.48	0.65
task07_correct_n	6.33	1.26	1.12	not necessary

Table 2: Statistical analysis of the scales for sample from 16 to 40 years old.

Variable	Average	Variance	Standard Deviation	Cronbach Alpha
task01_PE01_correct_n	6.23	1.00	1.00	0.45
task01_PE02_correct_n	3.63	0.50	0.71	0.45
task01_PE03_correct_n	5.49	0.62	0.79	0.45
task01_PE04_correct_n	4.30	0.41	0.64	0.45
task01_PE05_correct_n	5.64	1.84	1.36	0.45
task01_PE06_correct_n	6.69	0.29	0.54	0.56
task01_PE07_correct_n	3.70	0.32	0.56	0.56
task01_PE08_correct_n	5.81	0.21	0.46	0.56
task01_PE09_correct_n	4.59	0.32	0.56	0.56
task01_PE10_correct_n	6.49	1.90	1.38	0.56
task01_PE11_correct_n	6.83	0.17	0.41	0.28

task01_PE12_correct_n	3.84	0.15	0.39	0.28
task01_PE13_correct_n	5.84	0.18	0.42	0.28
task01_PE14_correct_n	4.70	0.30	0.55	0.28
task01_PE15_correct_n	6.83	1.53	1.24	0.28
task01_time	210,974,12	3,950,858,252.63	62,855.85	0.78
task02_FAM01_correct_n	5.26	3.00	1.73	not necessary
task02_FAM02_correct_n	2.74	3.00	1.73	not necessary
task02_FAM03_correct_n	0.98	0.47	0.69	0.15
task02_FAM04_correct_n	1.18	0.86	0.93	0.15
task02_FAM05_correct_n	-0.53	0.25	0.50	0.15
task02_fam_correct_n	0.62	0.37	0.61	0.15
task02_fam_incorrect_n	2.30	0.53	0.73	0.15
task03_PE01_correct_n	4.84	2.40	1.55	0.63
task03_PE02_correct_n	2.51	1.55	1.25	0.63
task03_PE03_correct_n	3.99	2.28	1.51	0.63
task03_PE04_correct_n	2.75	1.30	1.14	0.63
task03_PE05_correct_n	5.70	1.98	1.41	0.63

task03_time	84,289.51	990,115,846.27	31,466.11	0.78
task05_PE01_correct_n	4.78	2.72	1.65	0.65
task05_PE02_correct_n	2.54	1.42	1.19	0.65
task05_PE03_correct_n	4.20	2.03	1.43	0.65
task05_PE04_correct_n	2.67	1.51	1.23	0.65
task05_PE05_correct_n	5.58	1.66	1.29	0.65
task05_time	83,243.38	904,366,499.67	30,072.69	0.78
task07_correct_n	6.59	0.71	0.84	not necessary

Table 3: Statistical analysis of the scales for sample from 41 to 67 years old.

Variable	Average	Variance	Standard Deviation	Cronbach Alpha
task01_PE01_correct_n	5.78	1.83	1.35	0.68
task01_PE02_correct_n	3.40	0.60	0.78	0.68
task01_PE03_correct_n	4.87	1.26	1.12	0.68
task01_PE04_correct_n	4	0.81	0.90	0.68
task01_PE05_correct_n	5.31	1.65	1.28	0.68
task01_PE06_correct_n	6.09	1.88	1.37	0.86

task01_PE07_correct_n	3.47	0.62	0.79	0.86
task01_PE08_correct_n	5.29	1.49	1.22	0.86
task01_PE09_correct_n	4.17	1.03	1.01	0.86
task01_PE10_correct_n	5.79	2.63	1.62	0.86
task01_PE11_correct_n	6.23	1.49	1.22	0.82
task01_PE12_correct_n	3.54	0.56	0.75	0.82
task01_PE13_correct_n	5.49	1.02	1.01	0.82
task01_PE14_correct_n	4.36	0.87	0.93	0.82
task01_PE15_correct_n	5.94	2.18	1.48	0.82
task01_time	260,267.16	9,618,144,292.00	98,072.14	0.64
task02_FAM01_correct_n	4.56	3.41	1.85	not necessary
task02_FAM02_correct_n	3.44	3.41	1.85	not necessary
task02_FAM03_correct_n	0.80	0.69	0.83	0.29
task02_FAM04_correct_n	0.90	1.17	1.08	0.29
task02_FAM05_correct_n	-0.49	0.25	0.50	0.29
task02_fam_correct_n	0.46	0.49	0.70	0.29
task02_fam_incorrect_n	2.02	0.73	0.86	0.29

task03_PE01_correct_n	3.87	3.49	1.87	0.70
task03_PE02_correct_n	2.02	1.25	1.12	0.70
task03_PE03_correct_n	3.63	2.37	1.54	0.70
task03_PE04_correct_n	2.30	1.32	1.15	0.70
task03_PE05_correct_n	5.13	2.43	1.56	0.70
task03_time	90,799.12	1,339,373,902.37	36,597.46	0.64
task05_PE01_correct_n	4.13	3.19	1.79	0.64
task05_PE02_correct_n	2.07	1.10	1.05	0.64
task05_PE03_correct_n	3.67	2.19	1.48	0.64
task05_PE04_correct_n	2.36	1.45	1.21	0.64
task05_PE05_correct_n	5.24	1.86	1.36	0.64
task05_time	93,441.03	1,099,331,849.82	33,156.17	0.64
task07_correct_n	6.28	1.52	1.23	not necessary

Table 4: Statistical analysis of the scales for sample from 68 to 84 years old.

Variable	Average	Variance	Standard Deviation	Cronbach Alpha
task01_PE01_correct_n	3.92	5.44	2.33	0.85

task01_PE02_correct_n	2.49	1.15	1.07	0.85
task01_PE03_correct_n	3.51	2.99	1.73	0.85
task01_PE04_correct_n	3.05	2.10	1.45	0.85
task01_PE05_correct_n	4.33	3.33	1.83	0.85
task01_PE06_correct_n	4.41	6.20	2.49	0.92
task01_PE07_correct_n	2.46	1.73	1.31	0.92
task01_PE08_correct_n	3.87	3.75	1.94	0.92
task01_PE09_correct_n	3.08	2.49	1.58	0.92
task01_PE10_correct_n	4.21	3.80	1.95	0.92
task01_PE11_correct_n	4.85	5.50	2.35	0.89
task01_PE12_correct_n	2.82	1.89	1.37	0.89
task01_PE13_correct_n	4.33	3.39	1.84	0.89
task01_PE14_correct_n	3.31	2.85	1.69	0.89
task01_PE15_correct_n	4.51	3.73	1.93	0.89
task01_time	457,304.03	56,611,624,360,973.00	237,931.97	0.60
task02_FAM01_correct_n	2.82	2.94	1.71	not necessary
task02_FAM02_correct_n	5.18	2.94	1.71	not necessary

task02_FAM03_correct_n	0.49	0.62	0.79	0.57
task02_FAM04_correct_n	0.23	0.92	0.96	0.57
task02_FAM05_correct_n	-0.38	0.24	0.49	0.57
task02_fam_correct_n	0.05	0.42	0.65	0.57
task02_fam_incorrect_n	1.41	1.20	1.09	0.57
task03_PE01_correct_n	2.18	3.47	1.86	0.81
task03_PE02_correct_n	1.21	0.96	0.98	0.81
task03_PE03_correct_n	2.18	2.31	1.52	0.81
task03_PE04_correct_n	1.79	1.59	1.26	0.81
task03_PE05_correct_n	3.77	2.76	1.66	0.81
task03_time	137,910.18	5,715,968,856.62	75,604.03	0.60
task05_PE01_correct_n	2.69	2.48	1.58	0.73
task05_PE02_correct_n	1.51	0.99	1.00	0.73
task05_PE03_correct_n	3.05	1.58	1.26	0.73
task05_PE04_correct_n	1.79	0.90	0.95	0.73
task05_PE05_correct_n	4.54	1.99	1.41	0.73
task05_time	127,939.69	4,527,641,453.11	67,287.75	0.60

task07_correct_n	5.69	1.38	1.17	not necessary