D4.1 – Normative document for ICSTEST

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TABLE OF CONTENTS

1. EXECUTIVE SUMMARY

VRMIND-ICECREAM (Nesplora Ice Cream from now on) is a neuropsychological test for executive functions in people from 16 to 90 years old. It is a test designed to evaluate the main components of executive functions as working memory, planification, cognitive flexibility and processing speed to support the diagnosis and severity of any clinical condition which course with frontal lobe impairment. This assessment is carried out through the performance of the person within a virtual ice cream shop. The proper assessment of executive functions is a crucial issue in many conditions as different types of dementia, 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 Ice Cream 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 "D2.1 – GEAR version ICSTEST", since this deliverable details the Nesplora Ice Cream tool. It is also related with D5.4, D5.5 and D5.6 that will explain in the future the clinical studies with Nesplora Ice Cream.

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 Ice Cream 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 394 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
394	18-84	51.5% Female 48.5% 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 Ice Cream 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 434, of which 394 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 Ice Cream 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 executive 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 Ice Cream 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 Ice Cream's normative study collecting also sociodemographic data of the participants. In addition, Nesplora Suite is been also administered in order to analyze convergent validity between some test variables, providing also data for the clinical studies of Nesplora Ice Cream.

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

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 Ice Cream 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 Suite. 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 Ice Cream produces more than 1100 variables with the information generated in the evaluation. From all these variables, a total of 27 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 27 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
s1_h_correcttime_mean	Average time from clicking on the avatar to indicate the number of ice cream you want until a correct ice cream is delivered.	ms
s1_h_rawscore_n	Number of ice creams delivered correctly.	n
s1_h_recipeopen_n	Number of queries in the cookbook.	n
s1_h_score_n	H_rawscore_n - H_recipeopen_n	n
s1_h_time_ms	Time elapsed from pressing on Ax until delivery of the ice cream to Ax. in T, Ta, Tb and Rx: respective sums of Ax_H_time_ms.	ms
s1_totaltime_ms	RX: Time from the start of the round until the last ice cream is delivered. | SX: Time from the beginning of the first round of the set until the last ice cream of the set is served. | TX: Time from the beginning of the first round until the last ice cream of the task is served.	ms
s1_tu_time_ms	Time elapsed since the click on the first client to which the turn is assigned to the last of them in round X.	ms
s1_tu_total_correct_n	Total number of ice cream delivered on S1	n
s1_worktime_ms	Rx_worktime_ms: time elapsed since the turn is given to the first avatar in Rx until the ice cream is delivered to the last avatar of Rx | Sx_worktime_ms: Sum of RX_worktime_ms of the set.	n
s2_h1_persepress_n	Total of persistent responses in H1	n
s2_h2_persepress_n	Total of persistent responses in H2	n
s2_h3_persepress_n	Total of persistent responses in H3	n
s2_h4_persepress_n	Total of persistent responses in H4	n
s2_h_correcttime_mean	Average time from clicking on the avatar to indicate the number of ice cream you want until a correct ice cream is delivered.	ms

s2_h_rawscore_n	Number of ice creams delivered correctly.	n
s2_h_recipeopen_n	Number of queries in the cookbook.	n
s2_h_score_n	H_rawscore_n - H_recipeopen_n	n
s2_h_time_ms	Time elapsed from pressing on Ax until delivery of the ice cream to Ax. in T, Ta, Tb and Rx: respective sums of Ax_H_time_ms.	ms
s2_totaltime_ms	RX: Time from the start of the round until the last ice cream is delivered. | SX: Time from the beginning of the first round of the set until the last ice cream of the set is served. | TX: Time from the beginning of the first round until the last ice cream of the task is served.	ms
s2_tu_time_ms	Time elapsed since the click on the first client to which the turn is assigned to the last of them in round X.	ms
s2_tu_total_correct_n	Total number of ice cream delivered on S2	n
s2_worktime_ms	Rx_worktime_ms: time elapsed since the turn is given to the first avatar in Rx until the ice cream is delivered to the last avatar of Rx | Sx_worktime_ms: Sum of RX_worktime_ms of the set.	ms
t_h_interferencecorrect_n	Interference score	n
s1_consecutive_correct_n_A	Consecutive correct answer given with this criteria	n
s1_consecutive_correct_n_C	Consecutive correct answer given with this criteria	n
s2_consecutive_correct_n_A	Consecutive correct answer given with this criteria	n
s2_consecutive_correct_n_C	Consecutive correct answer given with this criteria	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 four 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 Aquarium test have shown will be explained.

Description of the sample:

The objective of the normative study of Nesplora Ice Cream 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 394 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):
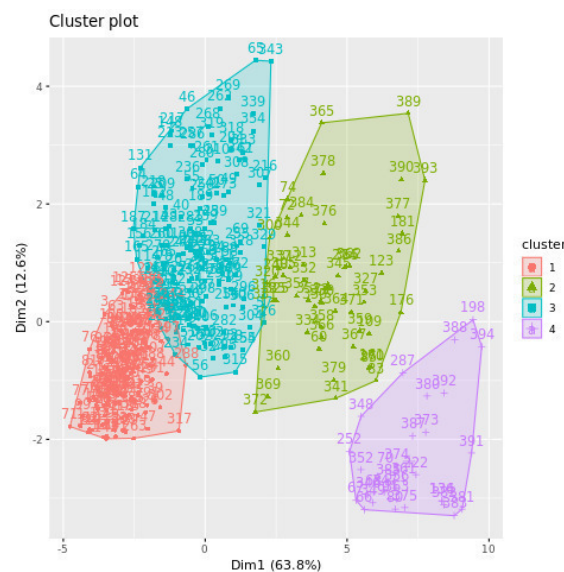
According to cluster analisis, 4 different age groups have been established: group 1 from 20 to 45 years old, group 2 from 46 to 60 years old, group 3 from 61 to 75 years old and group 4 from 76 to 80 years old. No gender differences have been found in these age groups.

The differences between age groups are analyzed for the total sample (n = 394) 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%) are highlighted with an asterisk. 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 = 394), 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, 4 age groups are obtained. The first age group ranges from 16 to 45 years, the second from 46 to 60 years, the third from 61 to 75 years and the fourth from 76 to 84.

The final sample of the first age group was 200 participants, 95 women and 105 men, aged between 16 and 45 years, with an average of 34.14 and a standard deviation of 6.76 years.

With regard to the second age group, the sample was 120 participants, 60 women and 60 men, aged between 45 and 60 years, with an average of 52.64 and a standard deviation of 4.41 years.

In the third age group, the sample consisted of 55 participants, 24 women and 31 men, with age between 61 to 74 years, with an average of 67.15 and a standard deviation of 3.90 years.

In the third age group, the sample consisted of 16 participants, 12 women and 4 men, with age between 75 to 84 years, with an average of 76.5 and a standard deviation of 1.71 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 ($\alpha < 0.05$), 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 27 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 = 394).
- Kruskal-Wallis test for the study of age differences.

<u>The results obtained ($\alpha < 0.05$) show:</u>

- 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.

5.2.3 Reliability study of the scales

The Nesplora Ice Cream 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 Ice Cream. 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 428 people and when our collaborators at the University of Oviedo finish passing us the sample will be surpassed in 34 people.

With these data, 4 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 tool Ice Cream, by the remote controller, 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 regulatory studies from other countries arrive a little later, that does not delay us in our marketing. In fact, in the first week of March, the Nesplora Ice Cream tool will be presented at the FANPSE congress in Madrid under the title: "Development of an ecological measure of functions through Virtual Reality. Pilot study".

ANNEX 1 – CHARACTERISTIC OF THE VARIABLES

Table 1: Homoscedasticity in variables of the complete sample

variable	BP	df	p_value
s1_h_correcttime_mean	15.70	3	<0.01
s1_h_rawscore_n	55.16	3	<0.01
s1_h_recipeopen_n	49.95	3	<0.01
s1_h_score_n	26.37	3	<0.01
s1_h_time_ms	47.89	3	<0.01
s1_totaltime_ms	1.88	3	0.01
s1_tu_time_ms	0.54	3	0.91
s1_tu_total_correct_n	3.82	3	0.28
s1_worktime_ms	21.07	3	<0.01
s2_h1_persepress_n	18.77	3	<0.01
s2_h2_persepress_n	0.53	3	0.91
s2_h3_persepress_n	8.78	3	0.03
s2_h4_persepress_n	18.55	3	<0.01
s2_h_correcttime_mean	23.48	3	<0.01
s2_h_rawscore_n	10.76	3	0.01

s2_h_recipeopen_n	60.43	3	<0.01
s2_h_score_n	5.02	3	0.17
s2_h_time_ms	20.01	3	<0.01
s2_totaltime_ms	2.74	3	0.43
s2_tu_time_ms	9.69	3	0.02
s2_tu_total_correct_n	5.23	3	0.16
s2_worktime_ms	8.31	3	0.04
t_h_interferencecorrect_n	13.52	3	<0.01
s1_consecutive_correct_n_A	26.64	3	<0.01
s1_consecutive_correct_n_C	10.43	3	0.02
s2_consecutive_correct_n_A	79.21	3	<0.01
s2_consecutive_correct_n_C	36.42	3	<0.01

Table 2: Normality in variables (Shapiro-Wilk) from 20 to 45 years old

variable	D	p.value
s1_h_correcttime_mean	0.187	0.000
s1_h_rawscore_n	0.266	0.000
s1_h_recipeopen_n	0.334	0.000
s1_h_score_n	0.257	0.000
s1_h_time_ms	0.168	0.000
s1_totaltime_ms	0.166	0.000
s1_tu_time_ms	0.248	0.000
s1_tu_total_correct_n	0.221	0.000
s1_worktime_ms	0.165	0.000
s2_h1_persepress_n	0.407	0.000
s2_h2_persepress_n	0.524	0.000
s2_h3_persepress_n	0.494	0.000
s2_h4_persepress_n	0.237	0.000
s2_h_correcttime_mean	0.151	0.000
s2_h_rawscore_n	0.176	0.000

s2_h_recipeopen_n	0.217	0.000
s2_h_score_n	0.143	0.000
s2_h_time_ms	0.129	0.000
s2_totaltime_ms	0.146	0.000
s2_tu_time_ms	0.192	0.000
s2_tu_total_correct_n	0.256	0.000
s2_worktime_ms	0.130	0.000
t_h_interferencecorrect_n	0.113	0.000
s1_consecutive_correct_n_A	0.220	0.000
s1_consecutive_correct_n_C	0.196	0.000
s2_consecutive_correct_n_A	0.083	0.002
s2_consecutive_correct_n_C	0.142	0.000

Table 3: Normality in variable**s (*Kolmogorov-Smirnov-Lilliefors*) f**rom 46 to 60 years old

variable	D	p.value
s1_h_correcttime_mean	0.20	0.00
s1_h_rawscore_n	0.23	0.00
s1_h_recipeopen_n	0.25	0.00

s1_h_score_n	0.16	0.00
s1_h_time_ms	0.16	0.00
s1_totaltime_ms	0.14	0.00
s1_tu_time_ms	0.26	0.00
s1_tu_total_correct_n	0.18	0.00
s1_worktime_ms	0.13	0.00
s2_h1_persepress_n	0.32	0.00
s2_h2_persepress_n	0.50	0.00
s2_h3_persepress_n	0.44	0.00
s2_h4_persepress_n	0.17	0.00
s2_h_correcttime_mean	0.10	0.01
s2_h_rawscore_n	0.13	0.00
s2_h_recipeopen_n	0.17	0.00
s2_h_score_n	0.08	0.06
s2_h_time_ms	0.10	0.01
s2_totaltime_ms	0.11	0.00
s2_tu_time_ms	0.14	0.00

s2_tu_total_correct_n	0.21	0.00
s2_worktime_ms	0.13	0.00
t_h_interferencecorrect_n	0.11	0.00
s1_consecutive_correct_n_A	0.12	0.00
s1_consecutive_correct_n_C	0.09	0.01
s2_consecutive_correct_n_A	0.15	0.00
s2_consecutive_correct_n_C	0.20	0.00

Table 4: Normality in variables (Kolmogorov-Smirnov-Lilliefors) from 61 to 74 years old

variable	D	p.value
s1_h_correcttime_mean	0.13	0.01
s1_h_rawscore_n	0.17	0.00
s1_h_recipeopen_n	0.15	0.00
s1_h_score_n	0.20	0.00
s1_h_time_ms	0.14	0.01
s1_totaltime_ms	0.09	0.28
s1_tu_time_ms	0.20	0.00
s1_tu_total_correct_n	0.22	0.00

s1_worktime_ms	0.09	0.27
s2_h1_persepress_n	0.31	0.00
s2_h2_persepress_n	0.48	0.00
s2_h3_persepress_n	0.47	0.00
s2_h4_persepress_n	0.25	0.00
s2_h_correcttime_mean	0.11	0.07
s2_h_rawscore_n	0.17	0.00
s2_h_recipeopen_n	0.18	0.00
s2_h_score_n	0.17	0.00
s2_h_time_ms	0.11	0.08
s2_totaltime_ms	0.07	0.70
s2_tu_time_ms	0.30	0.00
s2_tu_total_correct_n	0.24	0.00
s2_worktime_ms	0.08	0.44
t_h_interferencecorrect_n	0.23	0.00
s1_consecutive_correct_n_A	0.19	0.00
s1_consecutive_correct_n_C	0.22	0.00

| s2_consecutive_correct_n_A | 0.23 | 0.00 |
| s2_consecutive_correct_n_C | 0.27 | 0.00 |

Table 5: Normality in variables (Kolmogorov-Smirnov-Lilliefors) from 75 to 80 years old

variable	W	p.value
s1_h_correcttime_mean	0.954	0.552
s1_h_rawscore_n	0.954	0.562
s1_h_recipeopen_n	0.855	0.016
s1_h_score_n	0.624	0.000
s1_h_time_ms	0.959	0.642
s1_totaltime_ms	0.913	0.132
s1_tu_time_ms	0.746	0.001
s1_tu_total_correct_n	0.891	0.058
s1_worktime_ms	0.904	0.094
s2_h1_persepress_n	0.797	0.003
s2_h2_persepress_n	0.484	0.000
s2_h3_persepress_n	0.577	0.000

s2_h4_persepress_n	0.780	0.002
s2_h_correcttime_mean	0.937	0.319
s2_h_rawscore_n	0.890	0.055
s2_h_recipeopen_n	0.786	0.002
s2_h_score_n	0.806	0.003
s2_h_time_ms	0.959	0.651
s2_totaltime_ms	0.946	0.425
s2_tu_time_ms	0.768	0.001
s2_tu_total_correct_n	0.787	0.002
s2_worktime_ms	0.953	0.539
t_h_interferencecorrect_n	0.895	0.067
s1_consecutive_correct_n_A	0.705	0.000
s1_consecutive_correct_n_C	0.440	0.000
s2_consecutive_correct_n_A	0.794	0.002
s2_consecutive_correct_n_C	0.844	0.011

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.

	s1_h_correcttime_mean	s1_h_rawscore_n	s1_h_recipeopen_n	s1_h_score_n	s1_h_time_ms	s1_totaltime_ms	s1_worktime_ms	s2_h_correcttime_mean	s2_h_rawscore_n	s2_h_recipeopen_n	s2_h_score_n	s2_h_time_ms	s2_totaltime_ms	s2_worktime_ms	s1_consecutive_correct_n_A	s1_consecutive_correct_n_C	s2_consecutive_correct_n_A	s2_consecutive_correct_n_C
1	-0,62	0,57	-0,57	0,73	-0,69	-0,73	-0,73	-0,73	0,56	-0,63	0,97	-0,73	-0,77	-0,78	-0,57	0,87	-0,07	0,97
2	1,03	-0,6	1,08	-1,18	1,21	1,31	1,29	1,26	-0,02	1,03	-0,97	1,25	1,29	1,30	0,92	-1,05	0,66	-0,74
3	-0,23	-0,15	-0,32	0,14	-0,21	-0,15	-0,14	-0,11	-0,65	-0,21	-0,24	-0,12	-0,06	-0,05	0,46	-0,14	0,42	-0,48
4	2,25	-0,80	2,31	-2,08	2,13	1,86	1,90	1,8	0,39	2,16	-1,73	1,86	1,64	1,68	-1,02	-1,58	-2,75	-1,05

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

variable	chi_squared	df	p_value
s1_h_correcttime_mean	126.888	3	0.000
s1_h_rawscore_n	99.509	3	0.000
s1_h_recipeopen_n	82.682	3	0.000
s1_h_score_n	134.309	3	0.000
s1_h_time_ms	140.820	3	0.000
s1_totaltime_ms	130.166	3	0.000
s1_tu_time_ms	73.748	3	0.000
s1_tu_total_correct_n	67.568	3	0.000

s1_worktime_ms	133.603	3	0.000
s2_h1_persepress_n	13.749	3	0.003
s2_h2_persepress_n	9.132	3	0.028
s2_h3_persepress_n	3.556	3	0.314
s2_h4_persepress_n	19.870	3	0.000
s2_h_correcttime_mean	78.872	3	0.000
s2_h_rawscore_n	24.413	3	0.000
s2_h_recipeopen_n	47.011	3	0.000
s2_h_score_n	114.393	3	0.000
s2_h_time_ms	86.044	3	0.000
s2_totaltime_ms	111.706	3	0.000
s2_tu_time_ms	94.507	3	0.000
s2_tu_total_correct_n	66.998	3	0.000
s2_worktime_ms	112.375	3	0.000
t_h_interferencecorrect_n	44.595	3	0.000
s1_consecutive_correct_n_A	13.229	3	0.004
s1_consecutive_correct_n_C	135.054	3	0.000

s2_consecutive_correct_n_A	6.986	3	0.072
s2_consecutive_correct_n_C	106.268	3	0.000

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	N of items	Sample Size
s1_h_correcttime_mean	10161.545	37433777.424	6118.315	0.874	2	394
s1_h_rawscore_n	24.315	26.084	5.107	0.637	2	394
s1_h_recipeopen_n	5.287	69.080	8.311	0.930	2	394
s1_h_score_n	19.822	88.615	9.414	0.871	2	394
s1_h_time_ms	280560.726	21370073176.937	146185.065	0.910	2	394
s1_totaltime_ms	608715.256	56220848046.563	237109.359	0.907	2	394
s1_worktime_ms	466097.409	49302894871.153	222042.552	0.904	2	394
s2_h_correcttime_mean	11096.111	22255019.481	4717.523	0.874	2	394
s2_h_rawscore_n	21.954	34.110	5.840	0.637	2	394
s2_h_recipeopen_n	7.827	80.245	8.958	0.930	2	394
s2_h_score_n	15.008	74.888	8.654	0.871	2	394
s2_h_time_ms	313984.990	16098808659.588	126881.081	0.910	2	394
s2_totaltime_ms	595303.528	31100402658.504	176353.063	0.907	2	394
s2_worktime_ms	458577.530	27553043721.130	165991.095	0.904	2	394

s1_consecutive_correct_n_A	7.749	58.988	7.680	0.504	2	394
s1_consecutive_correct_n_C	16.170	103.989	10.197	0.765	2	394
s2_consecutive_correct_n_A	38.906	198.630	14.094	0.504	2	394
s2_consecutive_correct_n_C	8.769	68.997	8.306	0.765	2	394

Table 2: Statistical analysis of the scales for sample from 20 to 45 years old.

Variable	Average	Variance	Standard deviation	Cronbach Alpha	N of items	Sample Size
s1_h_correcttime_mean	7579.480	11376216.139	3372.865	0.852	2	200
s1_h_rawscore_n	26245	7.854	2.803	0.598	2	200
s1_h_recipeopen_n	2.090	18.786	4.334	0.846	2	200
s1_h_score_n	24365	30.936	5.562	0.774	2	200
s1_h_time_ms	211397.210	6916771957.503	83167.133	0.855	2	200
s1_totaltime_ms	503734935	29677405480.162	172271.314	0.894	2	200
s1_tu_time_ms	56624.750	2658737230.389	51562.944	0.430	2	200
s1_tu_total_correct_n	4.820	4.058	2.014	0.864	2	200

s1_worktime_ms	364755.370	23782178815.360	154214.717	0.880	2	200
s2_h1_persepress_n	0.480	0.733	0.856	is not necessary	1	200
s2_h2_persepress_n	0.120	0.257	0.507	is not necessary	1	200
s2_h3_persepress_n	195	0.198	0.445	is not necessary	1	200
s2_h4_persepress_n	1.050	1.595	1.263	is not necessary	1	200
s2_h_correcttime_mean	9175.752	11885167.694	3447.487	0.852	2	200
s2_h_rawscore_n	23305	24.655	4.965	0.598	2	200
s2_h_recipeopen_n	4555	32.741	5.722	0.846	2	200
s2_h_score_n	19225	47.341	6.880	0.774	2	200
s2_h_time_ms	262414.750	8684375767.153	93189.998	0.855	2	200
s2_totaltime_ms	521746055	21063204638.052	145131.680	0.894	2	200
s2_tu_time_ms	35386135	428388096.449	20697.538	0.430	2	200
s2_tu_total_correct_n	5115	5.409	2.326	0.864	2	200
s2_worktime_ms	386838.640	17304693313.478	131547.304	0.880	2	200
t_h_interferencecorrect_n	-4235	8.020	2.832	is not necessary	1	200

s1_consecutive_correct_n_A	6335	43.289	6.579	0.459	2	200
s1_consecutive_correct_n_C	21.290	61.473	7.840	0.687	2	200
s2_consecutive_correct_n_A	40.330	73.237	8.558	0.459	2	200
s2_consecutive_correct_n_C	12385	75.816	8.707	0.687	2	200

Table 3: Statistical analysis of the scales for sample from 46 to 60 years old.

Variable	Average	Variance	Standard deviation	Cronbach Alpha	N of items	Sample Size
s1_h_correcttime_mean	10614.171	36363205.169	6030.191	0.794	2	120
s1_h_rawscore_n	24.167	19.064	4.366	0.534	2	120
s1_h_recipeopen_n	5.608	69.249	8.322	0.901	2	120
s1_h_score_n	19.192	72.089	8.491	0.808	2	120
s1_h_time_ms	289784425	14429299494.616	120122.019	0.869	2	120
s1_totaltime_ms	616666.592	34558175651.521	185898.294	0.866	2	120
s1_tu_time_ms	63815.050	2292251376.149	47877.462	0.443	2	120
s1_tu_total_correct_n	4.217	5.028	2.242	0.878	2	120
s1_worktime_ms	472958.650	28228363485.776	168012.986	0.857	2	120
s2_h1_persepress_n	0.992	1.807	1.344	is not necessary	1	120

s2_h2_persepress_n	0.200	0.279	0.528	is not necessary	1	120
s2_h3_persepress_n	0.317	0.386	0.622	is not necessary	1	120
s2_h4_persepress_n	1.900	2.847	1.687	is not necessary	1	120
s2_h_correcttime_mean	11807.727	19244864.748	4386.897	0.794	2	120
s2_h_rawscore_n	20.500	33.630	5.799	0.534	2	120
s2_h_recipeopen_n	8.467	77.276	8.791	0.901	2	120
s2_h_score_n	12975	60.109	7.753	0.808	2	120
s2_h_time_ms	328440.408	13072841037.588	114336.525	0.869	2	120
s2_totaltime_ms	614748.133	22101910777.747	148667.114	0.866	2	120
s2_tu_time_ms	42406.700	262594084.413	16204.755	0.443	2	120
s2_tu_total_correct_n	4.133	6.957	2.638	0.878	2	120
s2_worktime_ms	476861.117	18566303758.743	136258.225	0.857	2	120
t_h_interferencecorrect_n	-4.750	11.029	3.321	is not necessary	1	120
s1_consecutive_correct_n_A	9.217	58.423	7.644	0.462	2	120
s1_consecutive_correct_n_C	14.483	84.806	9.209	0.652	2	120
s2_consecutive_correct_n_A	40.542	184.217	13.573	0.462	2	120

s2_consecutive_correct_n_C	6.300	41.069	6.409	0.652	2	120

Table 4: Statistical analysis of the scales for sample from 61 to 74 years old.

Variable	Average	Variance	Standard deviation	Cronbach Alpha	N of items	Sample Size
s1_h_correcttime_mean	16270.744	35233010.361	5935.740	0.877	2	55
s1_h_rawscore_n	20.800	31.681	5.629	0.678	2	55
s1_h_recipeopen_n	14.436	115.213	10.734	0.951	2	55
s1_h_score_n	8.891	80.618	8.979	0.798	2	55
s1_h_time_ms	439504.891	21333366305.877	146059.462	0.903	2	55
s1_totaltime_ms	849775.036	47402235321.628	217720.544	0.892	2	55
s1_tu_time_ms	85530.600	2229100439.689	47213.350	0.343	2	55
s1_tu_total_correct_n	2.109	3.803	1.950	0.895	2	55
s1_worktime_ms	699738.145	42496793404.090	206147.504	0.880	2	55
s2_h1_persepress_n	1.018	2.870	1.694	is not necessary	1	55
s2_h2_persepress_n	0.273	0.350	0.592	is not necessary	1	55
s2_h3_persepress_n	0.345	0.490	0.700	is not necessary	1	55

s2_h4_persepress_n	1.545	3.030	1.741	is not necessary	1	55
s2_h_correcttime_mean	15085.989	27320796.755	5226.930	0.877	2	55
s2_h_rawscore_n	20.655	51.897	7.204	0.678	2	55
s2_h_recipeopen_n	15.782	119.989	10.954	0.951	2	55
s2_h_score_n	6.691	48.032	6.931	0.798	2	55
s2_h_time_ms	420787.327	17896233905.113	133776.806	0.903	2	55
s2_totaltime_ms	752087.527	26124701657.291	161631.376	0.892	2	55
s2_tu_time_ms	64616.055	2953011171.053	54341.615	0.343	2	55
s2_tu_total_correct_n	2.091	5.269	2.296	0.895	2	55
s2_worktime_ms	610846.909	23989157030.529	154884.334	0.880	2	55
t_h_interferencecorrect_n	-2.091	14.640	3.826	is not necessary	1	55
s1_consecutive_correct_n_A	10.145	90.053	9.490	0.623	2	55
s1_consecutive_correct_n_C	4.945	42.682	6.533	0.669	2	55
s2_consecutive_correct_n_A	33.618	528.648	22.992	0.623	2	55
s2_consecutive_correct_n_C	2.873	17.632	4.199	0.669	2	55

Table 7: Statistical analysis of the scales for sample from 75 to 80 years old.

Variable	Average	Variance	Standard deviation	Cronbach Alpha	N of items	Sample Size
s1_h_correcttime_mean	18803.895	103960243.188	10196.090	0.836	2	16
s1_h_rawscore_n	12.813	75.763	8.704	0.762	2	16
s1_h_recipeopen_n	12.313	94.896	9.741	0.937	2	16
s1_h_score_n	4	55.200	7.430	0.792	2	16
s1_h_time_ms	548749875	40804922138.517	202002.283	0.907	2	16
s1_totaltime_ms	1059761.188	49891677036.163	223364.449	0.864	2	16
s1_tu_time_ms	115674.688	4525339245.163	67270.642	0.142	2	16
s1_tu_total_correct_n	1.688	2.096	1.448	0.744	2	16
s1_worktime_ms	906072.438	49237342236.529	221894.890	0.868	2	16
s2_h1_persepress_n	1375	2.650	1.628	is not necessary	1	16
s2_h2_persepress_n	0.188	0.163	0.403	is not necessary	1	16
s2_h3_persepress_n	375	0.517	0.719	is not necessary	1	16
s2_h4_persepress_n	1.938	6.063	2.462	is not necessary	1	16

s2_h_correcttime_mean	16666.224	27403031.683	5234.791	0.836	2	16
s2_h_rawscore_n	19.750	56.733	7.532	0.762	2	16
s2_h_recipeopen_n	17625	135.183	11.627	0.937	2	16
s2_h_score_n	4.563	29.463	5.428	0.792	2	16
s2_h_time_ms	497035125	22540662240.250	150135.480	0.907	2	16
s2_totaltime_ms	850863375	28519716917.317	168877.817	0.864	2	16
s2_tu_time_ms	62854.250	1153890564.200	33968.965	0.142	2	16
s2_tu_total_correct_n	1.188	2.163	1.471	0.744	2	16
s2_worktime_ms	715181625	29738503315.850	172448.553	0.868	2	16
t_h_interferencecorrect_n	0	8.667	2.944	is not necessary	1	16
s1_consecutive_correct_n_A	6.063	109.929	10.485	0.634	2	16
s1_consecutive_correct_n_C	2.563	41.196	6.418	0.390	2	16
s2_consecutive_correct_n_A	26.938	550.729	23.468	0.634	2	16
s2_consecutive_correct_n_C	1.688	3.296	1.815	0.390	2	16