Deliverable 4.4b

Field Trial Effectiveness and Performance Evaluation

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1 ABOUT THIS DOCUMENT

1.1 ROLE OF THE DELIVERABLE

This deliverable describes the information gathered from PETAL's first end-users while using the overall system and at the end of their experience during the second cycle of the field trial. A specific questionnaire was developed for both older adults and caregivers in order to collect their impressions at the end of the field trial; moreover the caregivers' personal feedback was collected monthly while the field trial were running. This document aims to analyse the effectiveness and performance of the PETAL system; furthermore a multidimensional evaluation was conducted at the end in order to detect the elderlies' behavioural and cognitive status.

1.2 STRUCTURE OF THIS DOCUMENT

After a brief description of the context where the field trials took place and a quick overview of the principal procedures followed, detailed analyses of the performance and effectiveness evaluation of PETAL will be presented. Finally, results on the possible effect on cognition, behaviour and caregiver burden will be presented.

1.3 TERMINOLOGY SPECIFICATION

In order to permit a clear and exhaustive understanding of our focus in a specific issue, the term "PETAL system" is used. With "PETAL system" we mean:

- the set of lights with changing intensity and colour
- the tablet which displays notifications and permits to play the Mementia Games
- the different sensors, in particular the smart-watch
- the "rule editor" that permits the definition of actions triggered by some events and/or conditions
- the automatic actions in form of notifications and changes in the lighting situation related to the defined rules.

2 BRIEF DESCRIPTION OF THE CONTEXT

PETAL was tested by eight elderlies suffering from Mild cognitive impairment (MCI) and their caregivers between June and October 2020; due to Covid-19 pandemic the start of the field trial was postponed in order to consent safe installation in elders' home. This second cycle of field trial was handled in Italy (Bolzano and Rome), Austria (Aldrans) and Romania (Bucharest). All participants completed the field test; only for the Italian partners two subjects were already involved in the first round of trial and accepted to participate in the second cycle.

Before using PETAL, a specific training about PETAL components (tablet, Mementia App, smart-watch, lights, Alexa, bed sensor and rule editor) was provided to all subjects; specifically for Roman trials, only Petal 1 has been provided of a bed sensor since the site was equipped with only one device and differently to Petal 2, she lived alone and had sleep disorders (early and late insomnia). In order to obtain monthly information about PETAL performances from the users point of view, a specific document was generated. Caregivers were asked to regularly monitor the operation of PETAL system and record their experience with the system in the "Routine control check list and diary". At the end of the test period, each partner involved in the field trial administered the "Field Trial Effectiveness Questionnaire" both to elders and caregivers involved. The following paragraphs describe not only the procedures applied in the construction of these tools but also the results obtained from the analysis of the data this second cycle of field trial.

3 PERFORMANCE EVALUATION

3.1 ROUTINE CONTROL CHECK LIST AND DIARY FOR THE CAREGIVER

In order to evaluate the PETAL system performance and end-users progress in the use of the devices, the “Routine control check list and diary” was developed by APOLLIS with partners’ contribution. It was translated in German, Italian and Romanian language and distributed at each of the locations where the partners involved in this phase carried out the field trials. The first part of the document consists in a routine control check list, in order to maximize the use of the devices in the correct way, with particular attention on what to control (if the tablet is charged, if the elderly wears the watch and it is charged, if the lighting system works). Contact persons and addresses for technical issues were inserted in the first page of the document. The second part of the document contains boxes for each week in which caregivers could report on important events that could have a significant impact on the well being, performance or health of the elderly person. The third part concerns the Rule Editor, its use and the definition of new rules or the changes to existing ones. For a complete version of the diary and for reference to the role of each partner in the co-creation phase, please refer to Deliverable D.4.4a.
Finally, at the end of each month, caregivers were asked to express their opinion on a scale from 0 (very bad) to 10 (Very good) regarding the general functioning of the Petal system in its entirety.

3.2 ROUTINE CONTROL CHECK LIST AND DIARY ANALYSES

3.2.1 ANA

Both senior involved in ANA field trial had not a formal or informal caregiver. Unfortunately, they did not have a relative or a healthcare professional who could be defined as their caregiver. However, the consortium decided to test these users in the field trial both because they had mild cognitive difficulties and to understand if the elderly without a caregiver could easily accept the system. The second round of field trial at ANA1’s home started with some complications: firstly the elder encountered some issues with Kwido Mementia application (e.g. troubles logging in or errors submitting the results), during the installation the smart

watch stopped to work and the Great Luminaire was not triggered by the rules created. About the new devices added in this second round, sometimes the elder did not understand the Alexa messages and the bed sensors did not work as expected. About ANA2, a 73 years old woman, the field trial started with issues with the smartwatch, in particular it stopped working during the in site test phase, just prior to the installation. Ordering another watch was not an option due to fund allocation and delayed shipping availability so was installed the proximity delegate on her smartphone as she is used to carrying it around.

In summary the issues were similar to ANA1, in particular difficulties to access Kwido Mementia, a few times the GREAT Luminaire was suddenly turning on without any rules being active at that particular moment (also during her absence for three weeks for holidays). After the first weeks, the Kwido app raised some issues when attempting to connect which were immediately resolved. Occasionally the app malfunction has been encountered, varying from troubles logging in to errors submitting the results.

As a general feedback, the seniors expressed the opinion that a more manual approach of devices would suit them best for the basic actions such as turning on and off the lighting to be automatic.

3.2.2 APOLLIS

Both participants of the Apollis field trials live in Egna (Italy, province of Bolzano) in two protected apartments managed by the Griesfeld Foundation, which is a public organisation for the care and nursing of elderly, based in Egna. The elderly APO1 also participated in the first phase of the field trials of Petal and gave his consent to continue testing the system also in this second phase. APO1 is an 82 years old gentleman who suffers from MCI. He lives alone in a small apartment, has no relatives living nearby but is visited daily by a caregiver of the Griesfeld Foundation. His main caregiver who followed Petal was a professional nurse very interested in the project and very collaborative. In the months between May and July he was hospitalized for an operation and for complications that occurred after the operation. For this reason the field trial had to be postponed and started a little late compared to the others. Despite this, the participant really appreciated the lighting, especially the Great luminaire. Since he has this lighting he reads a lot more according to his statements because he can see better both during the day (since the apartment was quite dark before) and at night. He has done the Mementia exercises quite regularly and his assessment is very positive. The gentleman wore the smart watch every

day, although he complained about the short battery life. He also rated Alexa's voice messages positively and occasionally used Alexa's extra features to ask for the weather forecast or to listen to the news of the day.

In general, the caregiver evaluated the functionality of the Petal system with an overall average score of 8.3/10. The elder was very happy to participate in the project and since he wanted to keep some of the devices after the trial, Apollis signed a "free rental contract" with him for all the lighting including the Great lamp and the smart-watch. This illustrates how much the elderly person has enjoyed the new devices installed.

APO2 is an 84 years old woman who lives alone in a small sunny flat. APO2's daughter, who is also the main caregiver, convinced her mother to participate in the project to stimulate her into something new. The daughter was cooperative but she was very busy with work.

In terms of health status, in the summer APO2 did several specialist examinations at a memory clinic and was diagnosed with the onset of Alzheimer's disease. Although APO2 lives in an apartment by herself, she is no longer able to prepare her own meals and so she goes to the canteen of the retirement home or her daughters house almost every day to eat there. She also receives assistance with household cleaning and personal hygiene. However, in her opinion she did not rely on any kind of help or support, she just needed her children to visit her often to spend some time with her. About Petal, she appreciated the new light in general, in particular the automatic switching on of some lights but unfortunately she found it difficult to use the switch to turn on/off the Great luminaire. Furthermore the lady had problems to learn how to use the tablet to play cognitive games, because it was difficult for her to use the touchscreen correctly. After several attempts she got used to it a little bit but nevertheless did the exercises only in the presence of the caregiver, never alone by herself. In addition, in these months of field trial the elder APO2 and the caregiver spent several weeks of vacation so the trial was interrupted more than once. The aspects mentioned, including several vacation trips (with groups of elderly people and with her children) that have interrupted the trial several times but also the deterioration of the lady's short-term memory in recent months have affected the conduct of the trial in the field test and its evaluation by the assistant. The caregiver evaluated the functionality of the system with an average of 5/10.

3.2.3 BARTENBACH

Both patients in Austria live in the vicinity of the Bartenbach office. BART1 lives in Lans, BART2 in Sistrans. The formal caregiver for both is the Sozialsprengel Aldrans, which is a local public care organisation helping elderly people in their homes in all aspects of life (housekeeping, medications, appointments…). BART1 is an 81-years-old woman living with her husband, who was included as an informal caregiver. She suffers from MCI and heart problems as well as diabetes. In the trial, she had problems with using the tablet, because the touchscreen was difficult to use the correct way for her. Despite multiple training sessions, these problems persisted. Also, she did not really understand the usefulness of wearing the smart-watch and often forgot to charge it or wear it. Her husband tried to remind her and convince her to use it, but often she did not want it. She also felt that the reminders are not really necessary, because her husband is always there and reminds her to take the medication. On the positive side, she liked the automatic lighting at night on the way to the bathroom very much.

During the duration of the trial, the patient was hospitalized multiple times for different reasons. During the last 3 weeks of the trial, the patient was also in the hospital. The caregiver rated the PETAL system on an average of 5.4. A possible explanation for the relatively low ratings is that the patient did not really see the usefulness and helpfulness of the system (with an exception for the automatic light at night), although the ratings seemed to improve over the course of the trial. Of course, also the hospitalizations may play a role in the ratings.

BART2 is a 78-year-old man living with his wife, who was included as an informal caregiver. He suffers from MCI, heart problems and sleep problems. In the trial, he liked most the automatic light at night, especially since the previous lighting in the corridor was very bad and did not work correctly. He did not like the smart-watch at all, he felt it was too heavy and clunky and also could not see the usefulness of it. His wife often had to convince him to wear it. While he liked the Mementia games, he often had difficulties understanding the instructions and using the touchscreen. His wife could not help him there (the touchscreen was difficult for her to use as well), so it was agreed to have their grandchildren do the exercises with him. Due to COVID-19 restrictions, the grandchildren could not visit the patient very often, so he did not do the exercises very often in the end.

During the trial, the patient was never hospitalized and only was sick once for a few days in October. Besides that, no other major events were reported. The caregiver rated the PETAL

system with an average of 7.8. The ratings seemed enthusiastic at first (especially because of the lighting), but gradually got more towards an average rating over the course of the trial. Possible explanations might be frustration with having to wear the smart-watch, since his wife had to remind and convince him almost every day; or getting accustomed to the system and not seeing it as something special any more. In the end, the rating got back up to a very good value.

3.2.4 FSL

Two MCI patients in care at Santa Lucia Foundation and their caregivers were involved in the second round of the field trial. About FSL1, an 80 years old woman widow who lives alone and very far from her caregivers, she was involved also in the first round of trial. The report of issues starts with difficulties in the usage of tablet, in particular how to play games and control lights and sensors. FSL team organised a second training session in order to refresh the use of the different components and permit a better understanding of the system. After this session, a small manual was drawn up together with the lady, in order to have a small-simplified guide about the use of the devices. Week after week, an improvement in the elder's skills was highlighted in the document. As in the first round of trial, was still present a specific and personal use of coloured lights was still present. Moreover Alexa, a new installation of this second cycle, was gladly welcomed as a good company and a useful tool for not forgetting things (e.g. to pay the bills, to go to the doctors). The initial judgement of PETAL system in its entirety starts with a monthly score of 6/10 determined, probably, by the difficulty on remembering how to use the devices. During the second month the score was 8/10, probably determined by the fact that all the devices worked well and the lady was really enthusiastic about Alexa. In general, based on monthly evaluation the system obtained an overall average score of 7.5/10; therefore the experience with PETAL system is positive.

About FSL2, she is a 75 years old woman who lives with her husband in a big flat in the south of Rome. She decided to participate in the project on the advice of her psychiatrist. Her husband was really collaborative during the whole duration of the project and supported her on using the devices. The trial started with issues with the luminaire and the sensors; this made a second appointment with the FSL team necessary to solve the inconvenience; for this reason the start evaluation was about 5/10. Once the problems were solved, the

ratings improved, with the highest value of 8/10; in general the Petal system obtained an average global score of 6/10. Unfortunately the lady was diagnosed with cancer; this news had a serious impact on her emotional state and consequently on the frequency with which she used the devices. However she completed the field trial, trying to do her best.

GENERAL CONSIDERATION

As a general consideration, what emerges from the informal diaries is that in some cases there were more difficulties during the installation of the devices or their usability compared to other users who used all the system without problems. Moreover, where the System was not fully understood it was rated negatively and not accepted.

Furthermore, it seems that the caregivers play an important role in terms of success of the project. In fact they help the elder to understand the System and use the devices constantly. In general, where there was a responsive and available caregiver the issues were less or more easily managed, affecting general satisfaction and adherence to the project.

4 FIELD TRIAL EFFECTIVENESS

4.1. THE FIELD TRIAL EFFECTIVENESS QUESTIONNAIRE

The survey, composed by 13 items, was conceived during the first round of trials in order to evaluate in its complex the effectiveness of the PETAL system. In particular the focus was centred on how the system had improved the end users' quality of life and in general in what manner they consider it recommendable to other elders. Please refer to Deliverable D4.4a for complete version of the survey.

At the end of this second round the questionnaire was implemented as suggested during the 2° Mid Term Review in Rome and formulated in two versions, one for elders and one for caregivers in order to collect the final impression from all the users involved.

As the previous version, after a brief introduction on the scope and what "PETAL System" means some socio-demographics are collected. In the seniors version the section two, comprehensive of seven questions, collects information about technological devices, attitude towards ICT and motivation to participate in the PETAL trial; the third section named "Evaluating the concepts/approach exploited in the PETAL system" collects the users' opinion in general terms, how they consider interesting and useful the possibility to personalize the behaviour of various devices; the fourth section inquiries the personal experience during the field trial with the system installed at home, it is composed by 22 statements (see Appendix 1 and 2 for a complete English version of the questionnaires).

The caregivers' version is similar to the elders' questionnaire, with additional questions about programming language knowledge and their opinion about how easily the PETAL system was accepted by the elders. Questions about the availability to purchase and the approximate cost for each device complete the questionnaire.

Both elders and caregivers were asked to express their level of agreement in a scale from 1 "strongly disagree" to 10 "strongly agree". The questionnaire was translated into the three languages of the partner countries.

4.2. QUALITY REPORT AND GLOBAL SCORE

The following paragraphs provide a detailed description of some aspects highlighted by PETAL end-users after the second round of field trial. The partners were able to gather information from all seniors and caregivers.

4.2.1 SENIORS

Regarding technological predisposition and its knowledge 38% feel a bit anxious, 37% need help and only 25% of the participants feel confident and autonomous as shown in Figure 1.

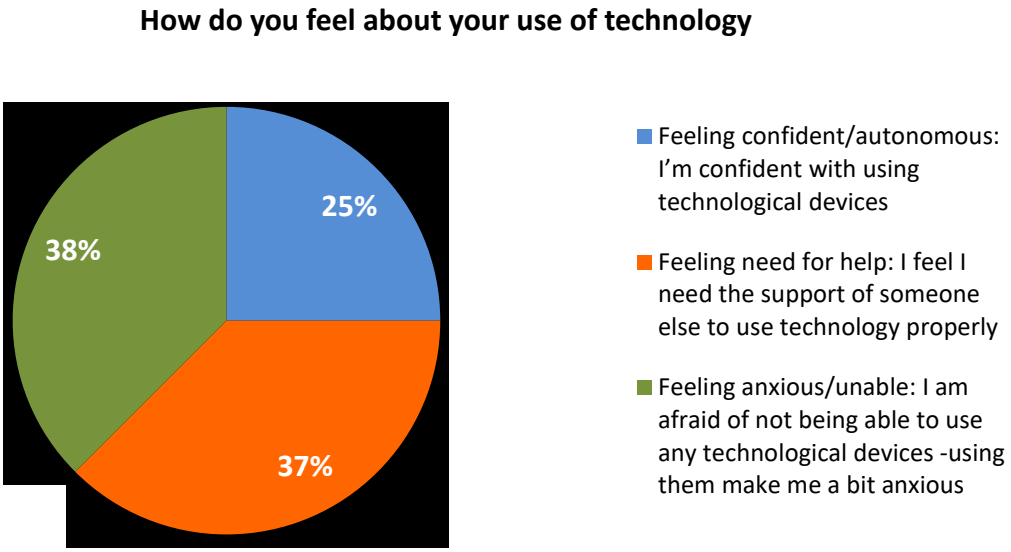

Figure 1. Ability on technology usage.

The 50% of seniors define themselves inclined to use new technologies (12% very much, 25% some what and 13% a little, see Figure 2).

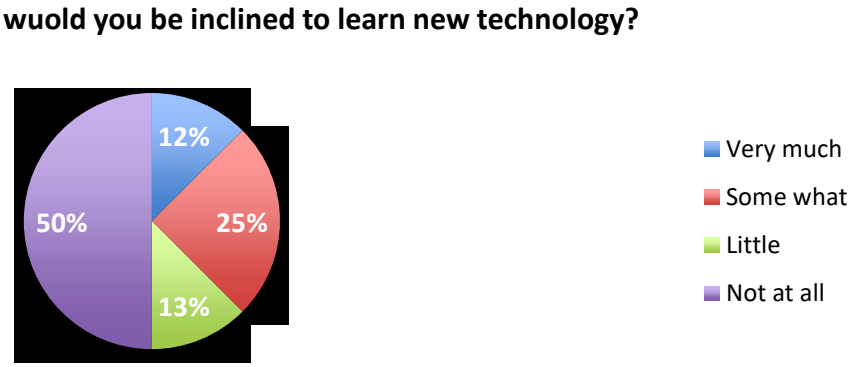

Figure 2. Personal inclination to learn new technologies.

Moreover, what motivate them to learn new technologies and in consequence to adhere to the project is for the 50% to improve their life, while 12% want to learn something new and for 13% it is only curiosity (Figure 3).

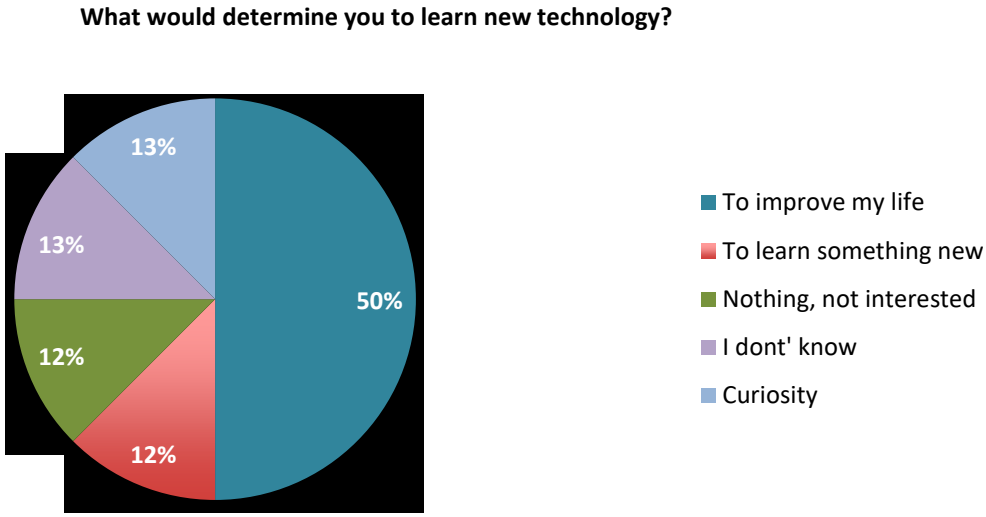

Figure 3. Motivation to learn new technologies.

As a general overview all the primary end users appreciated the PETAL system approach, conceived as a rule-based concept in order to personalize the behaviour of various devices (reminders, automatic light changes and notifications). In section 3 (see Appendix 1) each elder expressed his agreement with PETAL from 1 “strongly disagree” to 10 “strongly agree”; the ratio between the total score of all answers of this section and the maximum score feasible has been transformed into a percentage (Figure 4). On average the concept was evaluated positively by 63% (mean of percentages of each elder).

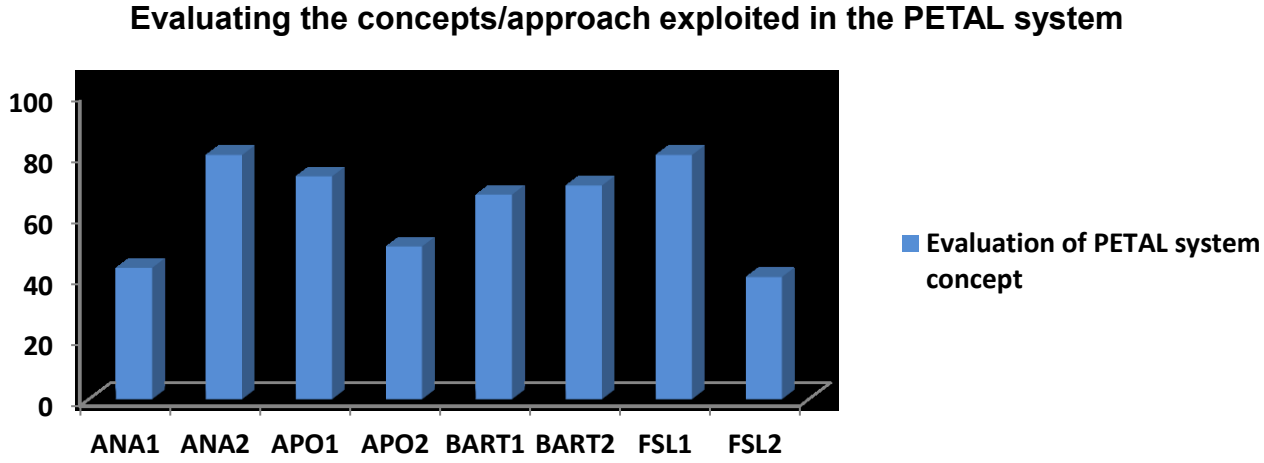

Figure 4. Evaluation of PETAL system concept

The fourth section of the questionnaire was about their personal experience with PETAL system. As for previous section, each elder expressed his agreement from 1 “strongly disagree” to 10 “strongly agree”; the ratio between the total score of all answers of this section and the maximum score feasible has been transformed into a percentage. APO2 was excluded due to the low number of answers.

Figure 5 shows the evaluation of lighting system based on answers to the following items (Q3: “I like the new lights in my home: the colours, the brightness and the possibility to adapt to special needs and daytime”; Q4: “The lights of the PETAL system are very useful for reading or for other tasks where I need to see well”; Q13: “The lighting system helps me relax more”; Q14: “The lighting system helps me sleep better”; Q15: “The lighting system helps me fall asleep faster”; Q16: “I feel less disoriented at night with the lighting system”; Q17: “The light strips help guiding me to the toilet at night”; Q18: “The coloured lights make me feel more comfortable at home”). In particular BART1, BART2 and FSL1 appreciated the lighting system more than the others and on average 59% of elders was satisfied by the lighting system installed in their homes.

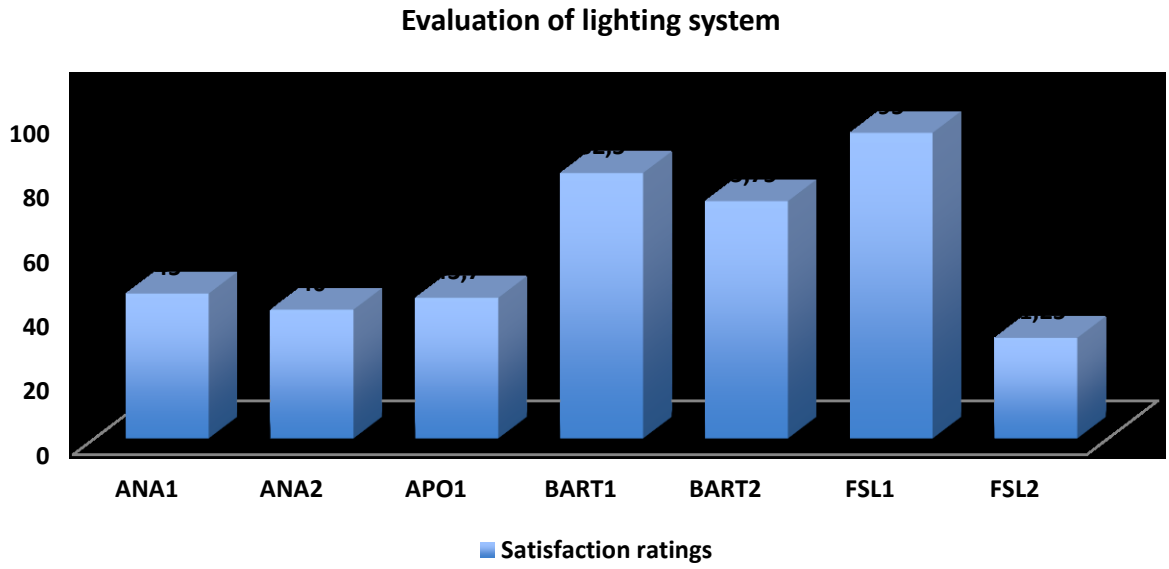

Figure 5. Evaluation of lighting system

The answers to items 5 and 6 (“I like playing the Mementia Games” and “I think that playing the Mementia Games helps me to stay mentally active”) are described in Figure 6. In

particular APO1 and FSL1 have appreciated more than the others the Kwido games, respectively at 75% and 90% and in general all the users satisfaction was on average 47%.

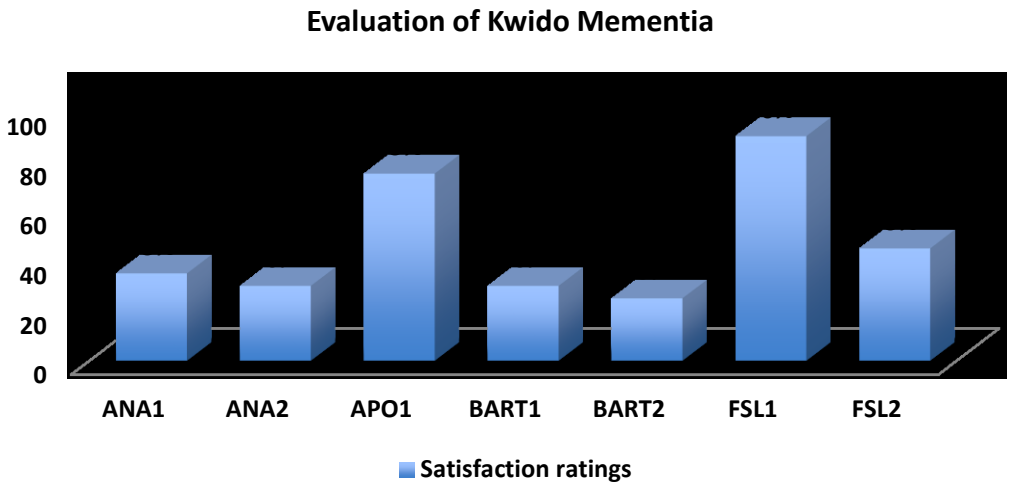

Figure 6. Evaluation of lighting system

Finally the elderlies' degree of satisfaction regarding their whole experience with PETAL is described in Figure 7. FSL1 was the most satisfied (87%); this is in line with her agreement with the PETAL system concept and is only a confirmation of her motivation to be also involved in the second round of trial. For ANA1 and ANA2 there are discrepancies between the evaluation of the system and their personal experience; despite the fact that they understand the concept and the concrete possibility to enhance their life quality through it, the objective difficulties encountered during the field trial made them less satisfied with respect to their expectations. However in open questions they define their experience globally positive, especially for automatic light. In general the elderlies' personal experience during the field trial was on average 47%.

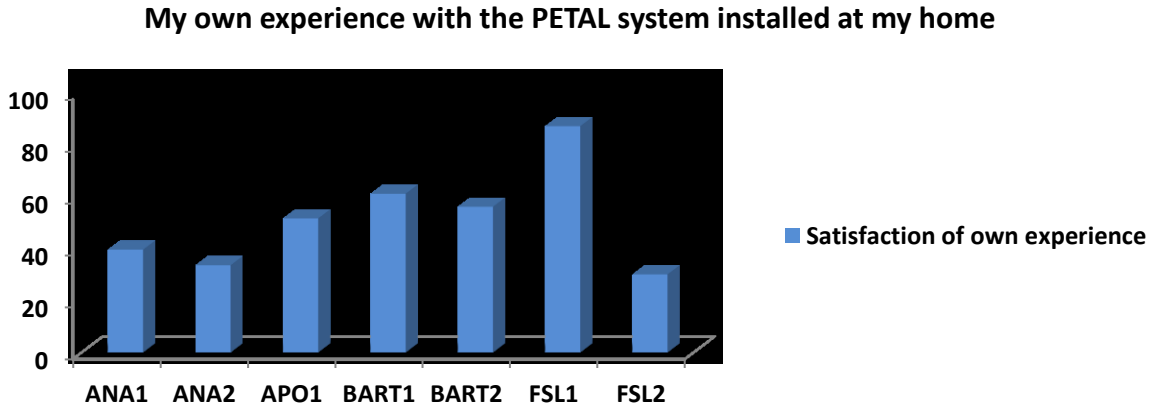

Figure 7. Evaluation of personal experience with PETAL

4.2.2 CAREGIVERS

As described in the introduction of this paragraph caregivers' version of survey was similar to the elders' questionnaire, with additional questions about programming language knowledge, about their opinion elderlies' experiences, purchase availability and hypothetic costs for devices (Appendix 2).

Regarding their general competence to use technological devices, 50% of the caregivers feel very comfortable with it while 37% express the need to improve on this; the remaining 13% are not interested at all. In general a total of 87% of caregivers have a good knowledge and ability to use technological devices (Figure 8).

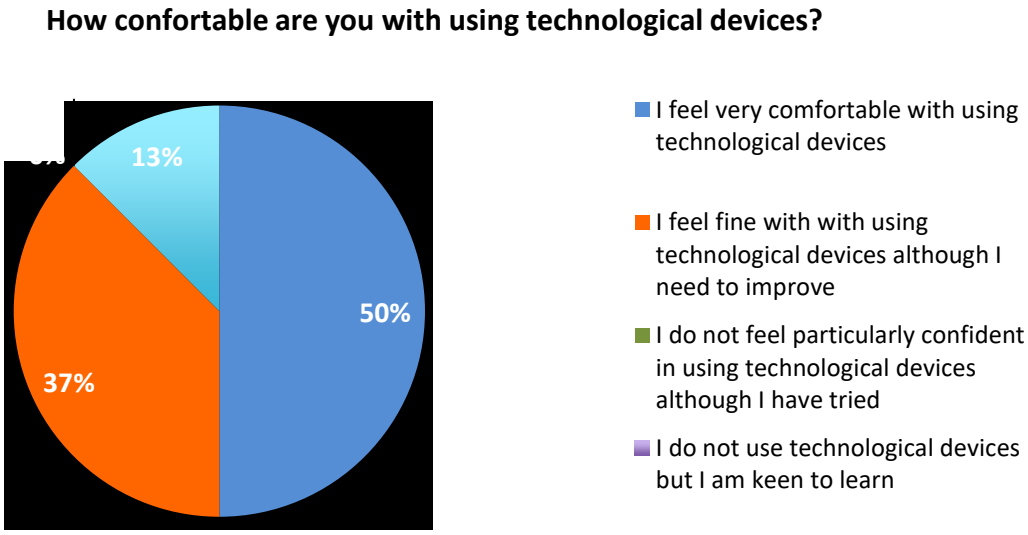

Figure 8. Ability with technological devices

Looking at the caregivers' motivation we can see that 87% decided to participate in the PETAL trial in order to improve seniors' life; for 13% the principal motivation was improving their own life (Figure 9).

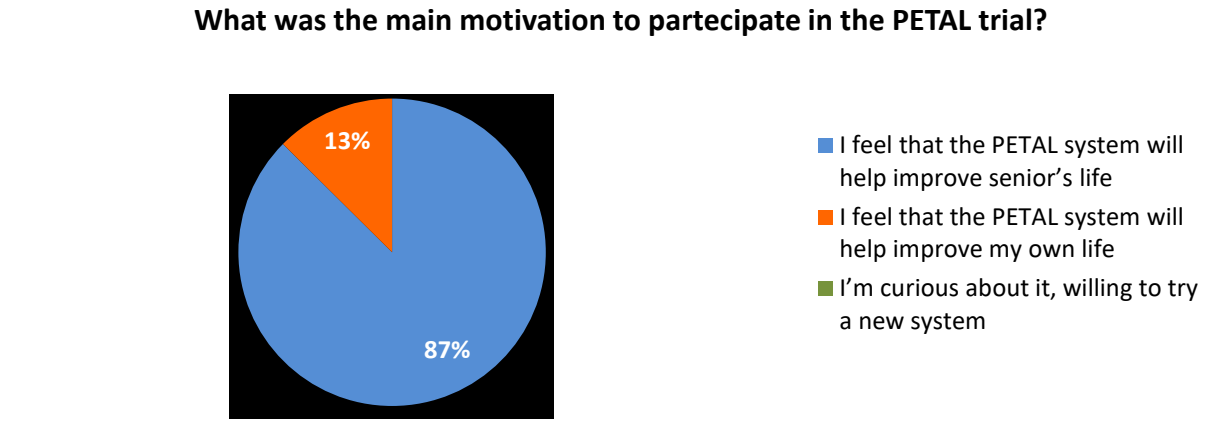

Figure 9. Motivation on being involved in PETAL trials

Figure 10 shows the percentage of evaluation for each partner (except for ANA trial due to the lack of a formal/informal caregiver). In the same ways as elderlies' data, the ratio between the total score of all answers of this section and the maximum score feasible has been transformed into a percentage. All the secondary end users appreciated the PETAL system approach, with an average of 83% (mean of percentage of each caregiver).

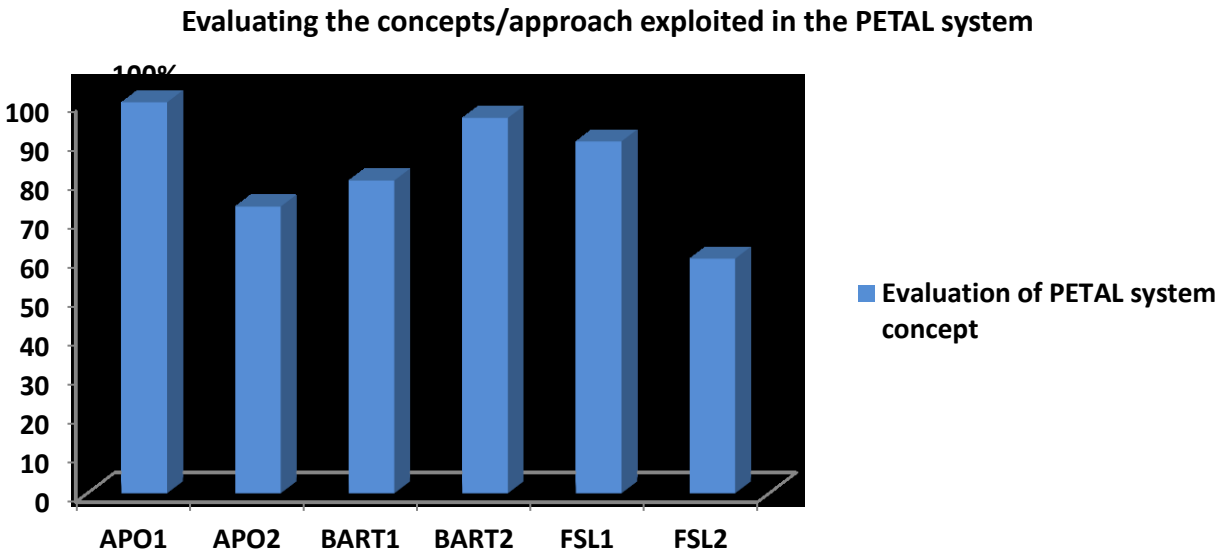

Figure 10. Evaluation of PETAL system concept

Finally about their satisfaction on how field trials went at seniors' home, the data are not in accordance with what emerged from elderlies' questionnaires; in particular primary users feel more satisfied respect to secondary users. An example for this is represented by FSL1, who was more satisfied then her caregiver. The difficulties encountered by the lady affected

the caregiver's opinion, while for the lady, being safe and reassured by the system have acquired a greater weight than the objective difficulties, principally caused by her cognitive deterioration (Figure 11).

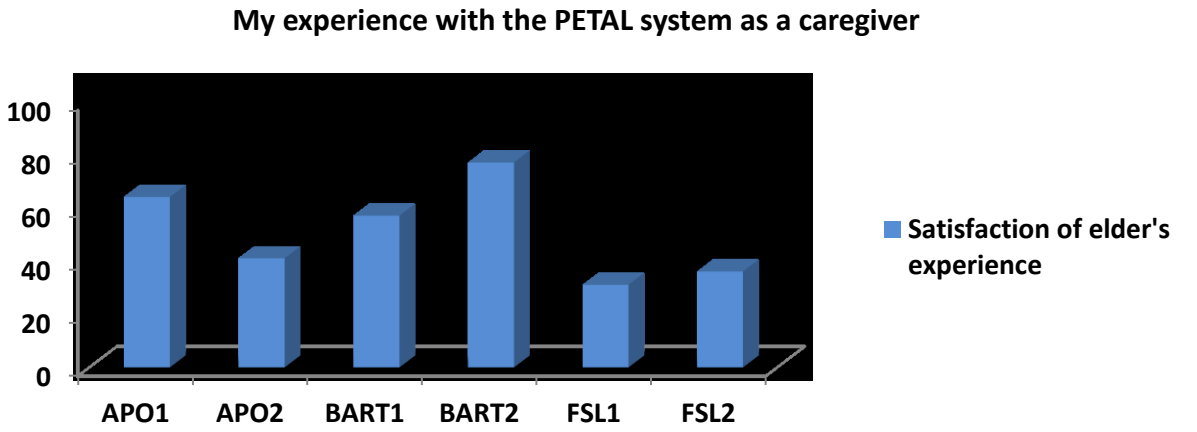

Figure 11. Evaluation of elders' personal experience with PETAL*

* The ratio between the total score of all answers of this section and the maximum score feasible has been transformed into a percentage

The last consideration concerns how much caregivers would be willing to spend to be supported by a system of this type in their lives: 66.7% are willing to pay an amount ranging from 25 to 50 euros per month (Figure 12).

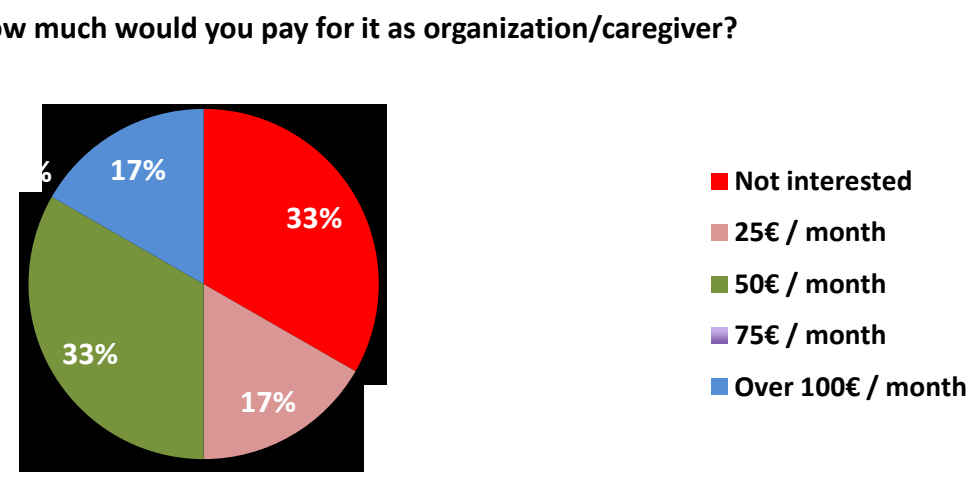

Figure 12. Estimated cost for Petal system purchase

GENERAL CONSIDERATION

In general, primary and secondary users are satisfied with the field test. The system approach was understood and welcomed by all the participants, considering it an opportunity to improve their lives. Far more than half of the caregivers would be willing to pay as a subscription for using the system in elderlies' homes.

5 FIELD TRIAL IMPACT ON PRIMARY END USERS

5.1. COGNITIVE PICTURES BEFORE AND AFTER PETAL SYSTEM USAGE

Despite the objective difficulties of these second field trials caused by the COVID-19 pandemic, it was possible to carry out the evaluations at the beginning and at the end in agreement with the field trial plan. MCI participants have undergone a neurocognitive assessment in order to evaluate the possible effects that the usage of PETAL could have in specific functional areas more sensitive to aging and correlated to dementia risk. The evaluation lasted approximately an hour and a half and involved the administration of cognitive tests, psychopathological scales and questionnaires to the elderly and caregivers.

5.1.1 COGNITIVE ASSESSMENT

The cognitive evaluations were performed at the beginning of the field trials, approximately between the end of February and the beginning of March (for Italian partners before the national lockdown), while the final evaluations were conducted between the end of October and the middle of November. For the complete description of the multidimensional battery please refer to Deliverable D4.2a. Raw scores, instead of normative ones, were taken into account for the analysis both to address differences between countries and because the aim was to record a possible change.

Table 1 summarizes the subjects' general information regarding socio-demographics variables, global cognitive level (MMSE)[1] and basic and instrumental activities of daily living (BADL and IADL).[2,3]

Table 1. Subjects' general information at baseline

Subject	Age	Gender	Education level (years)	Marital status	MMSE	BADL	IADL
ANA1	89	M	13	married	27	6/6	5/5
ANA2	73	F	13	widow	28	6/6	7/8
APO1	81	M	10	divorced	26	6/6	5/5
APO2	83	F	8	widow	22	3/6	4/8
BART1	83	F	8	married	21	5/6	1/8
BART2	78	M	8	married	26	3/6	4/5
FSL1	80	F	13	widow	28	6/6	7/8
FSL2	75	F	13	married	29	6/6	8/8

For a more detailed assessment of the individual cognitive domains was used a battery of tests specifically designed for the diagnosis of subjects with a dementia syndrome, the Mental Deterioration Battery (MDB).[4] In particular the following tests were administered to MCIs: Rey Auditory Verbal Learning Test with immediate and delayed recall for the evaluation of the short and long term episodic anterograde memory[5]; Copy of freehand drawings and Copy with programming elements to evaluate the simple constructional praxis and executive functions[6]; Raven's Progressive Coloured Matrices 47 for logical-deductive reasoning abilities[7]; Phonological Verbal Fluency and Semantic Verbal Fluency for language and executive functions.[8] In addition, the following test will be administered to all subjects: Wisconsin Card Sorting Test (WCST)[9] for the evaluation of the ability to elaborate abstract categories and the ability to change the category according to a modification of the contingent situation and Colour-word test or Stroop test used to evaluate the difficulty in suppressing an automatic response.[10]In Table 2 there is an overview of the elderlies' cognitive performances at baseline.

Table 2. Cognitive performances at baseline

Test	ANA1	ANA2	APO1	APO2	BART1	BART2	FSL1	FSL2
REY Verb I.R.	23	24	24	16	23	33	23	29
Rey Verb D.R	2	2	4	0	0	6	0	3
CD	10	12	8	9	3	6	10	10
CDP	62	65	49	65	13	62	65	65
RAVEN	23	24	23	21	19	30	30	24
Verbal Fluency	20	28	16	33	24	2	34	32
Semantic Fluency	15	16	16	15	14	11	19	11
Reaction time (RT)	37	39,6	41,6	43,6	40,6	48,3	38,3	40,3
Stroop errors (mean)	2	2	0	0	6	6	1	0
MWCST(n° cat)	5	6	6	6	4	5	6	6
MWCST PE	4	2	4	1	5	2	0	0
MWCST NPE	5	5	5	2	13	5	0	0

* Rey Verb I.R. (Rey Verbal auditory learning test Immediate Recall); Rey Verb D.R. (Rey Verbal auditory learning test Delayed Recall); CD (Copy of freehand drawing); CDP (copy with programming elements); Raven (Raven Attentive matrices); Verbal Fluency (Phonological verbal fluency; Semantic Fluency (Semantic verbal fluency); Reaction time (Average of reaction times in the three Stroop trials); MWCST n° cat (Modified Wisconsin Cart Sorting Test number of categories); MWCST PE (perseverative errors); MWCST (non perseverative errors)

5.1.2 RESULTS

A simple comparison was performed between 7 cognitive aspects (Memory, Attention, Executive Functions, Praxis, Language, Reaction time, and Reasoning). Firstly were obtained pre and post averages for each domain; then the difference was used to determine the number of points lost or gained at the end of field trial on each cognitive domain.

5.1.2.1 ANA

ANA1 as shown in Table 2 had problems in episodic memory and attention at baseline; at the end of field trial he had a better performance in most of cognitive domains, especially memory. Problems persist in attention and reaction time (Figure 13).

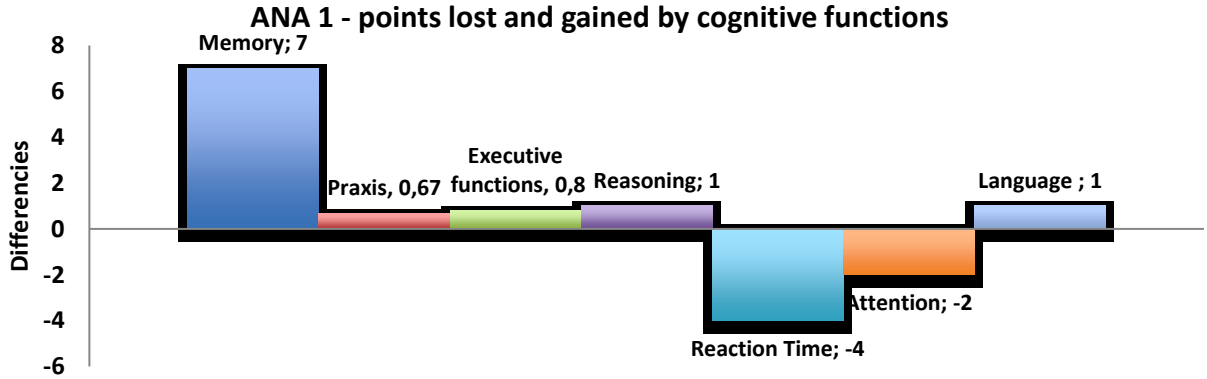

Figure 13. ANA1 – Overview on cognitive domains after trial

ANA2 at the beginning of the field trials had mild memory and attention problems. At the end of the field trial she showed an improvement especially in memory and mildly in executive functions and reasoning while there is a worsening in RT, attention and language (Figure 14).

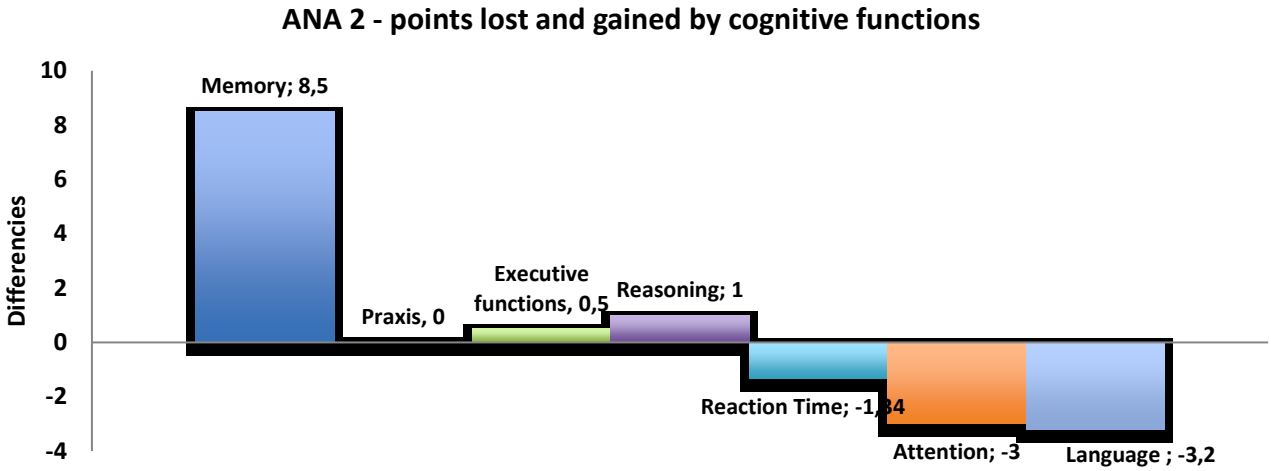

Figure 14. ANA2 – Overview on cognitive domains after trial

5.1.2.2 APOLLIS

APO1 showed a worse performance on memory, executive functions and attention. On the other side there was an improvement on praxis, RT and language (Figure 15).

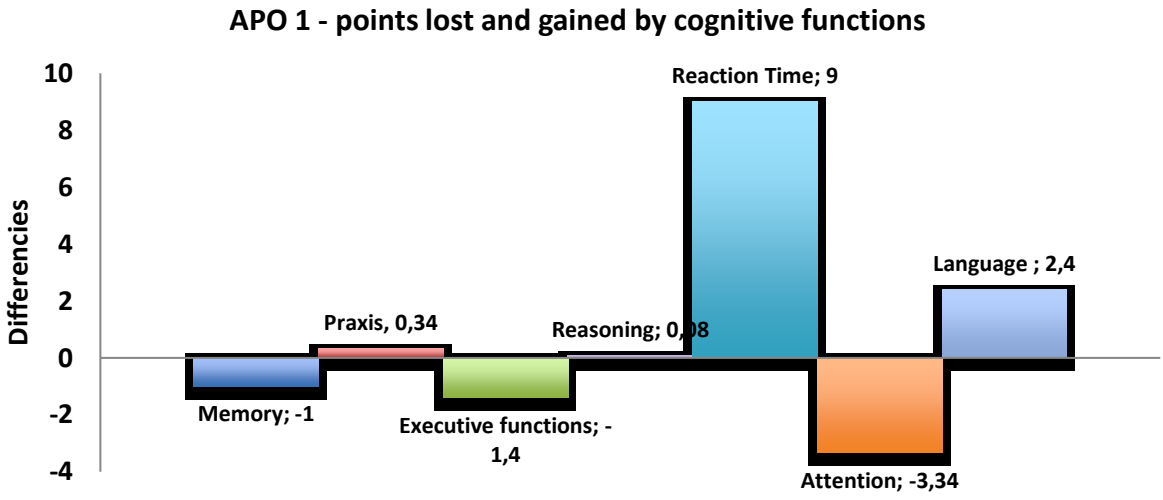

Figure 15. APO1 - Overview on cognitive domains after field trial

APO2 showed a worse score in memory, executive functions, reasoning, language, and RT. About praxis her performance remained stable and attention improved a little bit (Figure 16).

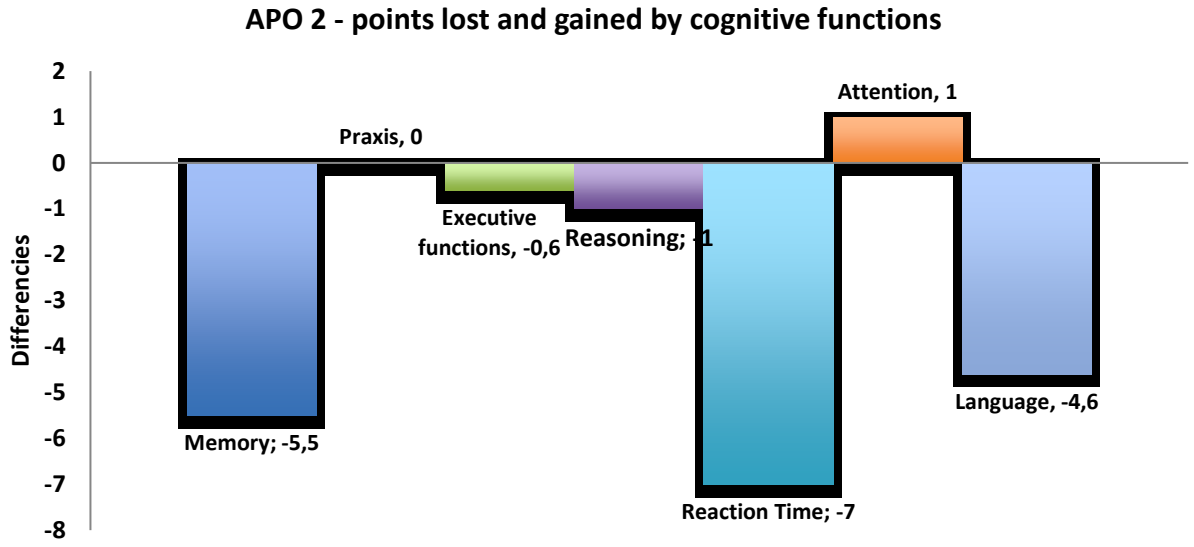

Figure 16. APO2 - Overview on cognitive domains after field trial

5.1.2.3 BARTENBACH

BART1 had difficulties in memory, praxis, reasoning, executive functioning and language at the beginning of trial. At the end her score on praxis and executive functions remain stable, while she had an improvement on attention and a worse performance on memory, reasoning, RT and language (Figure 17).

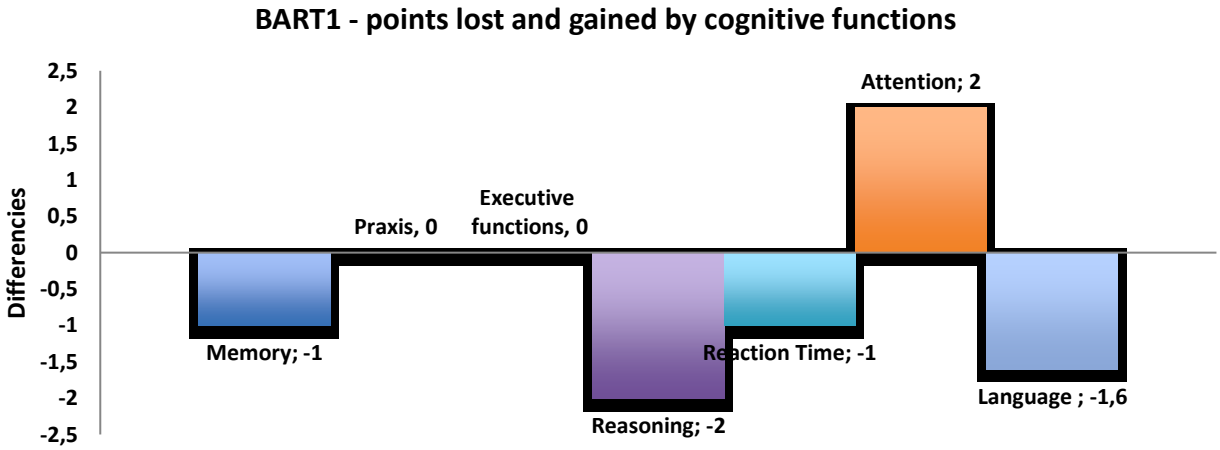

Figure 17. BART1 - Overview on cognitive domains after field trial

BART2 at baseline had difficulties in praxis, executive functions, reaction time and attention. At the end of trial her trend remain stable on praxis and executive functions, while had an

improvement on attention and language. About memory, reasoning and RT there is a worsening respect her performance at baseline (Figure 18).

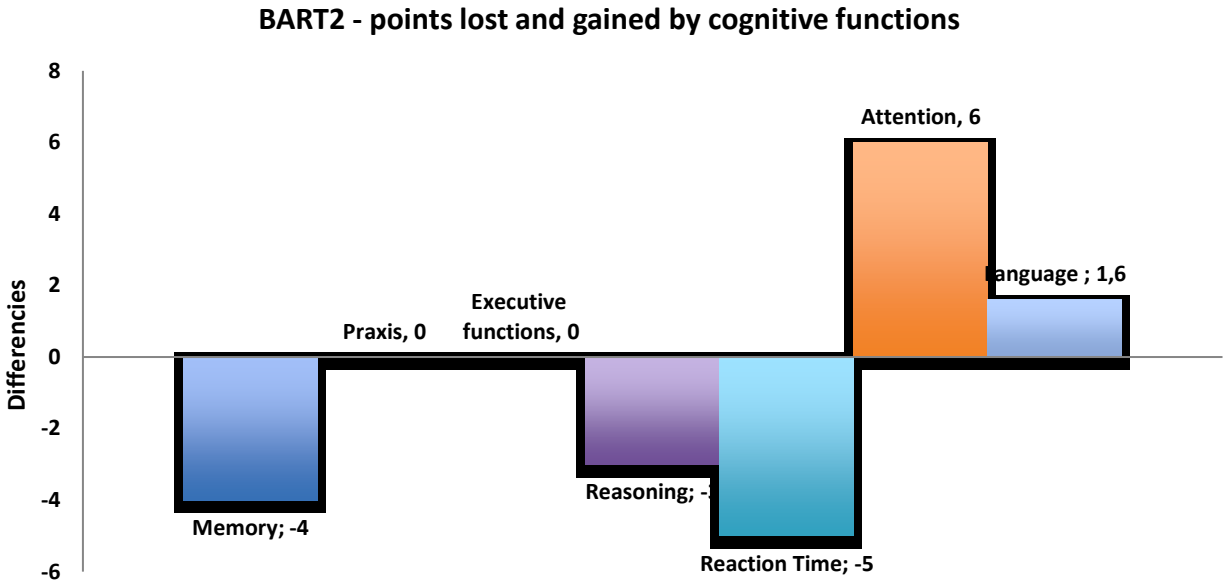

Figure 18. BART2 - Overview on cognitive domains after field trial

5.1.2.4 FSL

FSL1 had mild memory problems associate to slow reaction time and attention disorders; at the end of trial she showed a better score in praxis, attention and language while a worse score on memory, reasoning and RT (Figure 19).

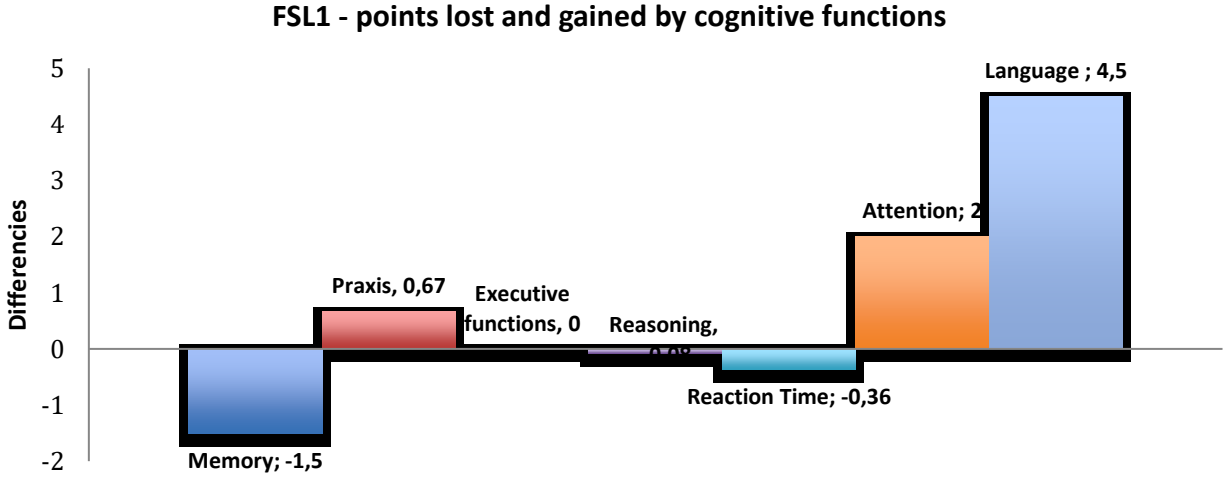

Figure 19. FSL1 - Overview on cognitive domains after field trial

FSL 2 started the field trial with mild memory disorders and slow reaction time. At the end of the field trial she obtained a worse score in memory, executive functions, reasoning, attention and language. She obtained an improvement only of her performance on reaction time (Figure 20).

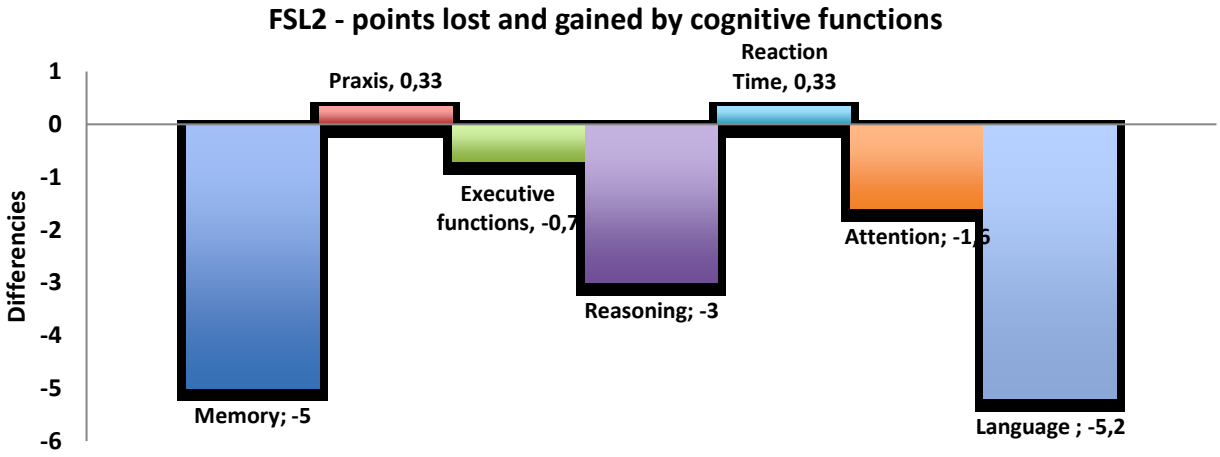

Figure 20. FSL2 - Overview on cognitive domains after field trial

GENERAL CONSIDERATION

In general, 50% of subjects had a better performance in praxis, attention and language while 25% improved in memory, executive functions, reasoning and reaction time at the end of field trial. Beyond the subjects' differences in the use of the devices installed, what emerges is that in general the PETAL system represented a challenge for them. The elderly kept themselves mentally active through learning new commands, using a tablet, carrying out cognitive training and in general all the system as whole represented stimulation for them.

5.2. PSYCHOPATHOLOGICAL PICTURES BEFORE AND AFTER PETAL SYSTEM USAGE

While the previous paragraphs described the possible effect of PETAL on the cognitive abilities of first end-users, the following paragraphs provide comparison on the perceived psychopathological burden of primary and secondary users before and after field trial.

5.2.1 ASSESSMENT

Psychopathological symptoms were investigated through the interview with the patient, the caregiver and through clinical observation with the Neuropsychiatric Inventory (NPI).[11] This has permitted to evaluate the frequency and severity of impairment of a wide range of behaviours: delusions, hallucinations, agitation/aggression, dysphoria, anxiety, euphoria, apathy, disinhibition, irritability/lability, sleep disturbances and aberrant motor activity and appetite. Moreover the NPI distress score permitted to understand the degree of caregivers' burnout associated to behavioural disorders. Furthermore the Zarit Burden Interview–revised version (ZBI)[12] was administered to the caregivers during the assessment interview in order to understand their degree of burden and, finally, the Quality of life in Alzheimer's disease[13] was administered to elderlies and caregivers to know the level of quality of life they perceived. In caregivers' version, they judged elderlies' life.

5.2.2 RESULTS

Table 3 shows data collected at baseline and at the end of the trials. In particular, since in clinical practice are considered as relevant factors those who reach a minimum score of 3 (Frequency x Gravity), the clinically significant values are signed in bold and flagged with a star.

At baseline ANA 1, ANA 2 and APO2 did not have any neuropsychiatric symptoms. About APO1 he suffered of apathetic syndrome, sleep disturbances and had an irregular feeding. The Elders involved at Bartenbach look as the ones with worse behavioural condition at baseline, in fact BART1 had agitation (i.e. obstinacy, aggression), depressive symptoms, apathetic syndrome, irritability and aberrant motor behavior (i.e. performing stereotyped actions) while BART2 had the same disturbances of the previous one with in addition sleep disorders. About the ladies involved in Rome trials, they had depressive symptoms, anxiety, apathetic syndrome and only FSL1 had sleep disturbances (like late and early insomnia) and appetite disorders.

At the end of trial the picture appear the same, with ANA1, ANA2 and APO2, which did not experienced neuropsychiatric disorders.

About APO1 there is an improvement of his behavioural disorders with reduction of apathetic syndrome and feeding disturbances, and only the persistence of sleep disturbances, but less severe than before.

BART1 showed the disappearance of symptoms of agitation, apathetic syndrome, the reduction of depressive symptoms and aberrant motor behaviour. On the other side two new symptoms arose: sleep disturbances and appetite. BART2 showed the remission of agitation, irritability and aberrant motor behaviour while persist depressive symptoms, apathy and sleep disturbances with the same degree than before.

Finally FSL1 had amelioration of apathetic symptoms but on the other side a worsening of anxiety and sleep disturbances. Only appetite disorders remained at the same degree. FSL2 had an amelioration of her anxiety and the onset of feeding disturbances, like lack of appetite and weight loss.

Table 3. Neuropsychiatric symptoms collected with NPI before and after trials

	Symptoms (FxG)																							
	Hallucinations		Delusions		Agitation		Dysphoria		Anxiety		Euphoria		Apathy		Disinibition		Irritability		Aberrant activity		Sleep		Appetite	
	PRE	POST	PRE	POST	PRE	POST	PRE	POST	PRE	POST	PRE	POST	PRE	POST	PRE	POST	PRE	POST	PRE	POST	PRE	POST	PRE	POST
ANA1	0	0	0	0	0	0	2	1	1	0	0	0	2	1	0	0	0	0	0	0	2	1	0	0
ANA2	0	0	0	0	0	0	0	0	2	1	0	0	1	0	0	0	0	0	0	0	2	2	0	0
APO1	0	0	0	0	0	0	2	0	2	0	0	0	**4***	2	0	0	2	1	0	0	**8***	**3***	**3***	0
APO2	0	0	0	0	0	0	0	2	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BART1	0	0	0	0	**3***	0	**6***	**3***	0	0	0	0	**8***	2	0	0	**3***	**3***	**8***	2	0	**4***	0	**6***
BART2	0	0	0	0	**8***	2	**4***	**4***	0	0	2	0	**6***	**6***	0	0	**4***	0	**3***	0	**12***	**12***	0	0
FSL1	0	0	0	0	0	0	**3***	**3***	**3***	**8***	0	0	**3***	0	0	0	2	0	0	0	**4***	**8***	**3***	**3***
FSL2	0	0	0	0	0	0	**4***	**4***	**4***	2	0	0	**3***	**3***	0	0	2	0	0	0	0	0	0	**3***

As said at the beginning of this section, the secondary users burden was collected in two ways: by the Neuropsychiatric Inventory, in order to understand how behavioural disturbances have influenced their distress and by Zarit Burden Interview – revised version (ZBI) [12] in order to measure the degree of their burden. For this section the data refer to Italy (Bolzano and Rome) and Austria.

About the first assessment, as shown in Figure 21 there was a decrease of caregivers distress for the 75% of caregivers, except for APO2 and BART1 who increased their distress although still minimal and without clinical relevance.

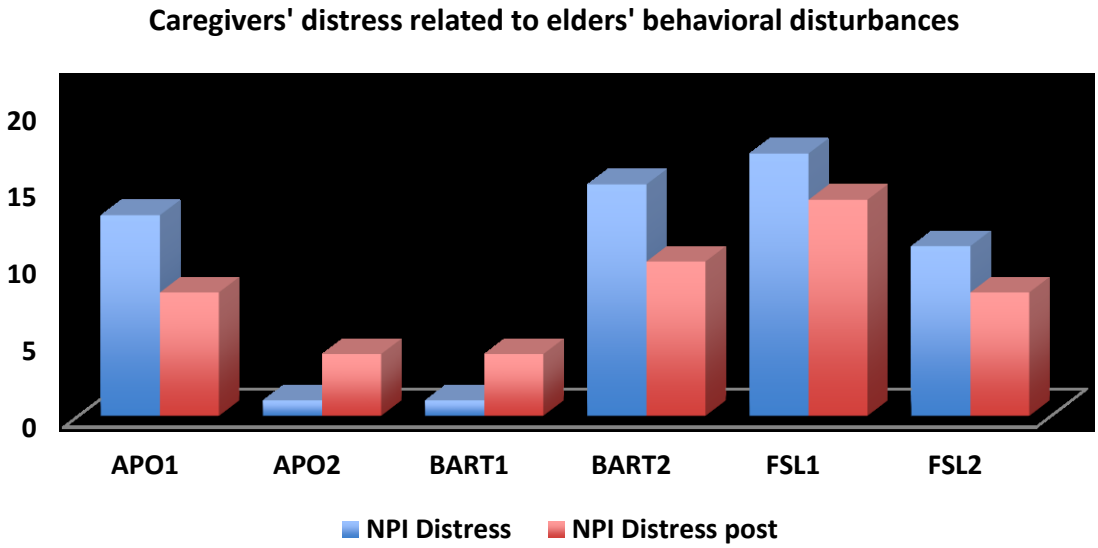

Figure 21. Caregivers' distress after field trial

About ZBI, as shown in Figure 22 only for FSL2's caregiver (her husband) the degree of burden perceived is worsened, but in this case it is probably that the hospitalization due to cancer and the difficult return to normality after the operation affected his sense of burden. In other cases the situation remain stable.

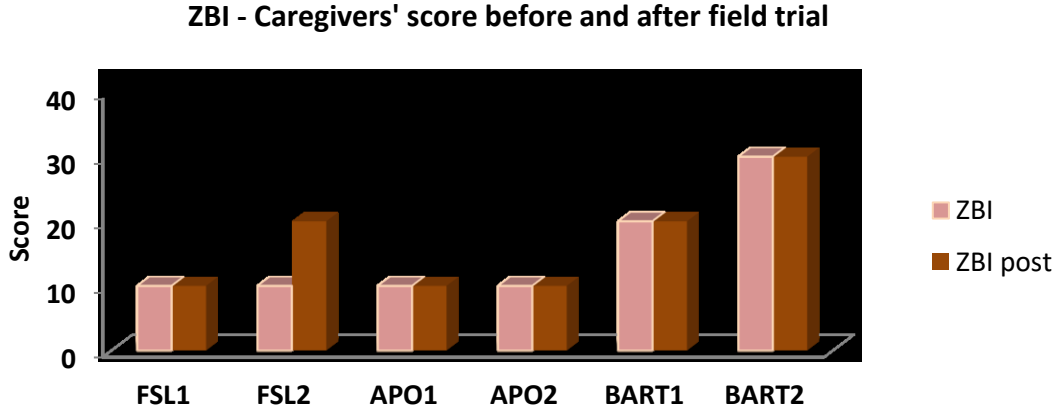

Figure 22. ZBI Caregivers' core before and after field trial

Furthermore, the Quality of life in Alzheimer's disease[13] which is composed of a version for patient and caregiver was administered to elderly and caregivers. A total wellbeing score has been calculated as a weighted average of patient and caregiver's perceptions. As show in Figure 23 only for APO1, the total wellbeing has substantially improved; probably because unlike the other test person he was really satisfied by the PETAL system and has not had health problems during the trial, which required a hospitalization (but he had been in hospital for quite a long time before starting the trial – see chapter 3.2.2).

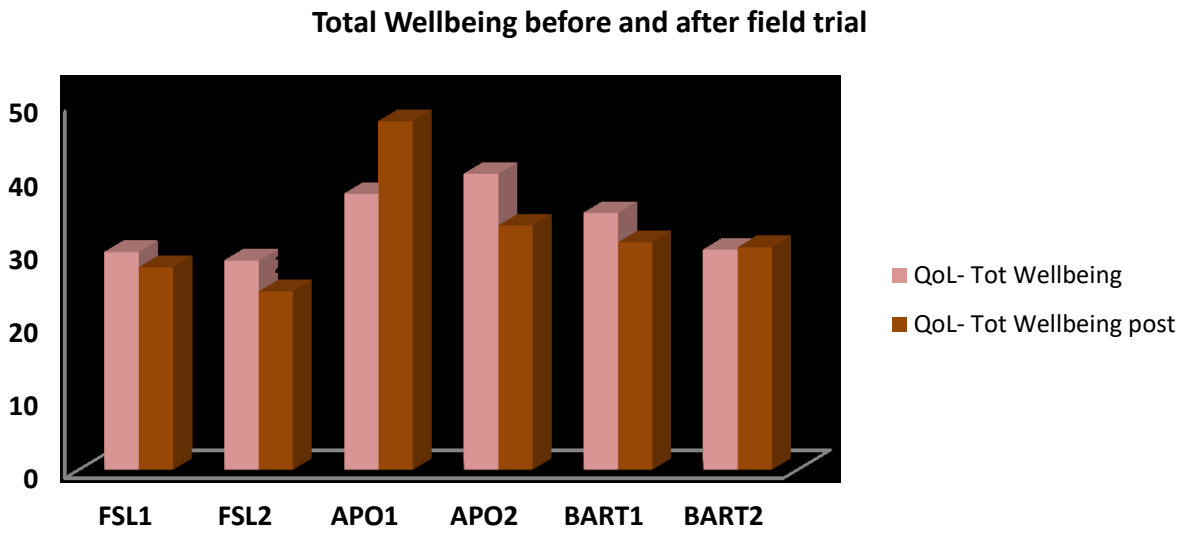

Figure 23. QoL total wellbeing before and after field trial

GENERAL CONSIDERATION

Going through the results described in the previous paragraphs, we can conclude that at least the caregivers' perceived level of stress was decreased. The PETAL system encouraged communication and helped to reduce the gap between caregivers and the elderly. It is important for a caregiver, especially the informal ones, to have everything under control, understand the needs of the elderly in time and try to solve their problems very fast. In MCI's management the acceptance of elder's deficiencies plays a key role in order to reduce the caregiver's burnout and patient's behavioural disturbances, sometimes a consequence of lack of communication and understanding between them. In this the PETAL system has given its contribution, since it permitted caregivers to dedicate more time, even at a distance, to their elderlies.

6 CONCLUSIVE REMARKS AND FUTURE CONSIDERATION

The preceding sections describe in detail all the tools adopted to evaluate the effectiveness of PETAL system. The explanations of results started with the informal diaries that give information on how the PETAL system was integrated into the real life; in these sections it was important to understand the objective difficulties in installation and how many weeks the elderly have needed to accept and become confident with the system. The second step was to collect the impressions directly from the users involved in the project, in order to understand how much the initial difficulties have affected the overall evaluation of the system.

Finally, through the administration of a multidimensional battery, we tried to understand if PETAL has contributed to the wellbeing of the elderly: from a subjective point of view, with the administration of psychopathological scales and from objective results, through the administration of validated cognitive tests.

Regarding the objective evaluation of PETAL what emerge is a remission of behavioural disorders in most cases: the use of light, the monitoring of system and the stronger presence of caregivers gave their contribution.

This second round took place during a worldwide pandemic, a whole new situation for science and for modern society; during the construction phase of the project no one would have imagined that such a health crisis could take place. This event represented an obstacle for project procedures, such as the postponement of home installations due to government decrees or the initial refusal of users to accept the visit of a stranger in their homes or the difficulty in accessing to houses to solve issues. However, beyond the objective difficulties, it represents an important opportunity to test this system especially with regard to future considerations. There are evidences in literature about the effects of social lockdown on neuropsychiatric disorders of patients with dementia[14–16], moreover the pandemic highlighted the need of intelligent systems that can monitor the patient remotely[17].

The principle result of this second round is the mitigation of behavioural disturbances and caregiver distress, despite the lockdown and social isolation. This means that the PETAL system has contributed, during such period, to inhibit the worsening of the behavioural health of elderlies and caregivers involved. This pandemic will not be the only or the last one, unfortunately; also for this it is important to continue with the study of intelligent systems for remote monitoring of elderly people with mild cognitive decline in their own homes.

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Appendix 1. Field trail effectiveness questionnaire – for Seniors

Date: ___ / ___ / ____

FIELD TRIAL EFFECTIVENESS QUESTIONNAIRE (for SENIORS)

The purpose of this questionnaire is to obtain information about your personal experience with the whole PETAL system and all the features it is capable of implementing, regardless of the possible features which may have not worked perfectly while you were testing the prototype:

- The possibility to create automations for specific needs in form of e.g. notifications and changes in the lighting situation related to the defined rules.
- the "Rule Editor" that permits the definition of actions triggered by some conditions
- the set of new lights with changing intensity and colour
- the tablet which displays notifications and permits you to play the Mementia Games
- the different sensors, in particular the smart-watch

This survey is completely anonymous and subject to the European and National privacy regulations. Your data will be used exclusively for statistical purposes.

Identification number of test person (account): _____

Test region: □ Austria □ Romania □ Italy/Rome □ Italy/Bolzano

1. Socio-demographic information

In the fields below, please enter some information about yourself.

Year of birth ____

Gender: □ Female □ Male

Education: Which is your highest educational degree?

□ Elementary school
□ Technical/vocational school
□ Junior high school (compulsory school)
□ Senior high school, general qualification for university entrance
□ Professional training/apprenticeship
□ Academic title of college, university

Relationship Status

□ Living with someone
□ Living alone

2. Technographic information/Attitude towards ICT

Which technological devices do you own?

□ smartphone
□ classic phone (not a smartphone)
□ tablet
□ laptop
□ desktop PC
□ TV
□ other (please specify)

What is the frequency with which you use the technological devices you own?

smartphone
□ daily □ no more than twice per week □ one per month □ never

classic phone (not a smartphone)
□ daily □ no more than twice per week □ one per month □ never

tablet
□ daily □ no more than twice per week □ one per month □ never

laptop

□ daily □ no more than twice per week □ one per month □ never

Desktop PC

□ daily □ no more than twice per week □ one per month □ never

TV

□ daily □ no more than twice per week □ one per month □ never

other (please specify)

□ daily □ no more than twice per week □ one per month □ never

For which kind of activity you use technological devices

□ entertainment

□ news/information

□ shopping

□ communication (sms, chat, phone calls)

□ social networking

□ work

□ health

□ other (please specify)

How do you feel about your use of technology?

□ feeling confident/autonomous: I'm confident with using technological devices

□ feeling need for help: I feel I need the support of someone else to use technology properly

□ feeling anxious/unable: I am afraid of not being able to use any technological devices -using them make me a bit anxious

How much would you be inclined to learn a new technology?

□ very much

□ somewhat

□ little

□ not at all

What would determine you to learn new technology?

□ to improve my life
□ to learn something new
□ other (please specify)

What was the main motivation to participate in the PETAL trial?

□ I feel that the PETAL system will help me improve my life
□ I feel that the PETAL system will help me improve my caregiver's life
□ I'm curious about it, willing to try a new system
□ Someone else told me that it would be good for me to participate in this trial
□ Other motivations (please specify)

3. Evaluating the concepts/approach exploited in the PETAL system

Please rate the following questions by placing a check on the number in the line, using a scale from 1 "strongly disagree" to 10 "strongly agree". Do not leave any item unanswered.

1. I think that having the possibility to personalize the behavior of various devices and appliances in my home is very useful:

Strongly disagree 1___ 2___ 3___ 4___ 5___ 6___ 7___ 8___ 9___ 10 ***Strongly agree***

2. Personalised notifications, reminders and automatic light changes can help me to cope with everyday life:

Strongly disagree 1___ 2___ 3___ 4___ 5___ 6___ 7___ 8___ 9___ 10 ***Strongly agree***

3. The rule-based approach used to specify trigger-action rules is a suitable way for intuitively expressing personalization:

Strongly disagree 1___ 2___ 3___ 4___ 5___ 6___ 7___ 8___ 9___ 10 ***Strongly agree***

4. My own experience with the PETAL system installed at my home

1. Adjusting the *PETAL system* to my needs and preferences requested less support than I thought:

Strongly disagree 1___ 2___ 3___ 4___ 5___ 6___ 7___ 8___ 9___ 10 ***Strongly agree***

2. The *PETAL system* facilitates the communication with my relatives:

Strongly disagree 1___ 2___ 3___ 4___ 5___ 6___ 7___ 8___ 9___ 10 ***Strongly agree***

3. I like the new lights in my home: the colours, the brightness and the possibility to adapt to special needs and daytime:

Strongly disagree 1___ 2___ 3___ 4___ 5___ 6___ 7___ 8___ 9___ 10 ***Strongly agree***

4. The lights of the *PETAL system* are very useful for reading or for other tasks where I need to see well:

   Strongly disagree 1___ 2___ 3___ 4___ 5___ 6___ 7___ 8___ 9___ 10 ***Strongly agree***

5. I like playing the Mementia Games:

Strongly disagree1___ 2___ 3___ 4___ 5___ 6___ 7___ 8___ 9___ 10 ***Strongly agree***

6. I think that playing the Mementia Games helps me to stay mentally active:

Strongly disagree1___ 2___ 3___ 4___ 5___ 6___ 7___ 8___ 9___ 10 ***Strongly agree***

7. I like wearing the smartwatch during the day:

Strongly disagree 1___ 2___ 3___ 4___ 5___ 6___ 7___ 8___ 9___ 10 ***Strongly agree***

8. I feel more secure with the *PETAL system*:

Strongly disagree 1___ 2___ 3___ 4___ 5___ 6___ 7___ 8___ 9___ 10 ***Strongly agree***

9. I would like to keep the *PETAL system* for my home:

Strongly disagree 1___ 2___ 3___ 4___ 5___ 6___ 7___ 8___ 9___ 10 ***Strongly agree***

10. I would suggest the *PETAL system* to other elderly like me:

Strongly disagree 1___ 2___ 3___ 4___ 5___ 6___ 7___ 8___ 9___ 10 ***Strongly agree***

11. I sleep better at night:

Strongly disagree 1___ 2___ 3___ 4___ 5___ 6___ 7___ 8___ 9___ 10 ***Strongly agree***

12. I relax better:

Strongly disagree 1___ 2___ 3___ 4___ 5___ 6___ 7___ 8___ 9___ 10 ***Strongly agree***

13. The lighting system helps me relax more:

Strongly disagree 1___ 2___ 3___ 4___ 5___ 6___ 7___ 8___ 9___ 10 ***Strongly agree***

14. The lighting system helps me sleep better:

Strongly disagree 1___ 2___ 3___ 4___ 5___ 6___ 7___ 8___ 9___ 10 ***Strongly agree***

15. The lighting system helps me fall asleep faster:

Strongly disagree 1___ 2___ 3___ 4___ 5___ 6___ 7___ 8___ 9___ 10 ***Strongly agree***

16. I feel less disoriented at night with the lighting system:

Strongly disagree 1___ 2___ 3___ 4___ 5___ 6___ 7___ 8___ 9___ 10 ***Strongly agree***

17. The light strips help guiding me to the toilet at night:

Strongly disagree 1___ 2___ 3___ 4___ 5___ 6___ 7___ 8___ 9___ 10 ***Strongly agree***

18. The coloured lights make me feel more comfortable at home:

Strongly disagree 1___ 2___ 3___ 4___ 5___ 6___ 7___ 8___ 9___ 10 ***Strongly agree***

19. My guest friends have asked me about the lighting and the *PETAL system*:

Strongly disagree 1___ 2___ 3___ 4___ 5___ 6___ 7___ 8___ 9___ 10 ***Strongly agree***

20. I am more serene ever since using *PETAL system*:

Strongly disagree 1___ 2___ 3___ 4___ 5___ 6___ 7___ 8___ 9___ 10 ***Strongly agree***

21. Do you have further specific comments on your personal experience with the *PETAL system*?

_____

_____

22. Do you have any final suggestions to improve the *PETAL system*?

_____

_____

Thank you!

Appendix 2. Field trial effectiveness questionnaire- for Caregivers

Date: ___ / ___ / ____

FIELD TRIAL EFFECTIVENESS QUESTIONNAIRE (for CAREGIVERS)

The purpose of this questionnaire is to obtain information about your personal experience with the whole PETAL system and all the features it is capable of implementing, regardless of the possible features which may have not worked perfectly while you were testing the prototype:

- The possibility to create automations for specific needs in form of e.g. notifications and changes in the lighting situation related to the defined rules.
- the "Rule Editor" that permits the definition of actions triggered by some conditions
- the set of new lights with changing intensity and colour
- the tablet which displays notifications and permits you to play the Mementia Games
- the different sensors, in particular the smart-watch

This survey is completely anonymous and subject to the European and National privacy regulations. Your data will be used exclusively for statistical purposes.

Identification number of test person (account): _____

Test region: □ Austria □ Romania □ Italy/Rome □ Italy/Bolzano

1. Socio-demographic information

In the fields below, please enter some information about yourself.

Year of birth ____

Gender: □ Female □ Male

Education: Which is your highest educational degree?

□ Elementary school
□ Technical/vocational school
□ Junior high school (compulsory school)
□ Senior high school, general qualification for university entrance
□ Professional training/apprenticeship
□ Academic title of college, university

Relationship with the Elderly involved in the Trial

□ I'm married with him (her) / I'm his (her) partner
□ I'm a professional caregiver (a nurse, a doctor)
□ I'm an informal caregiver not living with the senior (a friend, a relative)

2. Technographic information

Which technological devices do you own?

□ smartphone
□ classic phone (not a smartphone)
□ tablet
□ laptop
□ desktop PC
□ TV
□ other (please specify)

What is the frequency with which you use technological devices?

smartphone
□ daily □ no more than twice per week □ one per month □ never

classic phone (not a smartphone)
□ daily □ no more than twice per week □ one per month □ never

tablet
□ daily □ no more than twice per week □ one per month □ never

laptop
□ daily □ no more than twice per week □ one per month □ never

desktop PC

□ daily □ no more than twice per week □ one per month □ never

other (please specify which ones)

□ daily □ no more than twice per week □ one per month □ never

For which kind of activity you use technological devices

□ entertainment

□ work

□ news/information

□ shopping

□ communication (sms, chat, phone calls)

□ social networking

□ health

□ other (please specify)

What is the level of your programming knowledge?

□ no knowledge

□ low knowledge (which means: knowledge of HTML, CSS, and basic knowledge of JavaScript);

□ medium knowledge (which means: knowledge of JavaScript, basic knowledge of either PHP or Java or C++)

□ good knowledge (which means: good knowledge of either PHP or Java or C++);

□ very good knowledge (which means: knowledge of development languages at a professional level).

How confortable are you with using technological devices? Please, check only one.

- I feel very comfortable with using technological devices
- I feel fine with with using technological devices although I need to improve
- I do not feel particularly confident in using technological devices although I have tried
- I do not use technological devices but I am keen to learn
- I do not use technological devices and I am *not* keen to learn
- Other (Please, give details)

  ……..

What was the main motivation to participate in the PETAL trial?

□ I feel that the PETAL system will help improve senior's life
□ I feel that the PETAL system will help improve my own life
□ I'm just curious about it, willing to try a new technological system
□ Other motivations (please specify)

3. Evaluating the concepts/approach exploited in the PETAL system

Please rate the following questions by placing a check on the number in the line, using a scale from 1 "strongly disagree" to 10 "strongly agree". Do not leave any item unanswered.

I think that having the possibility to personalize the behavior of various devices and appliances is very useful:

Strongly disagree 1___ 2___ 3___ 4___ 5___ 6___ 7___ 8___ 9___ 10 ***Strongly agree***

4. Personalised notifications, reminders and automatic light changes can help to cope with everyday life:

Strongly disagree 1___ 2___ 3___ 4___ 5___ 6___ 7___ 8___ 9___ 10 ***Strongly agree***

5. The rule-based approach used to specify trigger-action rules is a suitable way for intuitively expressing personalization:

Strongly disagree 1___ 2___ 3___ 4___ 5___ 6___ 7___ 8___ 9___ 10 ***Strongly agree***

4. My experience with the PETAL system (installed at senior's home)

1. Adjusting the *PETAL system* to senior's needs and preferences requested less support than I thought:

Strongly disagree 1___ 2___ 3___ 4___ 5___ 6___ 7___ 8___ 9___ 10 ***Strongly agree***

2. The *PETAL system* facilitates the communication with the senior:

Strongly disagree 1___ 2___ 3___ 4___ 5___ 6___ 7___ 8___ 9___ 10 ***Strongly agree***

3. I feel more relaxed about senior's situation since the *PETAL system* is used:

Strongly disagree 1___ 2___ 3___ 4___ 5___ 6___ 7___ 8___ 9___ 10 ***Strongly agree***

4. The *PETAL system* allows for personalising several aspects aimed to support senior's life. Which are the features that you find more interesting for your user(s)? (Check the most interesting ones)

□ Medication reminders
□ Lights using automation
□ Cognitive stimulation games
□ Alarms
□ Other aspects (specify which ones)

5. Conversely, which are the features that you find less interesting for your user(s)? (Check the least interesting ones)

□ Medication reminders
□ Lights using automation
□ Cognitive stimulation games
□ Alarms
□ Other aspects (specify which ones)

6. Do you have any suggestions in order to improve the *PETAL system*?

_____

_____

7. The *PETAL system* is really useful for caring for elderly people:

Strongly disagree 1___ 2___ 3___ 4___ 5___ 6___ 7___ 8___ 9___ 10 ***Strongly agree***

8. The *PETAL system* is really accessible for the elderly people:

Strongly disagree 1___ 2___ 3___ 4___ 5___ 6___ 7___ 8___ 9___ 10 ***Strongly agree***

9. The *PETAL system* helps me a lot for a better caring

Strongly disagree 1___ 2___ 3___ 4___ 5___ 6___ 7___ 8___ 9___ 10 ***Strongly agree***

10. I want to pay for a solution like this as organization / caregiver

Strongly disagree 1___ 2___ 3___ 4___ 5___ 6___ 7___ 8___ 9___ 10 ***Strongly agree***

11. I would prefer a renting model instead of buying devices

Strongly disagree 1___ 2___ 3___ 4___ 5___ 6___ 7___ 8___ 9___ 10 ***Strongly agree***

12. How much would you pay for it as organization / caregiver?

- □ Not interested
- □ 25€ / month
- □ 50€ / month
- □ 75€ / month
- □ Over 100€ / month

13. I would like to buy the Great Luminaire if it costs around 2000€

Strongly disagree 1___ 2___ 3___ 4___ 5___ 6___ 7___ 8___ 9___ 10 ***Strongly agree***

14. I think that the families or elderly users should pay for it

Strongly disagree 1___ 2___ 3___ 4___ 5___ 6___ 7___ 8___ 9___ 10 ***Strongly agree***

Thank you!