Report of User Requirements and User Definition of the System

Deliverable D2.3

Work Package 2: End-User Analysis and Validation

DOCUMENT HISTORY

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EXECUTIVE SUMMARY

This document describes the process followed by INGEMA and CURE, as partners in charge of the users' requirements and validation.

The User Centered Design it is defined as a process in which users' wishes, preferences and needs are taken into account to develop the platform. In order to reach this knowledge final users are involved from the first steps to the final validation of 3rD-LIFE platform in which

This document is the first step to acquired understanding about the users' characteristics and their preferences about the platform regarding its appearance, applications and usefulness.

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1. INTRODUCTION

1.1. NOTES ON THE PROJECT

The aim of the 3rD-LIFE project is to create a 3D environment that allows elderly people interact with other people and perform a variety of leisure activities on a computer with Internet connection. One of the most important aspects that a 3rD-LIFE focuses on is the anxiety and the difficulties that elderly people usually face by the usage of new technologies. 3rD-LIFE addresses such difficulties with a focus on usability and accessibility issues on a 3D environment, where the user interaction takes place in a more visual and intuitive way.

1.2. SCOPE OF THE DELIVERABLE

In order to gain insight about the acceptance, usability and user experience of a 3D environment for the elderly target user group of the 3rD-LIFE Project, an extensive user requirements analysis was carried out with 3rD-LIFE potential users in two countries: Spain and Austria.

3rD-LIFE project follows a User Centered Design (UCD) approach. This implies, in the first place, taking into account the users' needs and wishes or, in other words, taking into account the specifications into account that influence the usability of the system and the user experience factors, such as the perceived benefit for the target users. In addition, UCD implies the active participation of the end users in the design process and in the evaluation process. WP2 – End-User Input and Validation includes; therefore, not only the initial requirement analysis phase, where the target end user groups actively participated, but also user trials for assessing the development of the system based on the user requirements analysis results.

The aim of this document is to present the results of the first user-related studies and tasks included in WP2. Section 2 presents the detailed results of the qualitative and quantitative research carried out in order to describe the users and the requirements of the system.

Finally, section 3 presents a summary of the main outcomes obtained from the user requirement analysis to guide the following project work and service development.

1.3. BACKGROUND: OVERVIEW OF ATTITUDES TOWARDS NEW TECHNOLOGIES ON ADULT PEOPLE

The increasing development of new assistive technology represents a way to enhance the lives of the world growing older population, enabling elderly individuals to live longer and independently at their place. However, to make a successful design of systems, products and environments for older adults, the guidelines for ICT-based solutions should be drawn starting from the results of the research on ageing. An appropriate profiling of users should be considered and users should be involved in the early stages of the design process, providing the designers with essential feedback on usability and system functionalities. Definition of the users group and identification of user's particular limitations, interests, and needs are two critical steps in the development process of assistive technology.

2. USER REQUIREMENT ASSESSMENT

2.1. USER REQUIREMENT ELICITATION: QUALITATIVE AND QUANTITATIVE

As defined in D.2.1 – Methodology for Users Involvement, the initial design phase aims to get to know and collect information about the end users, such as their experience with technology, their daily activities, their tasks, capabilities/limitations, which sets the basis for further steps in the project, such as definition of the 3D environment and the interactions between users. The target user groups are already defined in deliverable 2.1 – Methodology for user involvement:

- "Primary users": Older people without specific cognitive and/or physical problems, living independently, using computer and internet, and aged between 60 and 75 years
- "Secondary users": Relatives or friends of people susceptible of be in the primary users group. Please see section 4 of D.2.1 for more information.

In Spain INGEMA and in Austria CURE followed a two-phased elicitation process, as shown in Figure 1 applying both qualitative and quantitative methods. Both partners were in charge of involving users with two slightly different and complementary focus areas, which give the project a wider and more comprehensive analysis of the user needs. While INGEMA bases its expertise in analysing and studying the psychological and social needs of the elderly, CURE is more concentrated on the usability and user experience of technologies. Detailed procedures are explained in the following sections.

PHASE 1   Focus on the social life and communication habits of the elderly & younger family members

Austria	Spain
Method: Online survey	Method: Personal Interview

PHASE 2   Focus on the abilities and preferences of the elderly for the controls, GUI Elements, Avatars, Features, Activities etc. of the 3D Environment

Austria	Spain
Method: Semi-structured Interview Focus on: activities, control devices	Method: Focus Groups Focus on: Landscape, Avatars, etc.

Figure 1: Two phases of the user requirement assessment procedure followed in two countries.

User reports are based on the involvement of real users and the collection of their mental representations about the system proposed. Interviews, focus groups and questionnaires are typically employed data collection methods. Data collected provide a view of the "real-world" conditions in which users operate to provide context around the use of proposed technologies. A common approach is to include one round during the early phases of the project ("Research phase" or "Definition phase") to better understand the users, and then include one or more additional rounds just before starting the development phase in order to validate the design.

2.2. PHASE 1: GETTING TO KNOW THE TARGET USER GROUPS

It is commonly accepted that one of the main reasons of the failure in assistive technology development is the lack of key-users involved in the development process and the small amount of efforts invested in user involvement [2]. With the goal to provide designers with useful guidelines for further innovation and to ensure the validity of the information gathered, two different groups formed the sample of participants as it was defined in the D.2.1.: 1) primary users, 2) secondary users who will interact with them over the 3D environment.

The main goal of the first phase of the user requirement assessment was to gain an overview of the target users' characteristics, daily life and social activities. For this, a questionnaire was prepared by INGEMA and CURE in two versions targeted at both of the target user groups. The questionnaires included questions mainly about:

- Demographical information (age, gender, occupation, etc.).
- Communication habits with friends and family (frequency, type, distance).
- Leisure activities with friends and family.
- Usage of Internet and social network sites (playing games, attending courses, already using 3D platform).
- The devices that the participant regularly uses.
- Attitude towards Internet usage (ATIS).0

The questions except of some about communication habits and real life activities were same for both of the user groups. The younger participants were asked questions that focus on their relationship and communication with older family members and the activities they do together.

2.2.1. GENERAL PROCEDURE

To test users' perception of 3rD-LIFE, in this part of the project we employed qualitative and quantitative measurements. The aim was to gather data on participants' perception of elderly needs and of elderly people´s attitudes towards the system. The study was conducted in form of a series of semi-structured interviews.

For *user interviews* at Spain, users were contacted and a meeting was set in our lab. In a first preliminary phase of the interview, users were asked to complete three cognitive exercises of the CANTAB cognitive examination test [3]. The first exercise, Reaction time (RTI), is designed to measure the reaction time to a visual stimulus, where the stimulus is either predictable or not. The user must react (touching the screen or unpressing a button) to the stimulus as fast as possible. It has been demonstrated that the reaction time increases with age. For this reason, it is thought that this capacity may have an influence on the user´s interaction with virtual environments, when they are demanded to respond in a certain way.

The second exercise, Pairs Associated Learning (PAL), assesses visual memory and learning capacity. A certain number of boxes open randomly. Some of them contain objects and the users must keep in mind which objects are contained in their respective boxes. This is an essential capacity when navigating in virtual environments, as the users will be required to memorize and recognize the objects that are included.

The last task, Spatial Span is a computerized version of the Corsi Blocks task, assessing working memory capacity. This gives a measure of working memory; a capacity mediated by the frontal lobe. A pattern of white boxes is shown on the screen. Some of the boxes change in color, one by one, in a variable sequence. The subject must memorize the sequence and touch the boxes in this order. Working memory is an essential cognitive domain to plan and execute certain action sequences. This phase was obligatory in order to assure that the users were not impaired cognitively and can operate 3rD Life accurately. It is especially relevant given that it is desirable that the users participate along the whole phases of the project.

The second phase was the interview itself, where the participants were asked questions regarding technology usage and their social networks.

The questions except of some about communication habits and real life activities were same for both of the user groups. The younger participants were asked questions that focus on their relationship and communication with older family members and the activities they do together. Furthermore, secondary users were asked for the use they do to some technological devices for interacting with people between 60-75 years old and below 60 years old. (Annex 5.1 for primary users' questionnaire; Annex 5.2 for secondary users' questionnaire).

At Spain, the interviews with the primary users took place at INGEMA´s laboratory where each participant met one researcher who explained the study, handed over the informed consent, administered the questionnaire and conducted the cognitive assessment. The whole visit will lasted approximately 1.5 hour where half of the time was designated to the interview/questionnaire and half to the cognitive assessment. To facilitate for the elderly users and to get a good interaction between researcher and user to avoid eventual

misunderstandings, the questionnaire was read aloud by the researcher and the participant also answered orally. In that way eventual doubts were solved in the moment.

With the younger group the procedure was different. In addition to the differences in the questionnaire, there was not a cognitive assessment of the secondary users of 3rD LIFE since it was not really important for the purpose of the current project.

This phase was carried out during October 2011.

Regarding Austria case, CURE created two online questionnaires, one for primary target user group and one for the secondary user group of the project, in German by using EFS Survey Software **¡Error! No se encuentra el origen de la referencia.** based on the two versions of the questionnaires prepared. The online questionnaires were carried out between 06. – 24.10.2011, where 80 participants from each target user group were sent invitation emails including a link for the online questionnaire.

2.2.2. RESULTS IN SPAIN

2.2.2.1. DEMOGRAPHIC DATA OF PARTICIPANTS

Demographic data were collected just before the interview's start and after the informed consent was signed, and are presented in the table below:

Table 1. Demographic data of participants (Spain).

	N	Age	Gender	Education*
Primary	16	64,88 (range: 60-75)	10M, 6F	9 UD, 4SE, 3PE
Secondary	12	29,58 (range: 25-39)	5M, 7F	12UD

M: Male. F: Female. UD: University degrees. SE: Secondary education. PE: Primary education.
*: 12 people of the primary users are actually getting formal education in humanities at the "Aulas de la Experiencia" (University for the Elderly) of the University of the Basque Country. Furthermore, one case is now enrolled in a Doctoral Program and another one is studying Euskera at the Language Academy

All participants, primary and secondary users, speak Spanish correctly and uses it in their daily life.

Civil status and way of living were only asked to the primary users' group, since it was thought that for the purpose of the project, civil status and way of living of secondary users would not be interesting. Civil status is thought to have an important effect in the relations of elders [5] The aim of the second questions was to know with who are living the participants nowadays, since at Spain it is normal find that old people are living together with the closest relationships. On the other hand, it is uncommon that young people, at ages selected, share their homes with their older relatives. If the Figure 2 and 3 the results obtained can be seen.
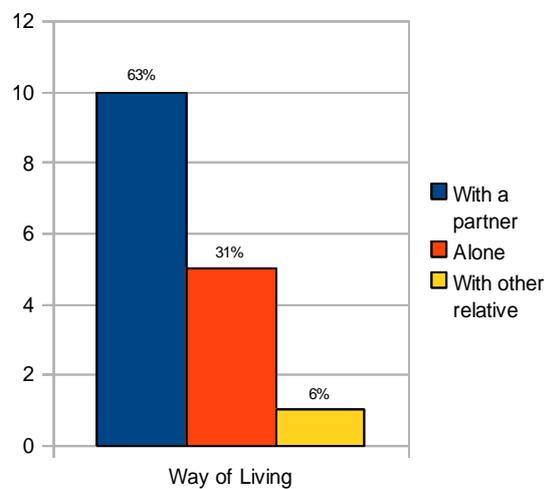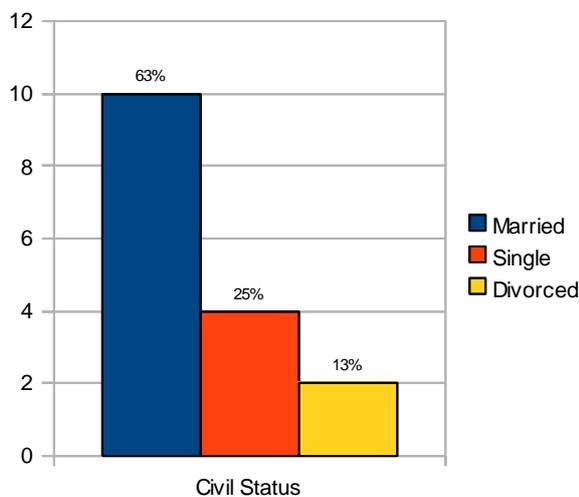
Figure 2: Civil status of primary users (Spain).   Figure 3: Way of living of primary users (Spain).

2.2.2.2. CLOSEST RELATIONSHIPS

Primary users were asked for their closest relationship, the distance at which they live from their closers and the frequency of interaction between them and their closer relationships indoor and outdoor. It has to be noticed that, for the question of "who is/are your closest relationships", those living in the same home were not considered, since people do not usually uses a technology such 3rD-LIFE for interaction. Therefore, the category "couple" is not considered there. The objective of this group of questions was to assess the possible uses of the 3rD-LIFE solution since different kinds of networks will determinate different applications of 3rD LIFE. Secondary users were asked for their closest relationships only with people with ages between 60 and 75 years old. Results can be seen in the figures 4 to 7 presented below.
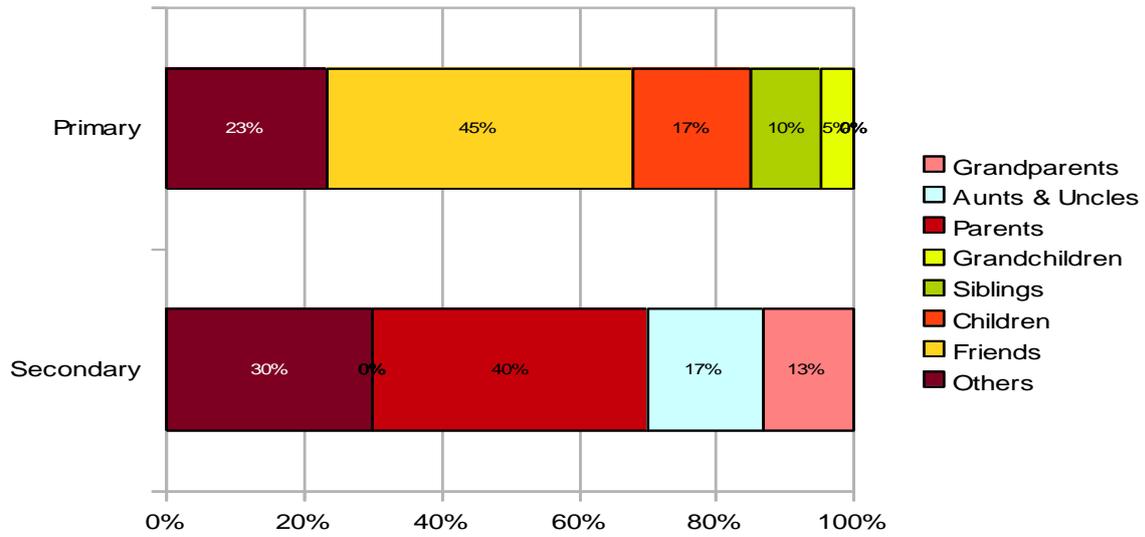
Figure 4: Closest relationships of the users of 3rD LIFE (Spain).
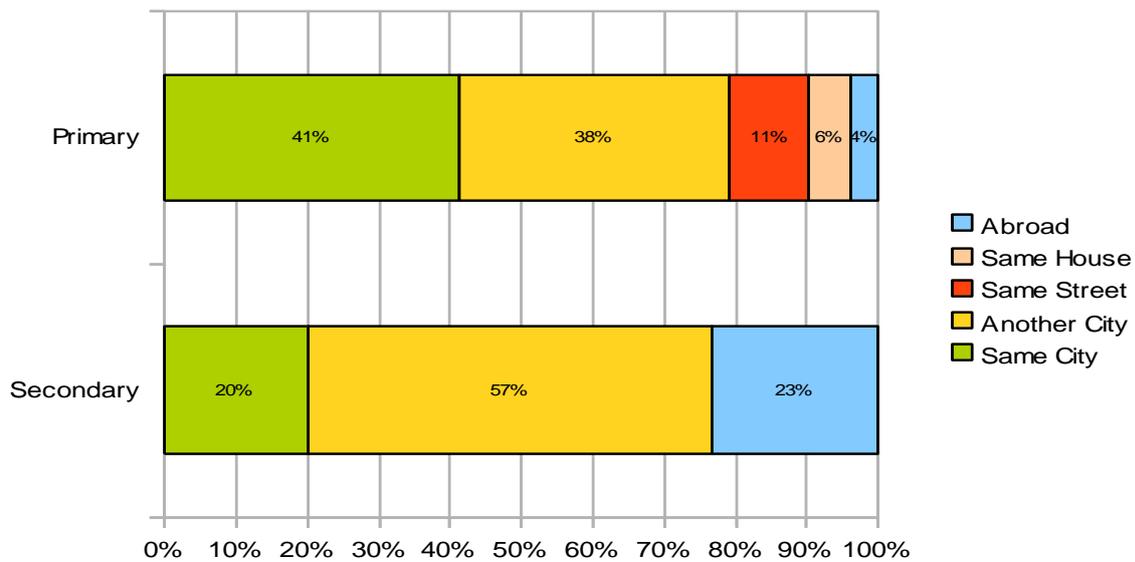
Figure 5. Distance at which users live from their closest relationships (Spain).
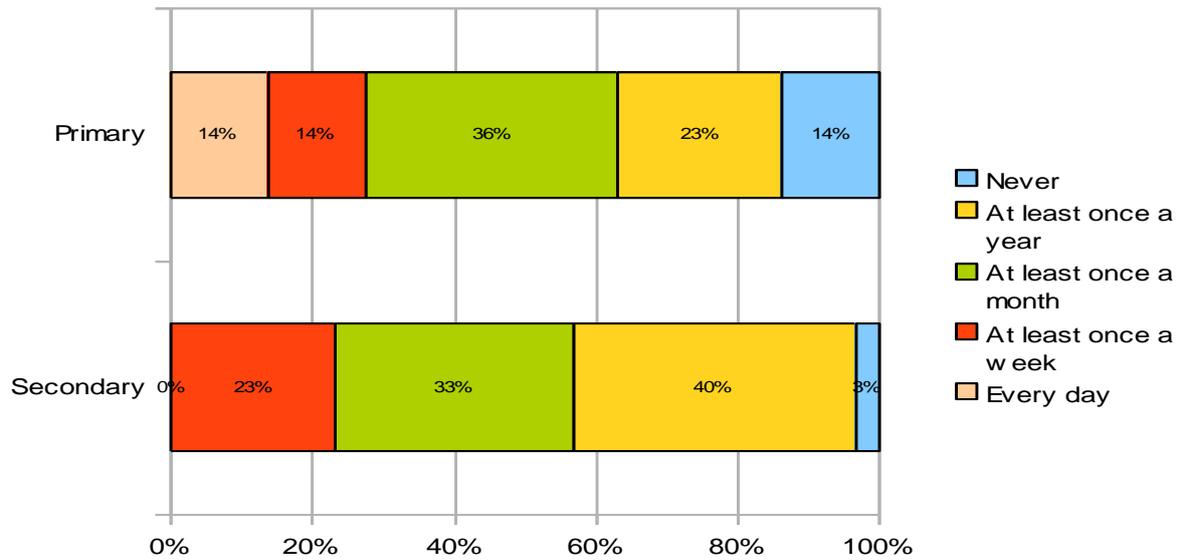
Figure 6. Frequency of interaction between users and their closest relationships inside their homes
(Spain).
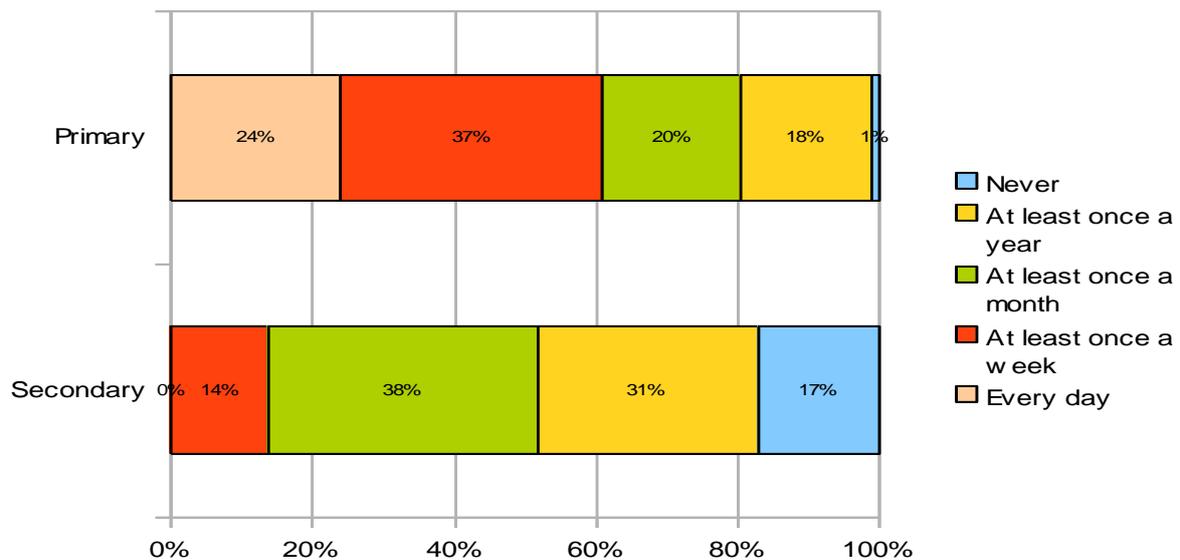
Figure 7. Frequency of interaction between users and their closest relationships outside their homes
(Spain).

As can be seen in the figures above for primary users friends are the largest group of closest
relationships with a 43%, followed by children (17%) and siblings (10%). Most of primary
users (57%) live in the same house, street or city than their closest relationships, 38% live in
another city, and only 6% lives in another country. It is very important for assessing 3rD-

LIFE platform usefulness that only a 17% of primary users lives in the same street or even in the same house, since this fact could make it useless. Finally, in the last figure can be seen that primary users interact outdoors face to face with their closer relationships, mostly at least once a week (61%).

As can be shown, secondary participants' more frequent closest relationship between 60 and 75 years old are parents (40%) and they live mostly in another city (57%) or even in another country (23%). These results are important for 3rD-LIFE since guarantee its usefulness.

2.2.2.3. USE OF THE COMMUNICATION CHANNELS FOR INTERACTING WITH THE CLOSEST RELATIONSHIPS

In this section, results from the question "With which frequency do you communicate with your closer social relationships (people you listed above) through/with/via...?". The aim of the questions was to assess the devices that participants (primary and secondary) use for interacting with their relationship. A difference was made between the groups of users. Secondary users were asked for the use of the devices for interacting with people between 60-75 years old separately from those below of 60 years old, whereas primary were asked for all their relationship in general. The reason of doing that was to assess if there were any important difference in the use of devices for interacting with the closest relationship based on their ages.

Results for primary users can be seen in figure 8, and for secondary users in figure 9.
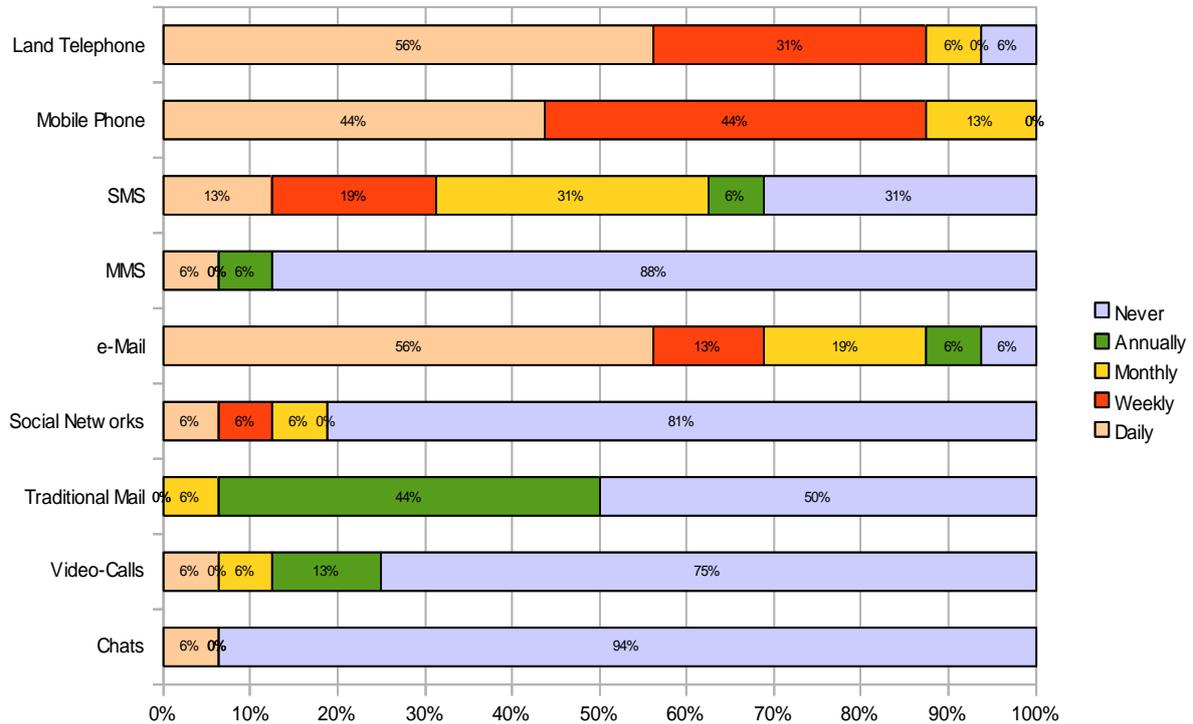
Figure 8. Primary users new technological devices' use for interacting with their relations (Spain).

As can be seen in the figures presented, the sample of primary users of 3rD-LIFE in Spain frequently uses land telephones (56% daily, 31% at least once a week), electronic mail (56% daily, 13% at least once a week) and mobile phone (44% daily, 44% at least once a week) for interacting with their closest relationships. On the other hand, they never use Multimedia Message Service (88%), social networks (81%), video calls (75%) and chat (94%) for this purpose.

As can be noticed, secondary users in Spain use more traditional ways for interacting with their oldest relationships than with their younger ones (<60 years old). So they mainly use land or mobile phone for communicating with the primary target users of 3rD-LIFE.
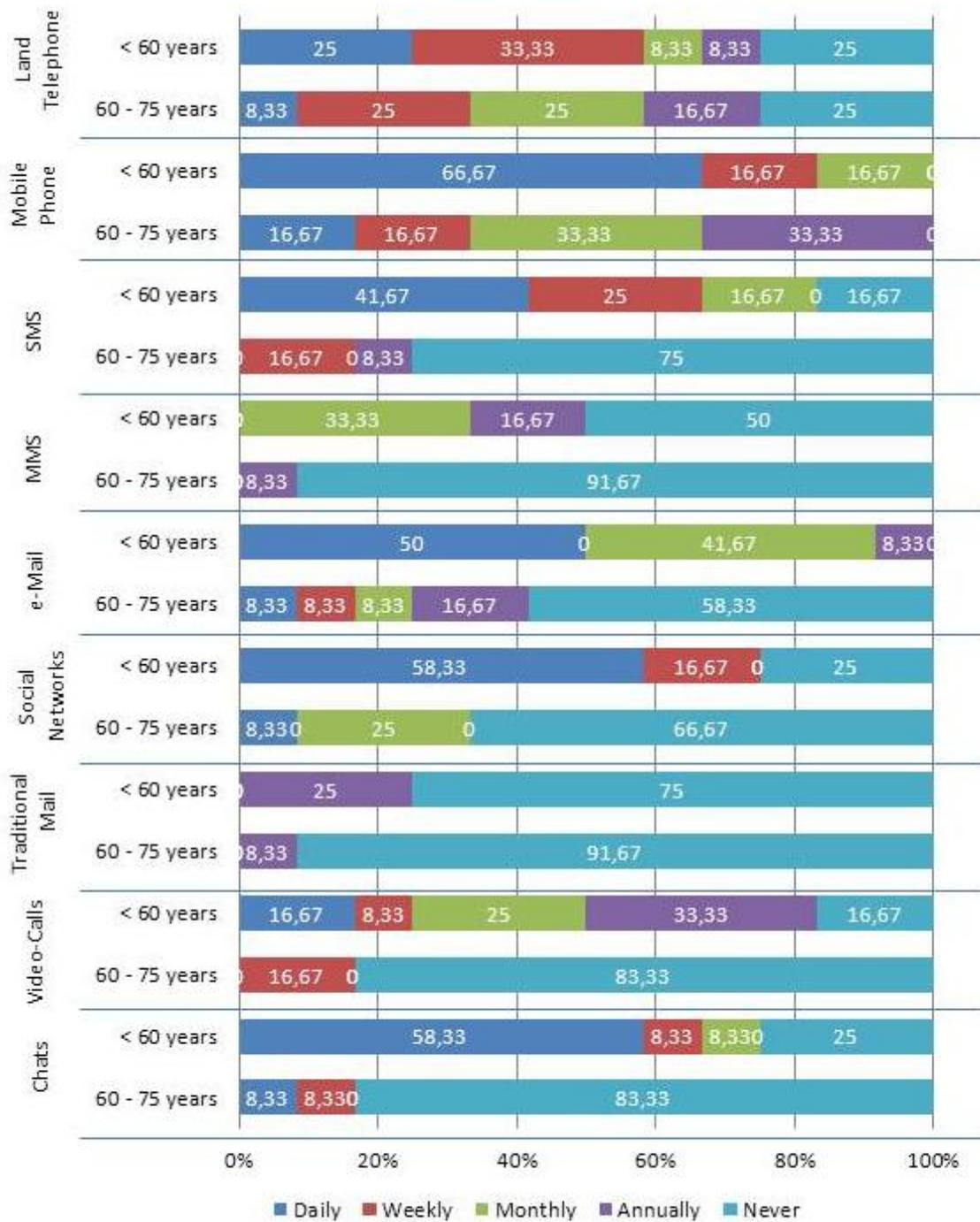
Figure 9. Secondary users new technological devices' use for interacting with their relations (Spain).

2.2.2.4. LEISURE ACTIVITIES IN DAILY LIFE

Participants were asked, in the interviews, for the activities that they perform in their free time. The aim of these questions was to know their preferences and use this information in the design of the 3rD-LIFE platform.

Participants from primary target group named the following activities as their favourites for doing in their free time:

- Sports.

The sport activity that most participants have interest in is walking and, especially in the nature ("through the mounts"). Also, in less proportion they have interest in going to gym (yoga, aerobic, etc.), cycling and swimming.

- Games.

The games that most participants do are playing cards, bingo and board games.

- Cultural activities.

From the information gathered in the interviews, the cultural activities that most of the primary users have interest are reading and taking course. Also, in less proportion, many participants like going to the cinema, music concerts and lectures. Some participants showed interest in theatre and museums.

- Social activities.

The social activities that most participants have interest are eating/meals and shearing time or going out with friends. Also, in less proportion, some participants like having drinks (going to bars or cafés) and doing excursions.

- Others activities.

In addition, most participants like to travel, and they like to travel with companion (family, friend or people with whom they shear other activities like courses or choir). Finally, some

participants mentioned some extra activities like using internet, sewing, doing manual labours and gardening.

Furthermore, the activities that they want to do with their relatives are chatting, sharing meals and walking. Furthermore, the activities that they would like to do with friends are more cultural, like going to lectures or having courses together.

Finally, they were asked for activities that they would like to do in a future. Most of these activities were adventure sports, like parachuting, bungee jumping or scuba diving; and travelling.

Secondary users were asked for activities that they would like to do with their closest relations with ages between 60 and 75 years old, that is with the primary users of 3rD LIFE.

They mentioned that they would like to play cards or board games together. Also, they would like go to the cinema, music concerts, museums, theatre and travelling with their relatives more often.

Finally, some of the secondary users said that they would like to have video-calls and using the social networks with their relatives as contacts.

2.2.2.5. USE OF OTHER TECHNOLOGICAL DEVICES AND SERVICES

Due to the need of knowing what technological devices are used by the potential users of 3rD-LIFE system, participants were asked for the use that they make of other devices. Some of them could be used for using 3rD-LIFE (i.e. smartphone) and others could be interesting for including them in the platform (i.e. mp3 player or radio).

As in previous sections, data from primary and secondary users are presented together below, in figures 10 and 11.

Results obtained in Spain by primary users show that, on a daily basis, they use a personal computer or a laptop, and Internet for general purposes. They also use Internet for banking and other government applications at least once a month.

Besides that, they also use television and radio as applications that can be potentially added to 3rD-LIFE platform.

In addition, two questions were asked in order to know if older participants were used to the video-games and the 3D environments. The answers to both questions were that they hardly ever had played to video-games or to a 3D video-game before.

In the other hand, results obtained by secondary users seems to indicate that they use television and radio in their daily life less than the primary users, and desktop computer, laptop computer, smartphone and mp3 player. In the same way, secondary users make more use of the Internet services than the primary ones.
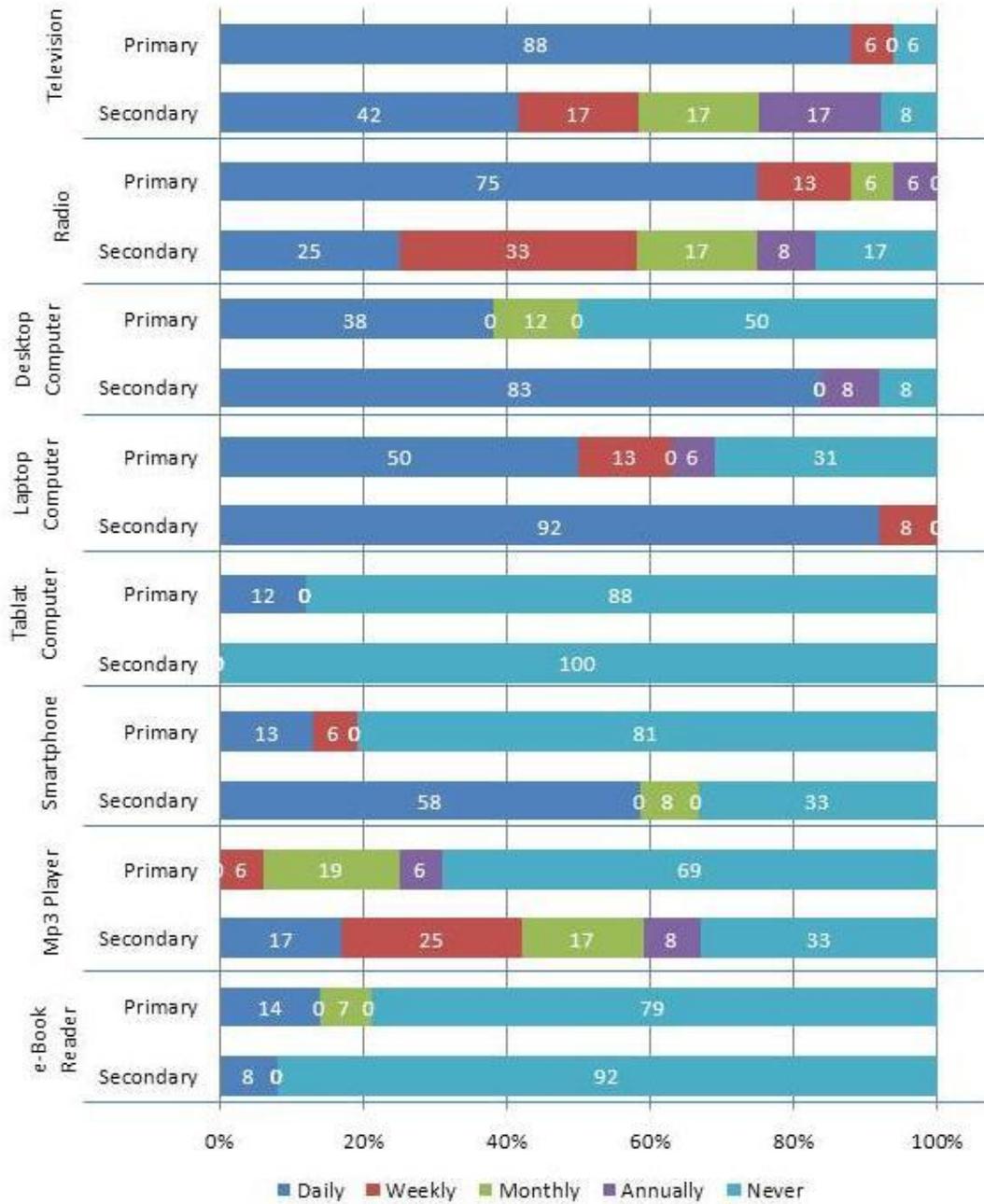
Figure 10. Users use of other technological devices (Spain).
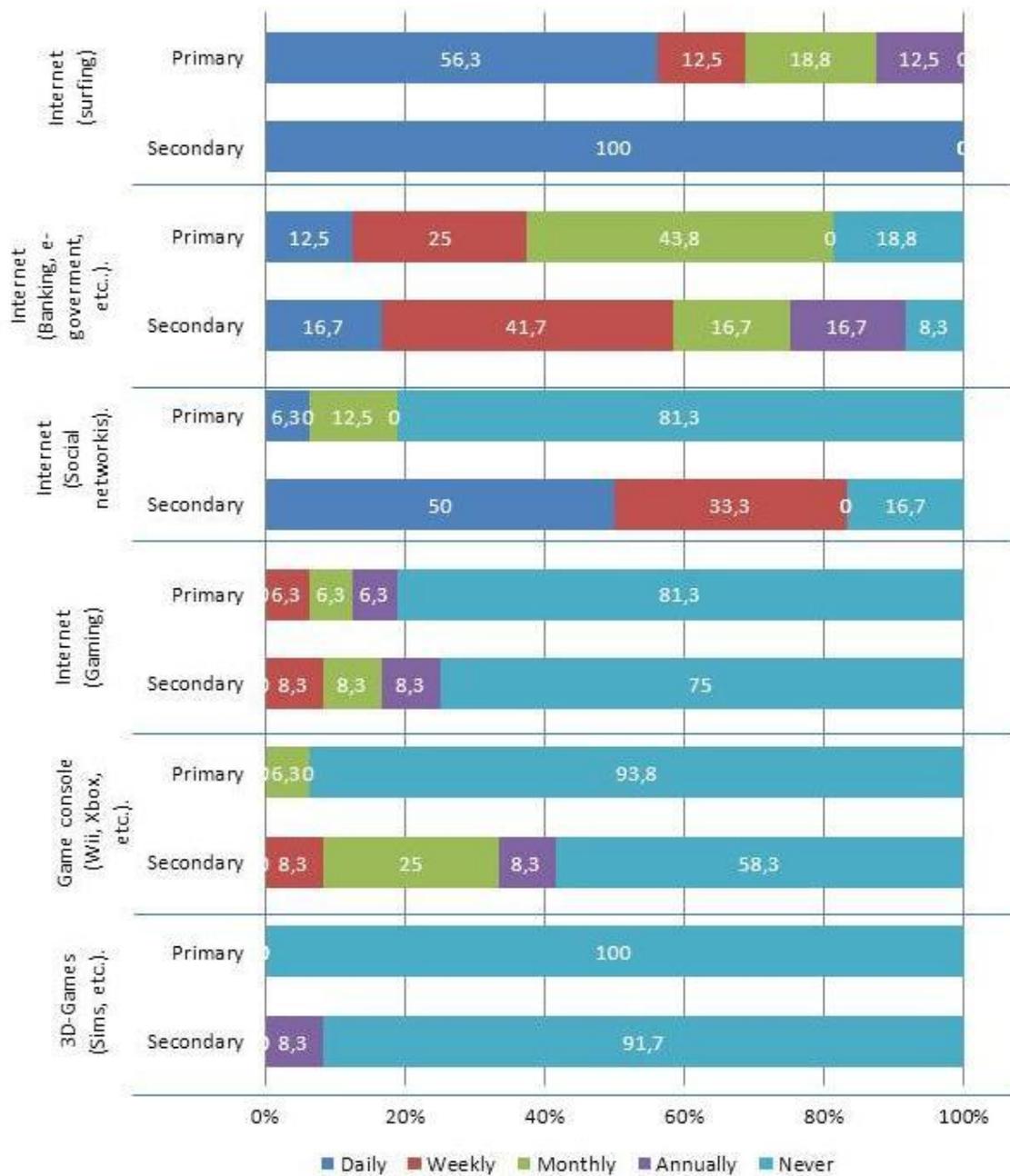
Figure 11. Users use of Internet services (Spain).

2.2.2.6.ATTITUDE TOWARDS THE INTERNET SCALE (ATIS)

We have transformed the data of the – Attitude towards the Internet Scale (ATIS), since we want to have a continuous measure of this Attitude. In order to have the same measurement level we inversed some of the items' outcomes. In this way, we have a range from 0 to 64, where 0 means a strong negative attitude toward the use of the Internet, and 64 means a strong positive attitude toward the use of the Internet. On table 2 can be seen the results of the users at Spain.

Table 2. Descriptive statistics obtained for the ATIS questionnaire (Spain).

	Mean	Std. Deviation	Range
Primary users	31,38	9,44	46 - 17
Secondary users	19,5	5,54	28 - 11

This means that primary users have, overall, a neutral attitude toward the use of the Internet whereas secondary users have, overall, a positive attitude.

In annex 5.3 it is presented a comparison between the results obtained for primary and secondary users in each of the items of ATIS questionnaire (all results are in percentages).

In figures presented in this annex can be seen that, overall, secondary users have a more positive attitude toward Internet than primary users. Moreover, secondary users prefer to use the different applications of the internet as searching for business and new information or the new ways for interacting like e-mails and social networks.

In the other hand, both groups have similar concerns, like privacy and the possibility that third people can access to their personal data, for example from banks and credit cards, and, overall both groups have had more good experiences than bad ones.

2.2.2.7.COGNITIVE ASSESSMENT

A cognitive assessment was carried out with 11 of the 16 primary users at Spain. The rest of primary users were not assessed because they did not want or can. CANTAB cognitive examination test [3] was used for this cognitive assessment.

The aim of those assessments was to ensure that primary users fulfilled the requirement for becoming part of 3rD LIFE users. As stated in D.2.1 primary users should not have cognitive deficits. For additional information, please go to section 4 of D.2.1.

Before explaining the outcomes obtained it is necessary to explain that outcome will be show as Z-score. Any outcome (Z-score) between -1,96 and +1,96 is in the 95% of the normal distribution. This means that if the outcomes lie in this range it can be said that they belong to someone who doesn't differ of the normal population when adjusted for its age. In other words, if all Z-scores are between -1,96 and +1,96 it can be said that the users fulfil the cognitive requirements.

The first exercise was the *Reaction Time Test* (RTI). As said before RTI is designed to measure the reaction time to a visual stimulus, where the stimulus is either predictable or not. The user must react (touching the screen or unpressing a button) to the stimulus as fast as possible.
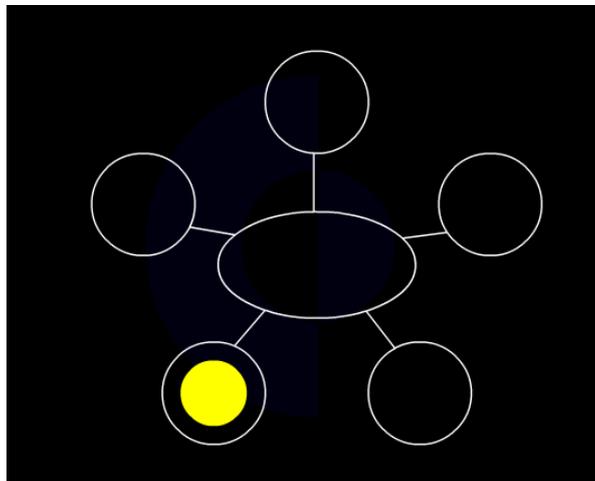

Figure 12. Screen-shot of the Reaction Time Test.

The outcome measures for the RTI test may be divided into the following groups:

-Reaction time.

In this section are included the "RTI Simple reaction time" and the "RTI Five-choice reaction time". These are "the speed with which the subject releases the press pad button in

response to the onset of a stimulus in a single location or in response to a stimulus in any one of five locations" [3], respectively. Reaction time latency is measured in milliseconds.

-Movement time.

"RTI Simple movement time" and "RTI Five-choice movement time" are in this other section. These are "the time taken to touch the stimulus after the press pad button has been released in trials where stimuli appear in one location only or in one of vive possible locations" [3], respectively. Movement time latency is measured in milliseconds.

In the Table 3 can be seen the results of primary users in the RTI test.

Table 3. Results of the primary users in the RTI test.

	Mean	Std. Deviation	Range	Z-score Range
Simple Reaction Time	347.92	131.85	209.00 (min.) 685.38 (max.)	1.39 (min.) -4.07 (max.)
Five-choice Reaction Time	349.53	59.35	284.63 (min.) 451.00 (max.)	1.26 (max.) -1.44 (min.)
Simple Movement Time	438.14	106.51	316.00 (min.) 648.25 (max.)	1.38 (max.) -1.02 (min.)
Five-choice Movement Time	385.16	76.97	274.13 (min.) 517.50 (max.)	1.81 (max.) -0.28 (min.)

As can be seen only one result is under -1.96. This result seems to indicate that a user is under the normal performance of the people with its age. But looking across the results of that user, it can be said that this result does not indicate properly the capacities of the user and the reason of that result could be a different one, maybe the users was not concentrate in this first test or maybe the evaluator did not explain the task properly. As conclusion, it can be said that users have a normative execution on this Reaction Time Test. So, in general the users show a good level of reaction to a visual stimulus.

The second exercise was the *Pairs Associated Learning* test (PAL). As said before, this test assesses visual memory and learning capacity. A certain number of boxes open randomly. Some of them contain objects and the users must keep in mind which objects are contained in their respective boxes.
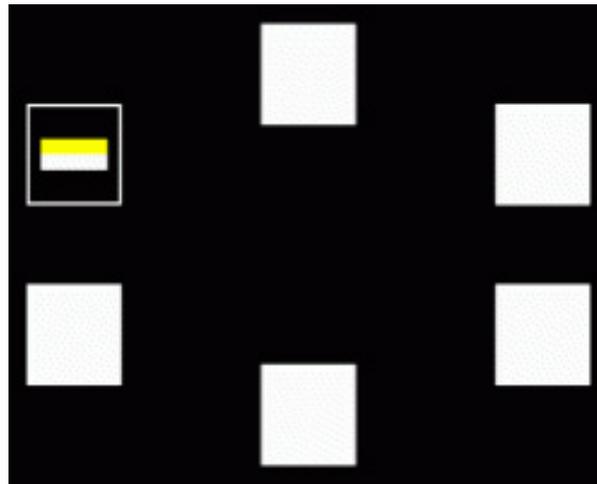
Figure 13. Screen-shot of the Pairs Associated Learning Test.

The outcomes measures for the PAL test may be divided into the following groups:

-Errors.

Errors are made in PAL when the subject selects a box that does not contain the target stimulus.

In this section are included "PAL Total Errors", "PAL Total Errors (adjusted)" and "PAL Mean Errors to Success". The first measure reports "the total number of errors. Note that subjects failing at any stage of the test have had less opportunity to make error than subjects who complete the test". The second measure "attempts to compensate this" and reports the "total number of errors, with and adjustment for each stage not attempted due to previous failure". The third measure "summaries, for all stages, the mean number of error made before the stage was successfully completed". [3]

-Trials.

In this section are included "PAL Mean Trials to Success", "PAL Total Trials" and "PAL Total Trials (adjusted)". The first "is calculated by calculating the total number of trials required to collate all the patterns correctly in all stages attempted, and dividing the result by the number of successfully completed stages". The second measure "represents the total number of trials required to locate all the patterns correctly in all stages". Note that subjects who fail to complete the test will have had fewer PAL Total trials, simply because they had

less opportunity to make error than subjects who completed the test. "One way of dealing this is use the third measure that attempts to control this situation. [3]

-Memory Score.

"PAL First Trial Memory Score" is included here. This measure "is the number of patterns correctly located after the first trial, summed across the stages completed" [3].

-Stages completed.

In this section are included "PAL Stages Completed" and "PAL Stages Completed on First Trial". The first measure is "a key indicator of the subject's overall success, recording how many stages were successfully completed. When analysing other outcomes measures from PAL it is crucial that analyses are conducted with reference to the number of stages completed. Clearly a subject that fails prior to the successful completion of the 8-pattern stage will have had less opportunity to make errors than a subject who completes the test". And the second measure "is the number of stages passed on the first trial". [3]

In the Table 4 can be seen the results of primary users in the PAL test.

Table 4. Results of the primary users in the PAL test.

	Mean	Std. Deviation	Range	Z-score Range
Total Errors	19.73	12.78	5.00 (min.) 38.00 (max.)	0.85 (max.) -0.94 (min.)
Total Errors (adjusted)	21.00	15.25	5.00 (min.) 52.00 (max.)	0.78 (max.) -1.06 (min.)
Mean Errors to Success	2.53	1.71	0.63 (min.) 5.43 (max.)	0.95 (max.) -1.39 (min.)
Mean Trials to Success	1.25	0.54	1.25 (min.) 2.86 (max.)	0.82 (max.) -1.09 (min.)
Total Trials	14.36	3.83	10.00 (min.) 20.00 (max.)	1.02 (max.) -1.05 (min.)
Total Trials (adjusted)	14.46	3.98	10.00 (min.) 21.00 (max.)	0.77 (max.) -0.71 (min.)
First Trial Memory Score	17.82	3.37	11.00 (min.) 21.00 (max.)	-1.43 (min.) 0.69 (max.)
Stages Completed	7.91	0.31	7.00 (min.) 8.00 (max.)	-1.49 (min.) 0.33 (max.)
Stages Completed on First Trial	5.55	0.82	4.00 (min.) 6.00 (max.)	-1.33 (min.) 0.32 (max.)

As expected, in the Table 4 can be seen all the results for users in the PAL test and they are between normal values.

The last task was the *Spatial Span* test (SSP). As explained earlier, this task is a computerized version of the Corsi Blocks task, assessing working memory capacity. This gives a measure of working memory; a capacity mediated by the frontal lobe. A pattern of white boxes is shown on the screen. Some of the boxes change in color, one by one, in a variable sequence. The subject must memorize the sequence and touch the boxes in this order.
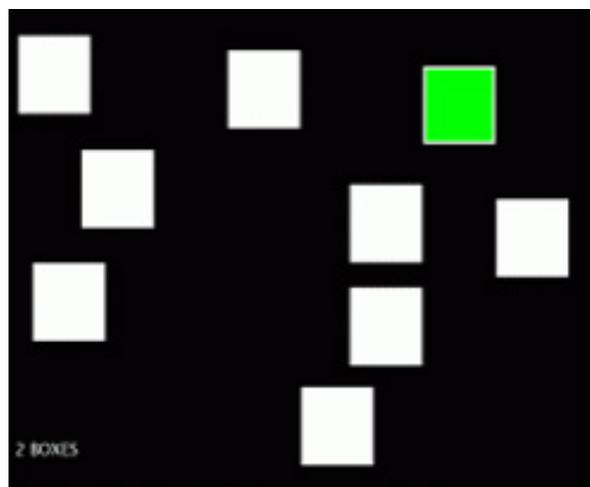

Figure 14. Screen-shot of the Spatial Span Test.

The outcome measures for the SSP test may be divided into the following groups:

-Span length.
"SSP Span Length" is "the longest sequence successfully recalled by the subject". [3]

-Errors.
"SSP Total Errors" and "SSP Total Usage Errors" are included here. The first is "the number of times the subject selected an incorrect box". The second is "the number of times the subject selected a box not in the sequence being recalled". [3]

In the Table 5 can be seen the results of primary users in the SSP test.

Table 5. Results of the primary users in the SSP test.

	Mean	Std. Deviation	Range	Z-score Range
Span Length	5.56	0.73	5.00 (min.) 7.00 (max.)	-0.39 (min.) 1.08 (max.)
Total Errors	12.64	5.50	6.00 (min.) 23.00 (max.)	1.23 (max.) -1.54 (min.)
Total Usage Errors	2.82	1.83	0.00 (min.) 6.00 (max.)	1.36 (max.) -1.77 (min.)

Again in the Table 5 can be seen all the results for users in the PAL test and they are between statiscally normal values.

As conclusion, all results of the assessed people are included between the statiscally normal range for people with their age. In this way, it can be concluded that all the assessed users are cognitively healthy people.

2.2.3. RESULTS IN AUSTRIA

2.2.3.1.   DEMOGRAPHIC DATA

In order to gain a general overview, we collected information on the target users groups, such as their education level and marital status.

80 participants from the primary target user group were sent an invitation for the participation. 36 (19 female, 17 male; Mean Age= 66,7) of them accepted the invitation and 30 of them fully completed the questionnaire. 28% of the participants from the primary target user group were living alone, 69% were married, and 91% were retired (See Figure 15.). Except of only 9% the participants graduated from a high school, university of similar higher education.

80 participants from the secondary target user group were sent an invitation for the participation. 37 (14 female, 24 male; Mean Age= 36,6) of them accepted the invitation and 25 of them fully completed the questionnaire. 57% of the participants from the secondary target user group were university or similar higher education graduates, and 46% is married (See Figure 15.) and only 3 of them were living with either parents or grandparents. Both of

the user groups were interested in evening courses or adult education primary users with 34% and secondary user with 30%.
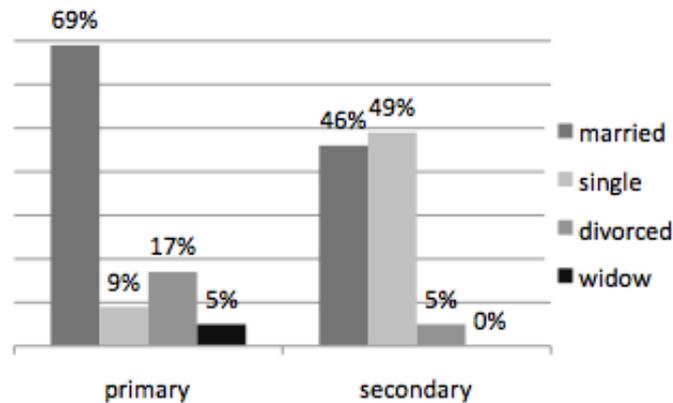

Figure 15. Marital status of the online questionnaire participants.

2.2.3.2. CLOSEST RELATIONSHIPS

3rD-LIFE project aims to help its primary users to create social interactions over the platform. Therefore, we asked about the relationships that the user groups have, in order to learn which user group see which kind of closer and have regular social contacts.

Both of the user groups were asked to list up to 15 people that they feel close to themselves (1=closest). Participants from the primary user group listed in the first 3 places mainly family members and listed friends and other relatives later on. Generally the children were listed as closer than the grandchildren and the ratio of friends listed is higher than the grandchildren. This indicates that for the primary user group the close connections are the siblings, children, friends and children-in-law and rarely grandchildren.

Participants from the secondary user group included friends also as closest relationship in the first three places. Grandparents and older family members were listed rarely and after the first three closest connections; however, parents were listed often, also as the closest person (only mother). The ratio of siblings listed is higher than friends.

Based on the listing, the participants from the primary user group were asked how distant these people live from the primary user group. Results indicate that even the closest relationships listed by the primary users live abroad or in another city. (See Figure)
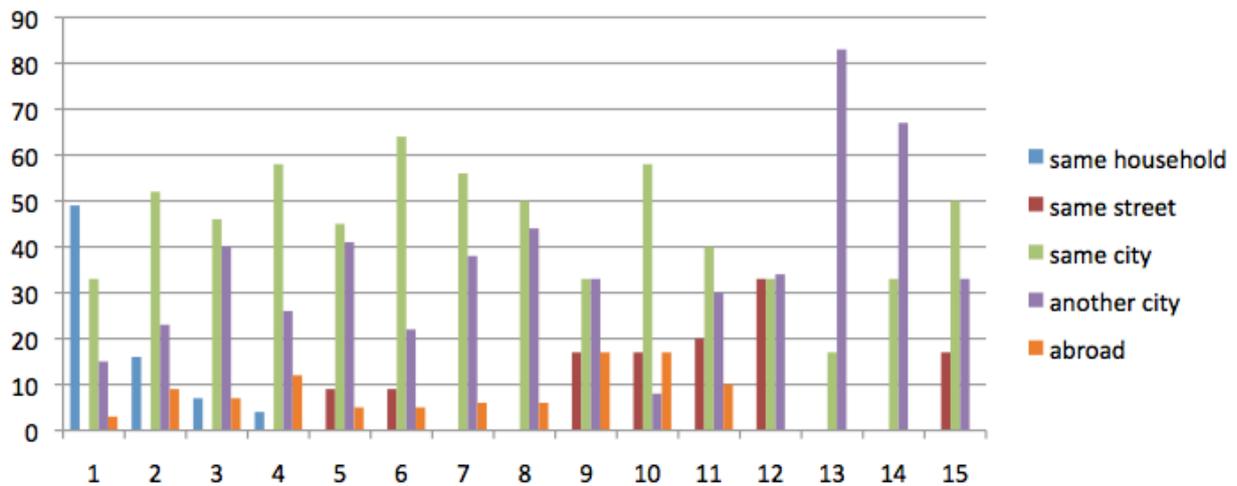
Figure 16. The distance of the households of the 15 close people listed by the primary users. 1= the closest person, mostly in the same household.
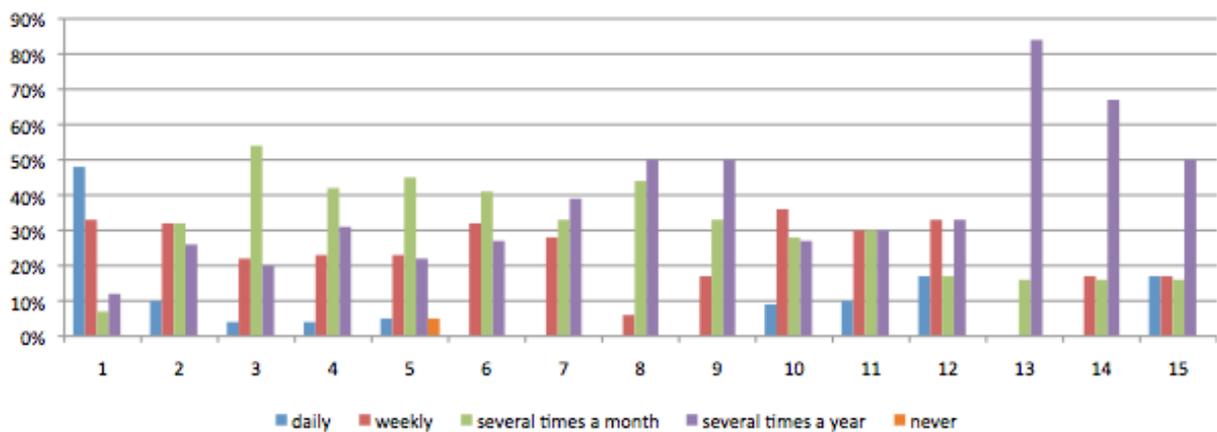

Figure 17. Frequency of meeting personally with the 15 close people listed (for the primary user group)

Consecutively, the participants were asked about the frequency of meeting these close people personally. Primary user group participants often have close contacts that they rarely or never see personally. (See Figure) 50% of the participants from the secondary target user group do not meet their grandparents personally. (See Figure) A reason for this is that because they may not be alive. However, meeting friends and parents show a similar pattern.
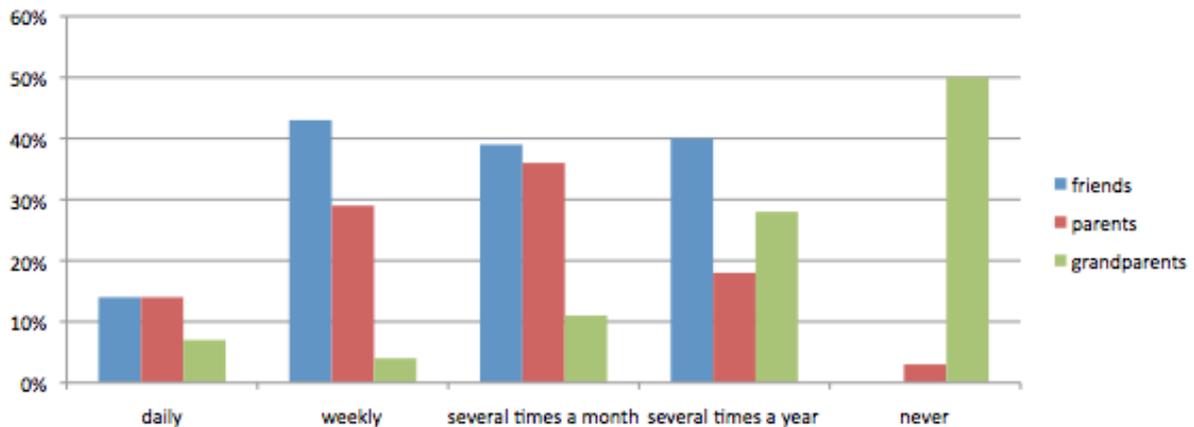
Figure 18. Frequency of meeting personally (for the secondary user group)

Majority of the participants from the primary target user group prefer receiving these close people as guests at their homes, and the second option is visiting them at their places. They prefer meeting in a coffee house, restaurant or shopping mall rather than meeting outside in a park, garden, etc. This question is again asked only for the relationship with grandparents, parents and friends in general, for the participants from the younger age group. The results indicate that they prefer visiting their parents and grandparent rather at their homes rather than receiving them as guests. However, this is balanced in the relationship with friends. Friends are preferred to meet in a shopping mall, library, etc, and grandparents are most preferred to meet outside in a park, garden, etc.

2.2.3.3. USE OF THE COMMUNICATION CHANNELS FOR INTERACTING WITH THE CLOSEST RELATIONSHIPS

We asked about the communication channels that are used for interacting with the closest contacts to see if there are differences in technology usage. Results indicate that (see Figure) the majority of the participants from the primary user group use mostly mobile phones daily (62,5%) to communicate with the close people they listed. They also use E-Mail daily (31.25) and SMS (12,5 %).
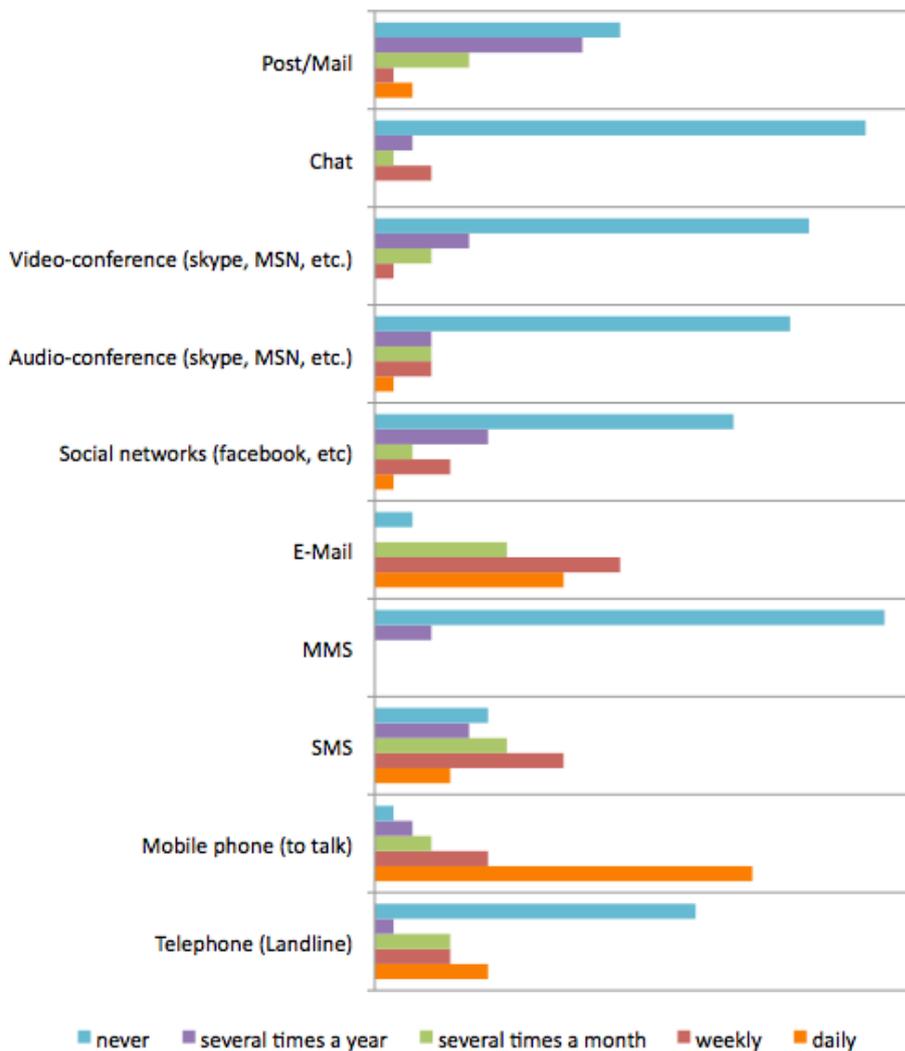
Figure 19. Frequency of communication channel usage by the primary user group

Overall the most used communication channel (overall percentage of users of the channel) by the primary user group is email (93,75%). Then the order of channels from most commonly used to the least used is: Mobile phone (to talk) (87,5%), SMS (81,25%), post (59,4%), telephone (46,9%), online social networks (40,6%), audio-conference (31,3%), video-conference (28,1%), chat (18,75%) and MMS (9,3%). (See Figure)
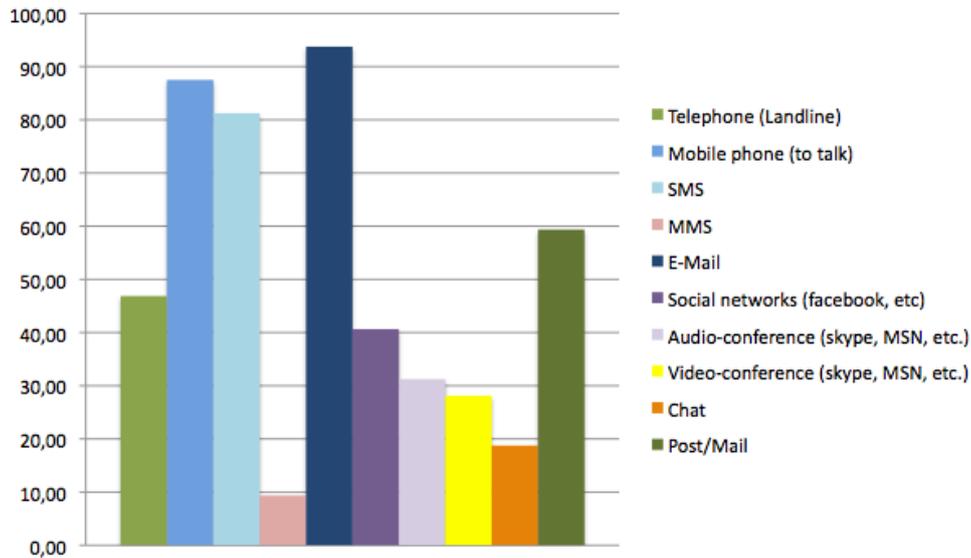
Figure 20. Overall percentage of the primary users interacting with the closest people they listed over the communication channel

The participants from the younger age group were asked this question separately for the communication with their grandparents, parents and friends. The results indicate that the participants have very little contact to their grandparents and other older family members, and the communication they have is mostly over mobile phone to talk (40,73%), landline phones (33,3%) or via post (33,33%). They have either no or almost no contact with their grandparents over chat, audio-& video-conference, online social networks or MMS. The result indicate that the secondary user group have more daily contacts with friends than parents and grandparents as expected. Participants from the secondary user group use all of the communication channels asked in the questionnaire and all of them used mobile phone to talk, SMS and almost all of them email (96,3%) to communicate. (See Table 3)

Table 6. Percentage of communication channel usage and frequencies (Secondary user group)

		daily	weekly	several times a month	several times a year	never	overal percentage of secondary users using
Telephone (Landline)	Friends	0,0	11,1	11,1	25,9	51,9	48,2
	Parents	11,1	25,9	11,1	3,7	48,2	51,9
	Greatparents	0,0	11,1	14,8	7,4	66,7	33,3
Mobile phone	Friends	44,4	29,6	22,2	3,7	0,0	100,0
	Parents	29,6	33,3	14,8	11,1	11,1	88,9
	Greatparents	0,0	3,7	22,2	14,8	59,3	40,7
SMS	Friends	51,9	18,5	22,2	7,4	0,0	100,0
	Parents	3,7	25,9	11,1	29,6	29,6	70,4
	Greatparents	0,0	0,0	11,1	3,7	85,2	14,8
MMS	Friends	0,0	3,7	14,8	22,2	59,3	40,7
	Parents	0,0	3,7	3,7	7,4	85,2	14,8
	Greatparents	0,0	0,0	0,0	0,0	100,0	0,0
E-Mail	Friends	29,6	25,9	33,3	7,4	3,7	96,3
	Parents	3,7	14,8	18,5	22,2	40,7	59,3
	Greatparents	0,0	0,0	3,7	11,1	85,2	14,8
Networks (facebook, etc)	Friends	33,3	25,9	11,1	0,0	29,6	70,4
	Parents	0,0	0,0	11,1	0,0	88,9	11,1
	Greatparents	0,0	0,0	0,0	3,7	96,3	3,7
conference (skype, MSN, etc.)	Friends	3,7	11,1	33,3	14,8	37,0	63,0
	Parents	0,0	0,0	14,8	7,4	77,8	22,2
	Greatparents	0,0	0,0	0,0	0,0	100,0	0,0
Video-conferen	Friends	3,7	3,7	22,2	25,9	44,4	55,6
	Parents	0,0	0,0	11,1	7,4	81,5	18,5
	Greatparents	0,0	0,0	0,0	3,7	96,3	3,7
Chat	Friends	18,5	22,2	11,1	14,8	33,3	66,7
	Parents	0,0	0,0	7,4	0,0	92,6	7,4
	Greatparents	0,0	0,0	0,0	0,0	100,0	0,0
Post/Mail	Friends	0,0	0,0	3,7	44,4	51,9	48,1
	Parents	0,0	0,0	3,7	44,4	51,9	48,1
	Greatparents	0,0	0,0	0,0	33,3	66,7	33,3

2.2.3.4. LEISURE ACTIVITIES IN DAILY LIFE

In order to gain insight about the leisure activities of the target user groups for collection ideas on possible activities to offer over 3rD-LIFE platform, we asked participants from the primary user group what they like to do in their leisure time alone, with friends and with family members. The secondary user group was asked the activities they like to do with their older family members. The participants from the primary user group named the following activities as their free time activities:

- Travelling

- Visiting museums or exhibitions

- Going to theatre, cinema

- Sports (walking, gymnastics, swimming)

- Handicrafts (technical, arts)

- Voluntary social work

- Gardening

- Games (Chess, cards, brain teasers)

- Discussions, conversations for intellectual exchange

The favourite activities highlighted by the participants from the primary target user group for doing together with **_friends_** are the following activities:

- Voluntary and social activities

- Travelling

- Cultural activities (theatre, exhibition, etc.)

- Political and intellectual discussions

The favourite activities highlighted by the participants from the primary target user group for doing together with **_family members_** are the following activities:

- Hiking, walking

- Travelling

- Celebrations (Birthday, etc.)

- Eating out together, or garden/ barbecue party

The participants from the secondary user group named the following activities as their free time activities:

- Different kinds of sports

- Reading

- Meeting friends

- Cooking

- Going to cinema

- Gaming

The younger participants named the following activities that they like doing together with their grandparents:

- Visiting the graveyard

- Playing cards and multiplayer cardboard games

- Having a chat over coffee/ tea

- Taking a walk

- Celebrations (Birthday, Christmas, etc.)

The younger participants named the following activities that they like doing together with their family in general:

- Eating together at a restaurant or having a coffee together

- Cooking together

- Taking a walk or going to a journey together

- Celebrations (Birthday, Christmas, etc.)

- Shopping

- Making sports (Tennis, gymnastics, ski, etc.)

These match with the favourite activities of the participants from the primary user group. Especially:

- Celebrating together,

- Cooking/ barbecue together or going out to eat

- Taking a walk together or sport activities (swimming, ski, etc.)

- Playing games

Participants from both of the user groups answered that they are attending courses in their free times. The common personal education courses that both groups attend in their free time are:

- Language courses

- Computer courses

- University lectures in different disciplines (Medicine, Management, etc.)

55% of the primary target user group participants listed activities that they would like to do, but cannot do anymore due to health condition, financial or other limitations. These are:

- Expeditions, long and distant travels (such as to Amazonas, Sahara, etc)

- Extreme sport activities (ski, climbing, diving, etc.) or sailing

The participants from the secondary target user group were asked this question differently. According to the results, 50 % of them listed activities that they would like to do together with their grandparents/parents or other older family members, but cannot do anymore due to health condition, financial or other limitations. These are:

- Travelling or having holiday together

- Swimming or diving

- Listening to the good old stories

58% of the participants from the primary target user group listed activities that they have never done before, but willing to do or dream of doing. These are:

- Balloon-tour, Paragliding, Skydiving

- Travelling with a ship, or train (also in places like Greenland, Siberia)

- Playing golf, tennis

- Doing extreme sports like diving, motor biking, survival training, climbing

Only 27% of the participants from the secondary target user group listed activities that they have never done before together with their grandparents/ parents or other older family members, but willing to do or dream of doing. These are:

- Wellness

- Using computer together

- Travelling together

- Making music together

2.2.3.5. USAGE OF TECHNOLOGICAL DEVICES AND SERVICES

We asked both of the user groups the technological devices they use in their daily life in order to investigate their experience with technological devices. Moreover, we asked them the purpose of their Internet usage. Results indicate that both of the user groups use intensively Internet (See Figure) and technological devices (See Figure).
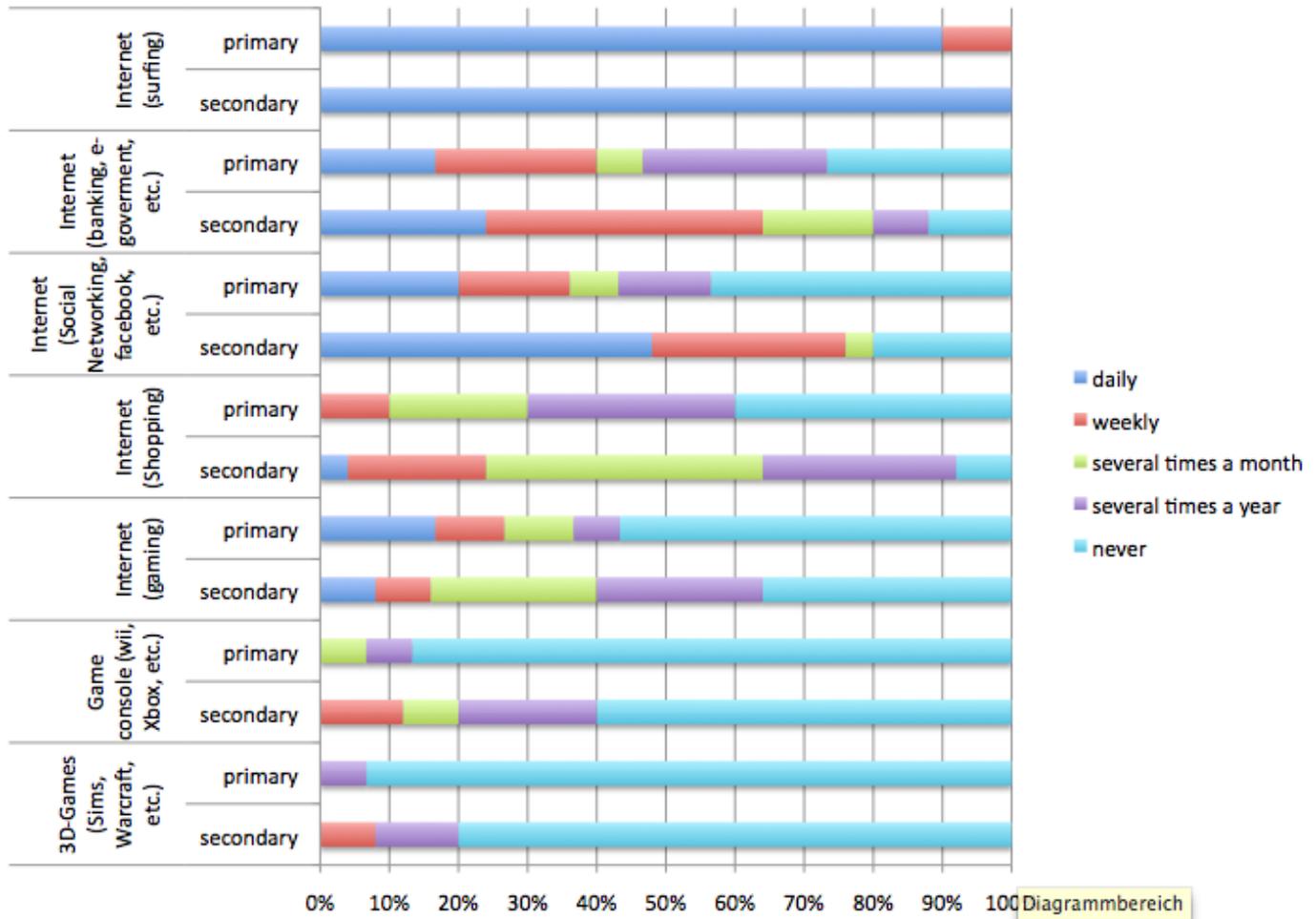
*Figure 21*. Frequency of Internet usage of both user groups with different purposes
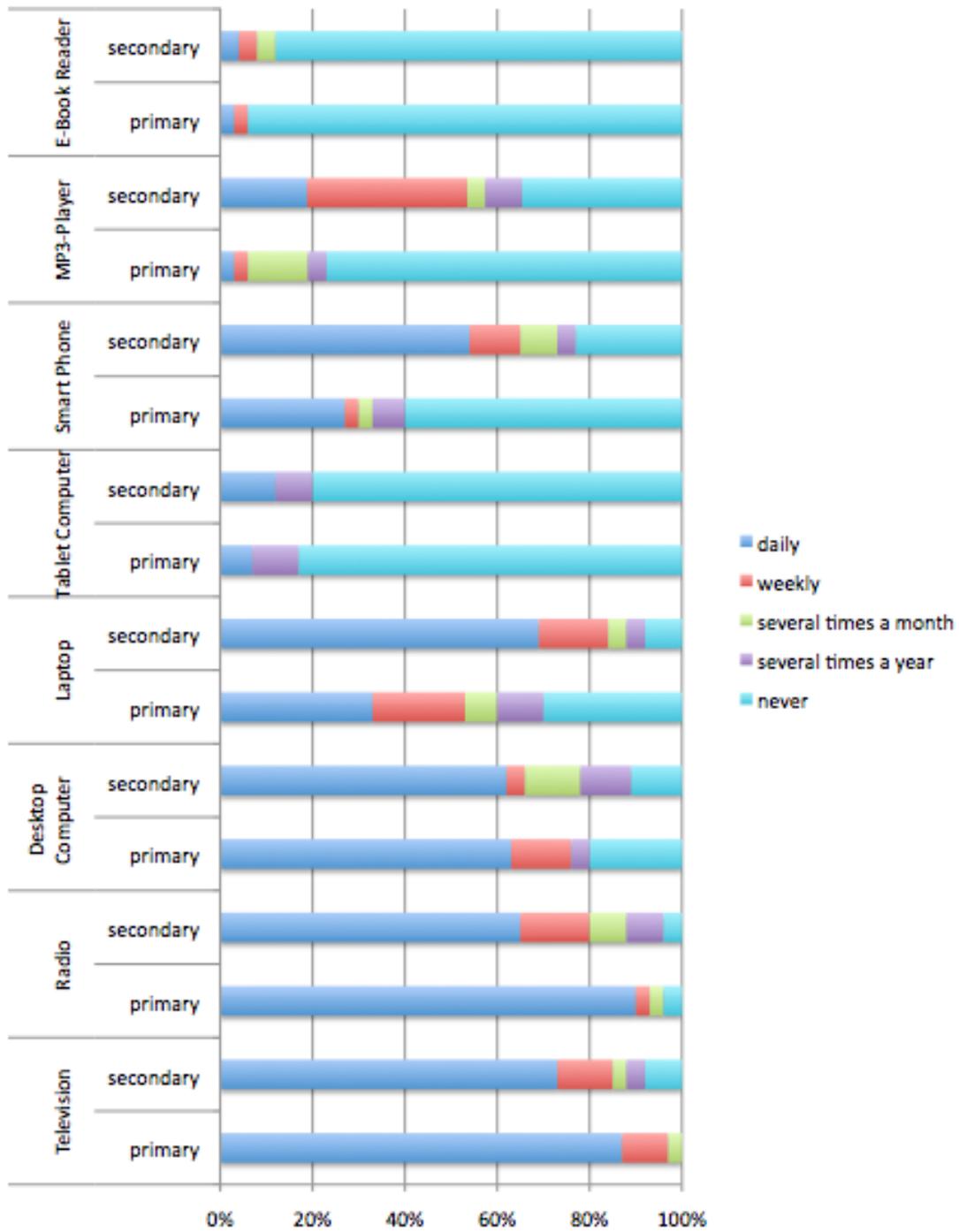
Figure 22. Frequency of technological device usage of both user groups

2.2.3.6. ATTITUDE TOWARDS INTERNET USAGE (ATIS)

The ATIS – Attitude towards the Internet Scale is used for both of the user groups (see Appendix). This validated general-purpose scale consists of 16 questions related to Internet usage [1]. Results (Primary Users N=30 , Secondary Users N=25) indicate that both of the participant groups use Internet and have generally a positive attitude towards using Internet (Primary 74%, Secondary 80%).

The results for single elements from the two different user groups are mostly parallel to each other, however the attitude of the younger participants are mostly more positive than the older users.

Even though they have some privacy concerns (anxiety that personal or communication information would be visible to others), both of the user groups stated that they had good experiences with Internet (Primary 93%, Secondary 96%). The results of the older participants indicate that they hesitate more to shop online (Primary 54%, Secondary 16%) or using credit cards online compared to the younger users (Primary 57%, Secondary 28%).

The questions and the different attitudes of the two user groups can be consulted in the annex 5.4.

2.3. PHASE 2: REQUIREMENTS ON THE CHARACTERISTICS OF THE 3D ENVIRONMENT

2.3.1. GENERAL PROCEDURE IN SPAIN

In a second round, focus groups were carried out in which more specific issues about the system were discussed. *Focus groups* are group discussions where a moderator leads participants through questions on a specific topic. It focuses on uncovering participants' feelings, attitudes, and ideas about the topic. In a focus group, about six to nine users are brought together to discuss new ideas and identify issues. The session is completed in about two hours. Each group is run by a moderator who is responsible for maintaining the focus of the group on the issues of interest. Often, the results of a focus group contain users' spontaneous reactions and ideas elicited through the interaction between the participants

3rD-LIFE focus group studies were conducted to gain qualitative data so as to identify basic primary and secondary users' needs and to gain input about the ways they interact between them.

The general procedure of user requirements gathering phase was previously detailed described in D2.1. In order to remember the main issues to the reader, these have been summarized in the next paragraphs.

During the focus group sessions, the goal was to obtain feedback from potential users on the usefulness and appropriateness of applications and services in future home environments to guide 3rD-LIFE design. All the focus groups were run in the language of the country where the participants work or live. The topics included in all the focus groups were the following:

- Analysis of the devices/applications used by the elderly (telephone, mobile phone, SMS, MMS, e-mail, social networks, chat, etc.) and discussion about their knowledge of the functionality, their reasons for not using them, etc.

- Presentation of similar platforms (Wonderland and Second-Life) and a brief description of their functionality, avatars and landscapes.

- Privacy issues: which information they do not like to share, what are they afraid of, information displayed on their profiles, identification in the platform, etc.

- Appearance of the system: landscapes (size, type, maps, places, etc.) and avatars (type, customizability, navigation, etc.)

- Functionalities of 3rD-LIFE (games, forum, information sharing, etc.) and discussion on advantages/disadvantages over other devices/applications.

2.3.2. GENERAL PROCEDURE IN AUSTRIA

During Phase 2, the ability of the target user groups to interact with the 3D platform and their preferences about the 3D interface and the environment were investigated by semi-structured Interviews. They were carried out in September and November 2011 in Experience Labs of CURE, Austria, with participation of 11 primary (5 female, 6 male; Mean age= 66,6) and 9 secondary (4 female, 5 male; Mean age= 31,4) users.

Except of two, all of the participants from the primary user groups were daily Internet and computer users. None of them had experience with 3D video games or interfaces. Except of two inexperienced users, all of them were moderately experienced in using touch devices. Only two if them had active social network profiles (facebook.com)

All of the participants from the secondary user group were daily Internet and computer users. Four of them knew about 3D video games and interfaces before but didn't have experience in using them. All of them were experienced in using touch devices and had social network profiles (facebook.com)

In the session the following main aspects about the 3D Platform were explored:

Character of the 3D Platform: The design of the virtual 3D platform is restricted with the creativity of the developers and offers endless possibilities. However, the results of the requirements analysis will shape the design decisions. The preferences, dislikes and needs of the target user groups about the character (look & feel) of the 3D environment were asked and examined.

Character of the avatars: The target users are familiar with existing 2D navigations, where they are present as users of an interface. However, the concept that they are also a dynamic part of the platform is quite new for them. After making this aspect clear that they are a part of the interface (for the others), the look and feel of the avatars (e.g. human, animals, fictive creatures, clothing, etc.) were explored.

Design of activities and features: Activities are the most important factor to acceptance and adoption of the 3rD–LIFE by the target user groups. In 3rD-LIFE Platform there may be different kinds of activities such as public, private group or private alone activities. The preferences of the user groups regarding the possible activities in the 3rD-LIFE platform, privacy concerns were investigated.

Input devices/ Controllers (hardware): As 3rD-LIFE can be accessed only by Internet connection, there may be different types of hardware used, such as a desktop computer, a laptop, a tablet. Existing interaction types for 3D games designed for different types of devices are mouse, keyboard, combination of mouse and keyboard, special controllers or touch interactions. The most suitable control method(s) will be explored for both of the user

groups. Moreover, it is also considered if target user groups should access the platform over mobile applications.

As the focus of the second phase was on the characteristics of the 3D Environment, the user interface elements, activities and control methods; individual semi-structured interviews were carried out, where the participants tried out some existing 3D online platforms such as Second Life 0 and Twinity 0 using four different control methods (only mouse, keyboard and mouse, touch and 3D Mouse – Space Navigator 0)

Think aloud method 0 was applied (the participants were asked to tell what they were thinking while using the platform) and observations were carried out during the individual sessions. Questions about possible activities and features in 3rD-LIFE and possible reasons and motivations for using such a 3D platform were asked. Questionnaires for rating (5-point Likert-Scale) different aspects and elements of the 3D platform were given to the participants, after the conductor introduced the 3D platform and its features.

After the participants carried out tasks (walk and look around) with 4 different control methods on an online 3D Platform (SecondLife 0), they evaluated each method by using EmoCards 0. EmoCards is a non-verbal tool for the participants to report their emotions. Moreover, after each method and at the end overall the "ease of usage", "joy of usage" and "self-rated performance" of the control methods were rated on a 5-point Likert Scale. At the end of each session a technology acceptance questionnaire was used, which applies TAM 0 with a focus on virtual worlds.

2.3.3. RESULTS IN SPAIN

2.3.3.1. USE OF NEW TECHNOLOGICAL DEVICES FOR SOCIAL INTERACTION

The focus groups with both primary and secondary users (separate occasions) started with a brief discussion about the *different use of the technological devices for interacting with their closest relationships*. (See figures 8 and 9).

- Primary users

This group stated that they would prefer to use devices that they are already familiar with, and those they know how to operate, because they find them easy and useful. Furthermore,

primary users state that they find themselves worthless with new technological devices and that they are afraid of break since they don't know how to handle them.

Another reason they give for the low rate of use of new technological devices is that they do not need them because their social network do not use them. So, even if they themselves had interest in using them, they would have no one to communicate with. In addition, they find to have more friendly devices such as the land line or mobile phone, and they are useful for interacting with their closest persons.

One more reason for not using new devices is that they prefer to interact face to face instead, since with the new technologies we loose a lot of important information, like mood and facial expressions. Although they recognise that video-calls are a good way to communicate with close persons living far away.

Regarding the advantages and disadvantages of the use of these new technological devices, their preferences are shown in the table below:

Table 7. Advantages and disadvantages of the use of new technological devices for interacting with the closest relationships, **stated by primary users** (Spain).

Advantages	Disadvantages
-More fluent communications. -Quicker communications. -Faster access to big amounts of information. -Could be a good way for communicate with an impaired person. -Could be used for interacting with a several people at a time.	-Time consuming, less face to face interaction and less free time (technologies consume a lot of time). -Security problems like having access to personal data without permission. -Difficult to find people of the same age to interact with.

- Secondary users

Regarding secondary users they expressed that the most important differences between the use of new technologies with their younger and older closer people is that, in their opinion, the elderly haven't grown up with this kind of technology, so they are not used to handle and use the devices, and they need time to learn how to use them.

The young participant group also considered that it can also depend on a general lack of knowledge within the elderly group, about the functionalities that ICTs could really offer.

Regarding preferences on how to meet, the group of younger people agrees with the elderly, in that they also prefer the face-to-face contact.

The secondary users also think that since elderly are not used to the devices it generates negative stress and that the elderly are afraid to break the devices. Also they said that primary users don't have enough patience to learn and to use them. If a problem comes up the elderly get nervous and don't have the same experience or strategies to find solutions, as younger users have.

They agree with the primary users in the fact that, the lack of friends who use some technologies and applications makes them useless for them. The elderly already have their established group of friends and their way of communicating with them, something that they are not keen to change.

Because of the fast technological development, it is hard to follow the technological advances, even for the secondary users with more experience with ICT. This reinforces the use of the traditional communication media or face to face communication by the group of primary users.

Another barrier that causes the difference is that primary users many times don't have the access to the devices or internet or even don´t know about the technology itself.

Elderly often also feel, due to lack of experience, insecure towards new ICT because they think that the problems that might rise are more complex and harder to fix than they really are.

The secondary users group also thinks that elderly in general posses a negative attitude towards technology because they think that ICTs are more designed in general for younger individuals.

Table 8. Advantages and disadvantages of using the new technological devices for interacting with the closest relationships, **stated by secondary users** (Spain).

Advantages	Disadvantages
-To spend spare-time. -If they know that elderly family or friends would use the platform, the younger would communicate with them there to occupy there day a bit, to spend some time with them, and to motivate them to stay active. -It could be used for supervising to their elderly family/friends, and it would help the younger to worry less about them.	-In general they are not use to use this kind of media to communicate to elderly persons since they don't use it. -It is easier to just pick up the existing devices.

2.3.3.2. SECURITY ASPECTS

Regarding security aspects, participants were asked for the information that they are concerned to share at the Internet.

- Primary users

Participants highlighted that, when using a new system, it is important to know well the information that they would share with people that they already know/do not know, and the purpose of sharing it.

Most of them expressed feeling uncomfortable sharing personal data like address, ID number, phone number, e-mail address, banking data, etc.

In general, they are concerned about the use that other people could make of their personal data. For example they are afraid of having their identity "stolen". Another fear is that someone could use the information for sending advertisements or, even for planning a rip-off.

Despite all the above mentioned fears, if they could set up the security level of the 3rD LIFE platform they would share personal data, like name or age, hobbies and interests, data for meetings, etc. They won't share information like address and telephone number. In their opinion, sharing that kind of information they could gain in meeting new people with the same hobbies and interest.

- Secondary users

Secondary users also showed worries about sharing bank details and personal data, even though they are aware of a comprehensive security system. The secondary users group is also worried about the right to own and use pictures that are uploaded in the net, as well as political opinions, and general information that identifies them.

They also worry about information that can be misused in recruitment situations, for example companies that can get access to personal information before an eventual employment.

The secondary users are, as the primary, concerned about the fact that companies can have access to personal information with the intention to generate advertisements.

As the primary users, the secondary ones would like to set up the security level for the access to the personal data. In this way, they won't share the same information with well-known people than with the unknown. With unknown people they would only share generic information like favourites films, news of interest, hobbies, etc. Whereas with well-known people the will share more personal data.

On the other hand, they are aware that if they share some personal data, like hobbies or even academic information, they could increase their social networks and have access to job opportunities.

2.3.3.3. APPEARANCE OF THE PLATFORM

The next group of questions were thought for assessing the appearance of the platform.

Regarding the *appearance of the virtual space:*

- Primary users

They prefer realistic spaces; specifically they showed preference for the nature, like the forest and the mountains. Furthermore, they would like to have realistic spaces for specific purposes, for example a Café for chatting or meeting new people, a Cinema for watching

films (or having video-forums), etc. They expressed their absolute reject to sci-fi or fantasy spaces since they consider them for kids.

About the sizes of the spaces, they would like to have some restrictions in order to make easier the movements and the use of the platform in general. In addition, they would like to have a little schematic map that allows them a more intuitive navigation inside the virtual world and reducing therefore the fear of feeling lost.

They would also appreciate some information or help about each part of the platform or the virtual space. This information could be useful for learning the applications and different uses of the platform.

Regarding navigation in the 3D world, they would like to have several links for "tele-transporting" them to the different spaces of 3D-LIFE, so they could use the system in a faster way.

Regarding the possibility of sharing some (or all) spaces, they would like to have different spaces for different uses and levels of privacy, and they would like to have the "privilege" of setting up the security level of each place. For example, they would like to set up who can have access to these spaces, and who can make changes and add things and who doesn´t.

- Secondary users

As the primary users, this group prefer realistic scenarios. They won't like abstract or video-game-like scenarios. They would like having scenarios set up in well-known cities or at least in cities that they like. The reason for this is that this set up could increase the motivation for using the platform. In addition, as the older users said before, they would like to have different spaces for different things; it means that there could be a café for chatting, a theatre for watching concerts, an auditorium for listening to lectures, etc. In the same sense than the primary users expressed, they would like to have the option of setting up the security level and the access from unknown people.

They would also appreciate places that are limited in space, and places where there is help available on how to use the 3rD-LIFE system. Furthermore, they would also like to have

various links for "tele-transporting" them to different spaces of 3rD-LIFE and for making a more intuitive use of it.

Regarding *Avatars:*

- Primary users

Regarding appearance of the avatars, they prefer realistic avatars, as realistic as possible. They considered the possibility of generate the avatar from a picture and then modify this avatar. All participants agreed with the idea of having different elements and complements for customizing them, like clothes, hair, accessories, etc.

When considering avatar movements, they also prefer realistic movements instead of flying or floating in the air. About the controls, their general preference is "the easier the better", as voice or a tactile screen. On the other hand, they do not mind to use the keyboard or mouse because they are already familiarized with them.

- Secondary users

Once again, we found that both groups agree. The only issue that secondary users added is having the option of showing emotional states in the avatars, or having signs that have a meaning, like crying when feeling sad or wearing headphones when they don't want to talk to anybody.

2.3.3.4.APPLICATIONS

Primary and secondary users were asked for the applications they wanted for 3rD LIFE platform to have.

As found in previous sections, we have not found differences in what was expressed by both groups, therefore the inputs offered have been compiled in one section.

Participants would like to share information and experiences with known people regarding events or personal events from their lives. With unknown people, they would like to talk

about different topics, films or music, for example, they would like to have a forum with different topics where they could exchange opinions.

In addition, they would like to have the opportunity to meet new people and chat with them. An example would be searching for people with the same hobbies or interest and meet them.

Educational and training applications like lectures, courses, e-learning, etc. were of high interest to all participants. Regarding contents of the training, their preferred were languages, cooking, art, history, etc. Furthermore, the secondary users would like to upload videos and documents showing tutorials. With this application the users could have an e-learning tool in which users can have both roles, teacher and student, depending on the topic. It could be something like a "bank for exchange of knowledge".

Other kind of applications could be information of events in their cities (lectures, performances, concerts, etc.), links to newspapers or to the more important news in several newspapers, an application for listening to music or an application for communicate directly and quicker with the emergency services.

Finally, they expressed they would like to have cognitive games like sudokus, crosswords, real time games (cards, chess) to play with real people. Other kinds of games or video-games that they would appreciate are exercises of motor coordination, exercises for rehabilitation and to maintain their daily life functionality.

More specifically, for *interacting with their closest relationships*, they would like to have voice communication, video-calls, e-mail service, etc. In addition they would like to have the possibility to share music, pictures and videos, and be able to make comments in a forum or blog.

Asking for the *3rD LIFE advantages and disadvantages*, a difference between younger and older group is made here because the different answers given by them.

In Table 9 inputs obtained from the primary users group are shown. Inputs from the secondary users group are shown in the table 6.

Table 9. Advantages and disadvantages of using 3rD LIFE solution, **stated by primary users** (Spain).

Advantages	Disadvantages
-Using the Internet it is going to be more intuitive and this can be useful for introduce the users to it. -It is going to facilitate the contact between users that are far away one from another. -Users will have a lot of information at hand. -It is going to enhance personal interactions. -It could help to avoid loneliness in the elders. -It could facilitate sharing information and knowledge about several topics. -It could be useful for people with physical limitations.	-It is a new system and way of interacting and they are not familiarised with it. -Users could lose face to face contact. -High cognitive functioning is needed for learning to use it. -Previous knowledge about computers it is needed. -It is easier to use the current devices for communication, than a new one.

Table 10. Advantages and disadvantages of using 3rD LIFE solution, **stated by the secondary users** (Spain).

Advantages	Disadvantages
-3rD-LIFE will integrate different applications of the Internet in one tool and this fact could help to use them. -It could help to increase the social network and to improve the contact among people that are far one from another. -3rD-LIFE could be adapted to the needs and wishes of the elders. -It could improve the intergenerational contact between the elders and a younger generations.	-It is possible that some errors appear. If this happens, the users probably will leave the use of 3rD-LIFE and start using other tools that already exist. -It is probably going to be difficult to use 3rD-LIFE platform, but the existence of a virtual pet or virtual personal assistant who could help with the doubts and problems at any time could be of great help. -Using 3rD-LIFE could be a waste of time since several tools for interacting with other people on the Internet (like Skype, social networks, chats, e-mail servers, etc.) already exist.

2.3.4. RESULTS IN AUSTRIA

2.3.4.1.CHARACTER OF THE 3D-PLATFORM

As expected, it was difficult for some of the primary users to understand the main concept of 3rD–LIFE. At the beginning of the session, they thought that 3rD–LIFE is a game and they

were unconvinced about the usefulness. First after using the two different 3D platforms they were able to think about possible activities on 3rD–LIFE and how they may like to use it.

All of the participants from the primary target user group preferred to have an environment with some fine details, so that the environment wouldn't seem artificial or not too far from being realistic. Some example environments were shown to the users collected from SecondLife 0 and some other online platforms, such as twinity 0 and Active Worlds 0. The environments chosen among these by the majority of the participants from the primary target user group are shown in Figure 23..

Figure 23. The most preferred environments 0 by the primary user group for 3rD–LIFE. On the left, indoors - a museum, theatre or concert hall and on the right, outdoors – a city centre with possible extra indoor places.

There are two main reasons behind this preference. First, the key intention of the primary user group to spend time on "something that makes sense" such as cultural activities, visiting museums, watching concerts, gathering information about a city that they may like to visit, etc. The second is the difficulty they had as they tried to navigate in an outdoor environment with natural barriers such as, trees, bushes, fences, etc. On the other hand, they also had difficulties indoors in way finding and manoeuvring, especially on the way back to the entrance hall through narrow corridors and rooms.

Participants form the secondary user group were more open for different ideas and some of them liked the idea of being able to explore a fantasy land. Especially the participants from the secondary user group found it very cumbersome and time consuming to have to walk long distances in the 3D environment, just to be able to enter a special area or use a feature such as video call.

Both of the user groups found background music inacceptable and annoying. However, all thought of discreet sound effects, such as the sound of footsteps, closing doors or birds

attractive, which may also be used as alarms or signals for the object to be interacted, however not as a primary feature of the system.

2.3.4.2.CHARACTER OF THE AVATARS

The conception of avatars as mediators for being in a virtual world is an important factor in designing virtual worlds. On the one hand the user transforms and becomes his/her avatar, on the other hand the user is transformed by the avatar. Different concerns and viewpoints were raised for the outlook of the avatars. While some of the participants tend to have an avatar, which looks like them, some preferred having a cartoon-like character.

In Figure 12, on the left (Photofit application selected by 5 participants – 2 elderly & 3 younger) and in the middle (smeet 0 avatars selected by 6 participants – 2 elderly & 4 younger) are realistic avatars, which were preferred by both of the user groups, however more by the secondary user group. On the right the character selected by 4 participants – 3 elderly & 1 younger) is a completely other style, which was preferred most by the primary user group participants.
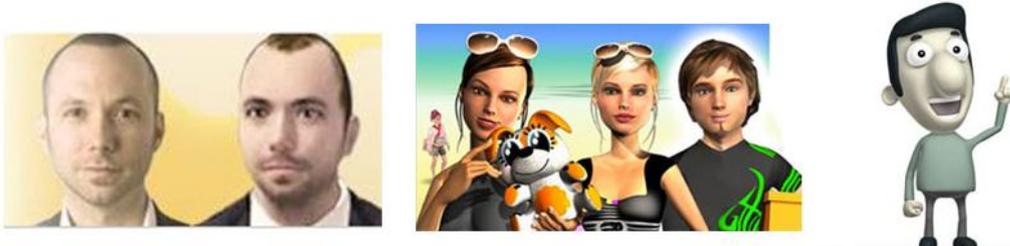
Figure 12. The most preferred avatars by both of the user groups for 3rD–LIFE.

The idea of being able to change her/himself sounded very attractive for a group of primary users, on the other hand some wanted to have only realistic avatars for each user, so that nobody will have the chance to "fake" him/herself. A different comment came from the secondary users. They suggested using the realistic outlook, at least with hair colour, height, body proportions and style, so that the elderly can recognize, whom that avatar is, without having to read the name.

It was important for some of the participants, mostly female, that they are able to change the style and outlook of their avatars within the time, such as hair colour, clothes or accessories.

Facial animations and body language possibilities were shown to the participants on the twinity 0 platform, however, the reactions from both of the user groups were not positive against these animations and mimics. The participants found them funny and entertaining but didn't find them useful or necessary.

2.3.4.3.PRIVACY AND USER PROFILES

Privacy came up as a very important aspect of the system. Except of two participants, none of them preferred to give public access to their personal and contact information, other than interests, location, etc. Majority of the participants from both of the user groups told that they would prefer using a nickname rather than their real names. If they had a public profile, almost all of them would have preferred not to give personal information, or possibility to set Participants were asked if they could think of or need private activities and places while using 3rD–LIFE. Different ideas came up, also inspired by the entrance hall of twinity 0. (See Figure)

Figure 25. Doors at the entrance hall of twinity [11]: "My Home", "Shops", "Games".

An idea is to create a "home" for the avatars, where they can "invite" certain people to have family conversations, to hear music together and to share photos or videos (from a holiday, or trip) for example on the walls. One participant suggested a system, which may be running together with facebook or other platforms for photo sharing (e.g. flickr.com) to update the

photos on the private wall in 3rD-LIFE. Also, for the times that the users are not or cannot (due to time differences) be online at the same time, a private pin wall for photos and notes came up as an idea.

Another idea is to use such a "home" for the personal interests, such as placing a chessboard or billiard table to invite people for a play, or a TV to watch something together. Additionally, family activities were suggested for the families that cannot easily come together as they are living in different cities, such as celebrations on birthdays, special dates.

Another idea for private rooms was to create special areas for special interests, for example photography, dance, etc. This was suggested as a solution for privacy concerns, so that the users wouldn't need to create a profile with interest but just attend to the private areas and meet people there with the same interests.

2.3.4.4. IDEAS FOR ACTIVITIES IN 3RD-LIFE

All of the participants found the concept of 3rD-LIFE very interesting, even though they sometimes couldn't categorize it concretely. Time is very valuable for the elderly, who are active and want to use the time they have effectively besides enjoying it. The perceived usefulness of the system depends mainly on the activities available on 3rD-LIFE. The main categories listed during the interviews were learning, cultural activities, conversation, entertainment and shopping. Some common ideas suggested by the participant for activities are as follows:

Games: Chess, billiard, card games, cardboard games, puzzles

Discussion sessions about specific themes for idea and information exchange (also using a chat board or a protocol to document what has been told)

Courses: photography, computer, gymnastics, music instruments – where visual input that could be shown on may be attractive

Language courses or tandem exchange, where the objects in the 3D environment can also be part of the course, or example for learning vocabulary

Watching TV, cinema, concerts or theatres online

Visiting museums or **sightseeing**, if it is possible to view the artwork as real images. The possibility to visit a virtual museum together with another avatar is attractive, as information and idea exchange can take place

Museums for air and space, botanic garden or zoo

Shopping, if it would be possible to see the items with photographs or videos. It may be nice to have avatars as salesperson to help.

3rD-LIFE as a management platform for online and digital activities: Browsing in the Internet may be extended by using this 3D platform. Instead of the "favourites" feature of browsers, the online world may be visualized in a concreter form for the elderly. Moreover, functionalities such as photo management could be built.

Offices for governmental and administrative agencies, banks, doctors to ask for information or help. A function similar to "live chat/ support", which is currently in use on some websites such as online shops.

Virtual Visits from help and support organisations or doctors to elderly, who are living alone, to check if they are doing all right. The aim should not be to replace the existing personal contact, but to increase the possible number of contacts, as an emotional and mental companionship in everyday life.

In addition, participants mentioned some doubts and concerns they have about such a 3D platform, such as the danger of being addicted, as it is in some extreme situations the case using online social platforms or games. Some of the participants, who were smart phones users themselves, noted that the communication and Internet is becoming mobile, especially for the younger generations over mobile applications and devices. The disadvantage of such a 3D platform is that it has to be used stationary at home. Since people may not prefer spending time at home in front of 3rD-LIFE platform without a good reason if they are able to go out or travel.

2.3.4.5. CONTROL METHODS

The participants tried out four control methods for using the 3D platform Second Life: "only Mouse", "Mouse and Keyboard", "Touch" and "Space Navigator". After the participants had

tried these four control methods, they were asked if they would prefer solely to use that control method while using a 3D platform for each method.
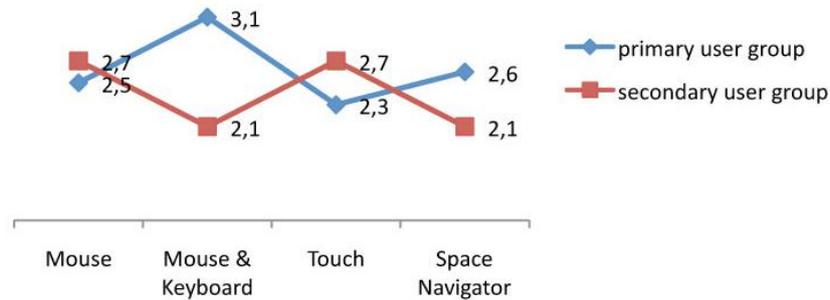

Figure 26. *The preferences of the user groups on a 5-point Likert Scale for the question if they would solely use the control method (1=strongly agree, 5=strongly disagree)*

The results (See Figure) indicate that primary user group preferred "touch" and "mouse" and the secondary user group preferred the "space navigator" (See *Figure*) and "mouse and keyboard" to control the 3D Environment. The 3D input device Space Navigator has six degrees of freedom and was used in non-dominant hand to navigate through the 3D platform Second Life. The primary users as well as secondary users liked the "Space Navigator", however they had difficulties in using this device because of the required fine motor skills. Some of them commented that with a little bit practice, or if it were like a joystick, offering a full grip, they may have preferred this control method.

Figure 27.*3D Mouse: 3D Connexion – Space Navigator*

The control method is a very important aspect of the User Experience of 3rD-LIFE. In order to have an insight about this aspect each control method was also rated with EmoCards 0. Each control method was used for three subtasks (walking to the target, looking at targets, walking back to start) and participants chose an EmoCard (See *Figure*) after each subtask. There were differences between the results of the two user groups. This indicates that

providing different control methods is considerable for the better user experience with the 3rD LIFE environment.
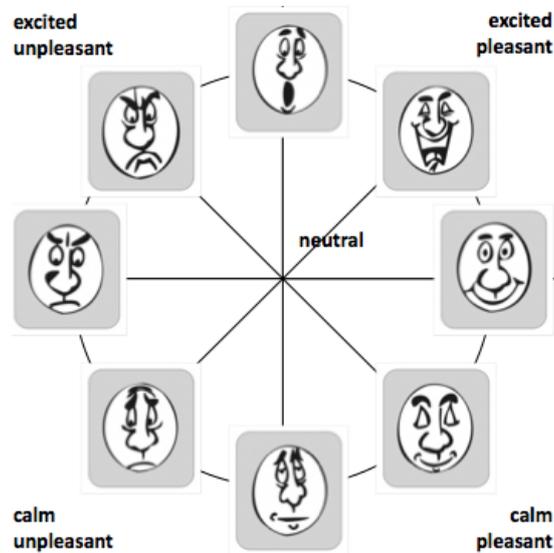

Figure 28. The EmoCards 0 shown to the participants to select

The results of the preference is compared to the results of EmoCards.
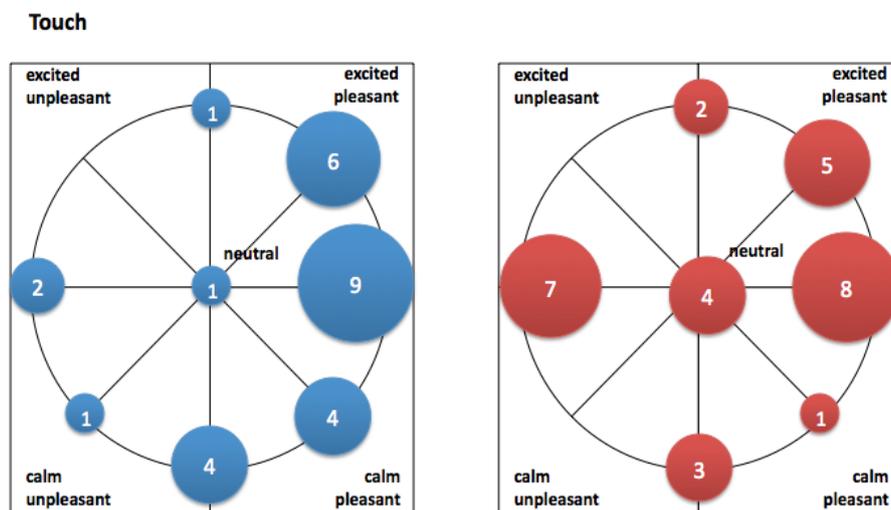
Figure 29. EmoCards results for the "Touch" control method (blue: primary user group; red: secondary user group)

"Touch" is the most preferred control method by the primary user group, it is also positively rated by the Emocards. They liked using this method, whereas secondary user group remained more neutral.

Mouse
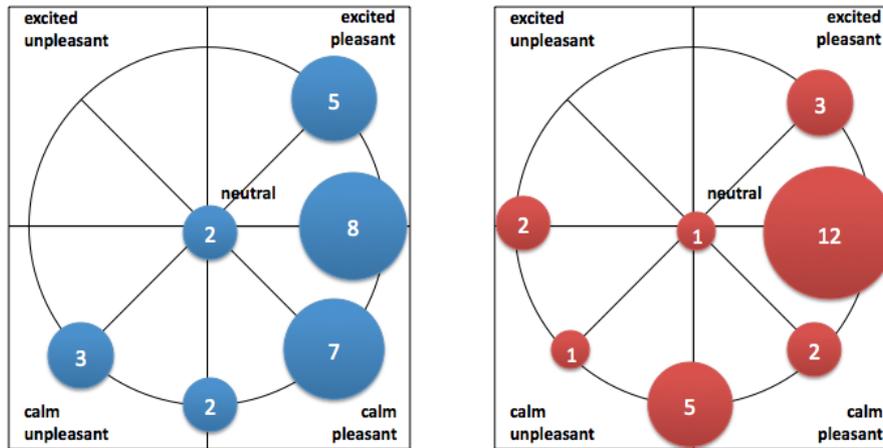
Figure 30. EmoCards results for the "Mouse" control method

"Mouse" is the second most preferred control method by the primary user group, even though it was always described as "already used to" during the interviews. It is also positively rated by the EmoCards, and more positively than the "touch" method. Secondary user group rated "mouse" control better than the "touch" control even though the preferences are the same.

Space Navigator
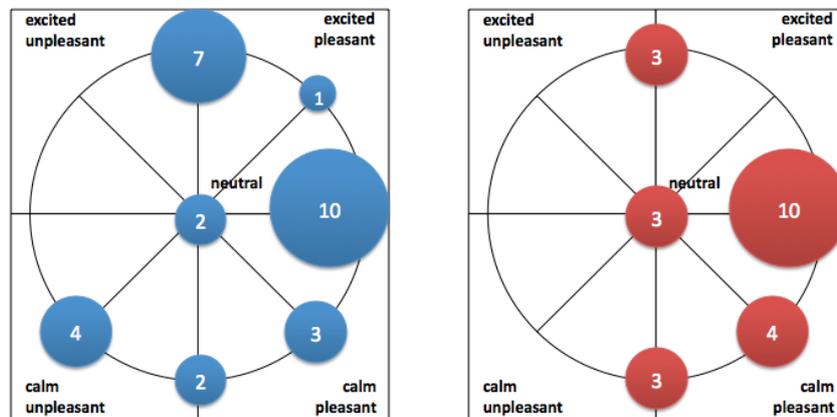
Figure 31. EmoCards results for the "Touch" control method

"Space Navigator" is the third preferred control method by the primary user group; however it is almost as positively rated as the by the EmoCards. The primary user group was excited using this new control method, whereas none of the secondary user group participant was unpleasant.
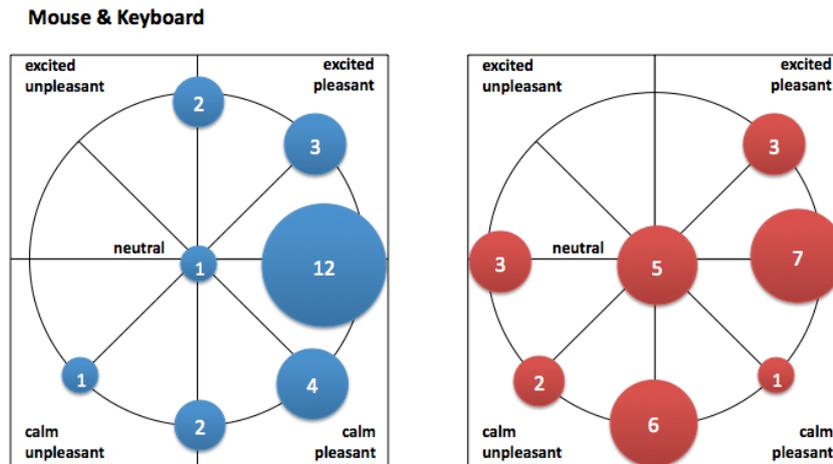
Figure 32. EmoCards results for the "Touch" control method

"Mouse & Keyboard" is the least preferred control method by the primary user group; however it is also positively rated as the by the EmoCards. On the other hand, the primary user group participants used both control devices with the right hand and were slow in action changing from one device to another, even though they were corrected many times by the test conductor, whereas the secondary user group participants used them simultaneously using both hands. Therefore, the primary users rated this method similar to the other ones. Even though this method is the most preferred control method together with the "Space Navigator" by the secondary user group, the ratings with EmoCards are not as good as the "Space Navigator".

2.3.4.6. TECHNOLOGY ACCEPTANCE

The technology acceptance questionnaire includes 7 scales:

Perceived Ease Of Use (PEOU – 5 items): related to ease of use

Primary user group rated the PEOU for 3D platforms better than the secondary user group. However, both of the user groups evaluated 3D platforms as easy to use and to learn to use.

Perceived Usefulness (PU – 5 items): related to usefulness

The two different user groups evaluate this scale almost parallel; however, primary user groups have a more positive view about collaborative work in 3rD-LIFE.

Behavioural Intention to Use (BIU – 4 items): related to intended use of the system

Similar to PU, the primary user groups have a more positive attitude for the usage of 3rD-LIFE. Making new friends is not an attractive feature for both of the user groups, however, taking part in 3rD-LIFE activities are attractive for both of the user groups.

Attitude Toward Technology (ATT – 4 items): attitude towards the system

This is the most positive evaluated scale for both of the user groups. Again, for this scale primary user group have a more positive view. Both user groups agree on that it is fun to communicate over 3rD-LIFE.

Social norms (SN – 3 items): related to social influence using the system:

This scale is evaluated quite poor by both of the user groups, indicating that they don't think that they would be encouraged or praised to use 3rD-LIFE. However, the primary user group is again more positive.

Performance Expectancy (PE – 2 items): performance of users of the system:

Primary user group think that using 3rD-LIFE will enhance their computer literacy, however, the secondary user group don't agree with that for their computer literacy. Both of the user groups don't agree that 3rD–LIFE is useful for the social connections.

Anxiety (ANX – 4 items): related to anxiety using the system:

Result indicate that the primary user are anxious using 3D platforms and this is not the case for the secondary users.

General Social Demographical (GEN – 5 items): socio-demographical variables:

The results of the technology acceptance questionnaire indicate that the participants from both user groups have more or less the necessary technical equipment to use 3rD-LIFE platform at home. They are satisfied with their social lives and activities in their daily life.
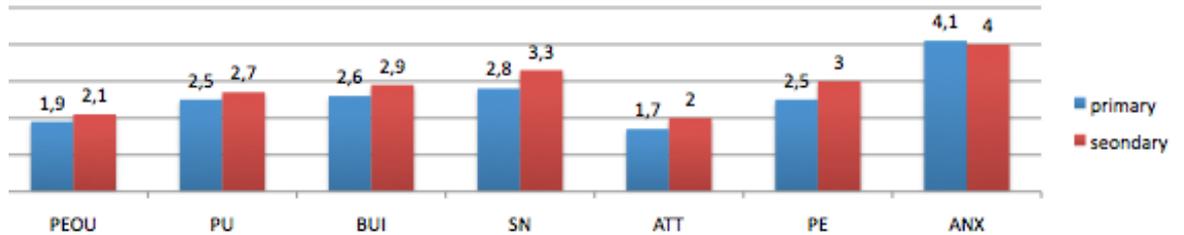
Figure 33. Results for the Technology Acceptance Questionnaire (1= strongly agree: positive, 5 strongly disagree: negative). Perceived Ease Of Use (PEOU), Perceived Usefulness (PU), Behavioural Intention to Use (BIU), Attitude Toward Technology (ATT), Social Norms (SN), Performance Expectancy (PE), Anxiety (ANX)

The results show that the thoughts of primary and secondary users concerning online 3D virtual environments are parallel to each other, whereas the primary users are more positive than the secondary users, except of ANX (Anxiety), where both of the user groups answered as not having anxiety, where the primary users have results indicating slightly more anxiety.

Even though there are slight differences, it can be argued that both of the user groups have similar attitudes and technology acceptance and adoption potential.

3. FINAL CONCLUSIONS

The requirements analysis was carried out in two different countries (Spain and Austria) with in two phases. The partners followed different methodologies depending on the focus area and the character of the participants. However, the results coming from the countries are parallel to each other. Both of the main user groups in Spain and Austria gave parallel answers to the questionnaire in the first phase. In the second phase, the focus of the activities in Spain and Austria were different, however the wishes and needs of the participants regarding the 3D environment remained similar according to the results.

3.1. PHASE 1

The results of the Phase 1 provided a general overview of the both user groups. The questionnaire also served as a participant selection tool for the second phase.

3.1.1. SPAIN

In Spain, both, primary and secondary users have University degrees or are now enrolled in it. This fact it is not normal at Spain, especially for primary users. Having contact with or knowledge about the new technologies was stated as an important requirement for becoming a potential users or 3rD LIFE. Among people between 60 and 75 years old, which are primary users, it is not normal at Spain, nowadays. However, there are several initiatives for learning the use of new technologies that arise from the Universities, and concretely from "Aulas de la Experiencia". For this reason we have to turn to the university student with ages between 60 and 75 years. This fact can explain properly the outcome obtained by the primary users regarding educational level.

In regards with their relationships, it was saw that the largest group of closers for primary users was their friends followed by their children and siblings. Secondary users' closers relations between 60 and 75 years old were their parents, as could be expected. Mostly of the users live in others cities than their closers live in. This is an important fact since it will determine the possible use of 3rD LIFE solution.

About the use of the new technologies with the aim of interacting with their relations, secondary users use more frequently these technologies for it than the primary users do. Furthermore, secondary users use in a different way these devices in function of the person they want to interact. They prefer traditional ways for interacting with their relations with ages above 60 years old; and use the new technological devices with their younger relations. This fact could determine the acceptance and feasibility of 3rD LIFE with the objective that was thought to have it.

Both groups use a computer (a desktop or a laptop one) almost everyday. It is necessary to remember that this was an initial requirement for becoming part of the participant group of users. But the technological devices that users use, in their daily life, are completely different between the primary and the secondary users. This is important due to the possibility of running 3rD LIFE in other devices rather than a computer. It would be interesting develop, in a future, 3rD LIFE for television (maybe, like an application of Digital Terrestrial Television) and for smartphone since they represent two of the technological devices most used by the primary and the secondary users, respectively.

Also, it can be seen an important difference in the use of the Internet between the two groups of users. Primary users mainly use it for general purposes whereas secondary users use it also for interacting with their well-known people.

In results obtained with the ATIS can be seen that secondary users have, overall, a more positive attitude than primary users. Also, many differences between both users group can be seen looking through their answers to the different items. In general secondary users have a more positive attitudes based probably in a broader use of the Internet than the primary users, as examples we can see what happen at items 1, 4, 6 or 12 (see annex 5.3). It seems that primary users prefer traditional services rather than make use of the services provided by the Internet.

Also, some agreements between primary and secondary users can be seen in the answers to the ATIS. Both groups are concerned about privacy and security aspect of sharing personal information with known people via Internet. In annex 5.3 can be seen that secondary users are more concerned of this fact, as an important aspect that needs to be highlighted.

Regarding activities that users perform and that can be used in the design of 3rD LIFE, primary users said that they enjoy doing psychical activities like walking or going to yoga or

aerobic. Also primary users like playing cards, bingo and board games. In regards to cultural activities, primary users have interest are reading and taking course. Furthermore, primary users like to travel and, in the future they would like to do some adventure sports.

Secondary users would like to play games (cards, board games), go to some cultural activities (cinema, music concert) and use the new technologies (chats, social networks, video-calls) with their relatives.

Finally, neuropsychological assessment of the primary users seems to indicate that all of them are in the healthy group of people at their age. The primary users who were assessed, fulfil the initial requirement for becoming part of 3rD LIFE users, that is not having cognitive deficits.

3.1.2. AUSTRIA

The majority of the participants in Austria from the primary user group were married and living with their partners. The close relationships named by the primary user group did not include grandchildren often. Participants from the secondary user group also named only friends and from the family "mother" as the closest relationships they have.

However, being close does not mean living close, according to the result of both of the user groups. The close contacts listed were often living in another city of abroad. Moreover, the frequency of the personal contact that the primary user group participants had with their close relationships was only high for the first person listed as the closest. Most of the secondary users had contact with their grandparents only a couple of times a year.

The general attitudes of the target user groups towards Internet and technology usage were examined and their preferences for activities and communication habits in real life were explored. The attitude towards using Internet and technological devices is essential for evaluating the potential of the 3D desktop environment. Moreover, the social activities, real life habits of communication give the basic ideas for application areas for 3rD–LIFE. Moreover, the wishes of the target user groups feed the ideas for possible activities in 3rD–LIFE.

The results of the first phase gave insight to the daily life communication habits and social activities and relationships of the target user group. Both of the user groups have a similar

positive attitude towards Internet usage and actively using Internet and computer daily for gathering information, bureaucratic and financial activities, social networking, gaming and shopping. Email is the most commonly used communication channel by the primary user groups. Mobile phone usage is also very high including SMS usage. The secondary user group participants used all of the communication channels asked in the questionnaire. However, they use only mobile phone to talk, post or landline phone to communicate with their grandparents. The results are parallel for the communication between the secondary user group and their parents but, the percentage is higher. Smart phones are also to some extend among the daily life objects for both of the user groups.

Moreover, the contrasting activity wishes and likes show that the secondary user group has a different image of the elderly population regarding the activities. For example, the idea "going to the graveyard makes my grandparent happy" may be true in the practice of daily life; however, this shouldn't result in a conclusion that the elderly people are not bounded to life or are not interested in activities anymore. Results indicate that the elderly are already doing a lot to keep up with the technological developments. To be able to bridge the generation gap, the image of the elderly in the minds of younger generations need to be changed by making this potential visible: what elderly can and would actually do.

3.2. PHASE 2

3.2.1. SPAIN

Results from focus groups regarding differences observed in the *use of the technological devices* to communicate with other people in function of the age primary users say that they prefer to use traditional ways for interacting with their relations because they are used to it. Although they know that new technological devices have more applications and some advantages when faced with the more traditional devices, they prefers these last because they allow to them to have more face-to-face interaction and they have less technological problems. Furthermore secondary users prefer to use traditional ways for interacting with their closest people between 60 and 75 years old because they are used to it.

When talking about *security aspects* of 3rD LIFE both groups of users, primary and secondary, are concern about. They would like to set up privacy level in order to share different personal information with different people and purposes.

Additional both groups, primary and secondary users, agree with the requirements they want with regards to the *appearance of the virtual space*. In order to guarantee and to encourage them to use 3rD LIFE, they would like to have spaces as realistic as possible. They want also to have some aids as maps of the virtual world, labels of the usefulness of the different spaces and short cuts for improving the navigation through 3rD LIFE platform.

Regarding *avatars*, primary and secondary users would like to have realistic ones with realistic movements and accessories. Furthermore, they would like to change the emotional state of the avatars. Finally they want to control the avatars movements with the easiest controller as possible.

The *applications* which users want for 3rD LIFE to have are:

- Some place for sharing information and experiences with known and unknown people in different way.

- Meet new people with similar interests.

- Educational and training applications (lectures, course, e-learning, etc.).

- Up-to-date information of events in their cities.

- Links to different services (newspapers, radios, etc.).

- On-line cognitive or serious games.

- Different tools for interacting with their closest relationships, like voice communication, video-calls, e-mail service, chat, sharing files, etc.

Finally, primary and secondary users recognise several *advantages of using 3rD LIFE* for interact with their closest relationships. The more important are:

- 3rD LIFE can integrate in one platform most of the services that the Internet allows to the users. This is seen for the users like a more intuitive way of introduce to the primary users in the use of the Internet services.

- 3rD LIFE can be a new and faster way for interacting with people which are far away and an intergenerational tool.

On the other hand, users can see some *disadvantages of using 3rD LIFE*. The more important are:

- Primary and secondary users prefer face-to-face interactions between them.

- There are already different applications that allow to the Internet users to interact.

- An interesting question that has to be answered arose: "Why should the elders learn to use 3rD LIFE instead of learning how to use the currently existing programs?"

3.2.2. AUSTRIA

Results in Austria indicate that:

- The 3D environment should be free of obstacles, barriers; should provide enough space for manoeuvring and sight, especially for primary user group.

- A realistic atmosphere, which is not artificial, is required. Indoors and outdoors can be used at the same time.

- The 3D environment should be compact and objects should be easy to reach without using much time and effort.

- Having to walk long distances in the 3D environment should be avoided. Walking can be offered as a feature to explore the environment, but an easier "teleport" option should be available.

- No background music should be used, but sound effects are nice to have for signalling interactive objects/ areas or for a more realistic atmosphere like birds, footsteps, etc.

- Avatar gesture animations and mimics are not necessary

- Being able to change the outlook of the avatar from time to time, such as hair colour, clothes or accessories, is nice to have

- Users prefer having a nickname rather than their own names even when only communicate with close contacts.

- A personal area in the 3D environment for private activities is required

- Different privacy levels is required for the public profile of the users, so that they can decide which personal information is visible to selected contacts (friends, family, game partner, etc.).

- Different control methods should be available for both of the user groups.

- A touch device may be considered for the usage of 3rD LIFE.

- A mobile application or a way of communication through mobile phones is considerable so that 3rD LIFE activities are connected to the real life.

As a result of functional limitations and less technological experience, older users are more affected by usability problems than younger users. Therefore besides the user requirements analysis results general design recommendations on 3D Environments have to be considered: functions that may have suffered decline, e.g. demanding on spatial memory or motor ability, should be minimized and the interface should be adaptable to compensate particular limitations 0. A general checklist for designing 3D Interfaces complementing common usability guidelines 0 include the following points:

- Keep the text readable: better rendering and no more than 30-degree tilt

- Avoid unnecessary visual clutter, distraction, contrast shifts, and reflections

- Simplify user movement: keep movements planar, avoid surprised like going through walls

- Simplify user movement: facilitate docking, follow predictable paths, limit rotation

- Organize groups of items in aligned structures to allow rapid visual research

- Enable users to construct visual groups to support spatial recall: placing items in corners or tinted areas

- Provide overviews so users can see the big picture: plan view, etc.

- Allow teleportation: rapid context shifts by selecting destination in an overview

- Offer x-ray vision so users can see into or beyond objects

- Provide history keeping: recording, undoing, replaying, editing

- Permit rich user actions on objects: save, copy, annotate, share, send

- Enable remote collaboration: synchronous, asynchronous

- Provide users with control over explanatory text (pop-up, floating, labels, screen tips) and let them view details on demand

- Offer tools to select mark and measure

- Implement dynamic queries to rapidly filter out unneeded items

- Support semantic zooming and movement

- Enable landmarks to show them even at a distance

- Develop novel 3D icons to represent concepts that are more recognizable and memorable

The accessibility in 3D virtual worlds has not yet received enough attention of researchers and designers as web accessibility, even though they are increasingly used for education, business and recreation 0. Basic features of the accessible 3D GUI should include 0:

- Customizable font size for all text in GUIs

- High contrast and low contrast text options

- Keyboard navigation of all GUIs with speech and visual feedback

- Self-voicing capability for heads-up displays

- Keyboard-only and point-and-click-only modes of in-world navigation

- The ability to remap controls

- The ability to adjust control sensitivity and time-sensitive parameters

- On-screen display of sounds and captions for spoken information

- A user interface for personalization of these features

- Training and help features

- Audio Feedback & Object-sound associations especially for visually impaired users e.g. footsteps, alerts, labels, tags

- Object/Location search feature

- "Controlled walk mode": with a key press the avatar is kept facing its target in a straight line. This mode is terminated when another player, an obstacle (e.g. a wall) or the target reached.

One of the most important elements of the 3rD-LIFE platform will be the services and activities available over the system. The results of the requirements analysis phase give already quite a lot of initial ideas about how to shape the activities and services which can be considered in 3rD-LIFE.

To sum up, as mentioned above, in Section 2.3.4.4, the main ideas come up as input for the project partners, who will design and develop the 3rD-LIFE environment can be listed as:

- Games (multi- or single player)

- Discussion rooms

- Educational Courses

- Virtual tours and visits to different places (fantasy or real-world)

- Virtual Museums, Cinemas, Concerts, Exhibitions to visit

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	177-184.

5. APPENDIX

5.1. INITIAL SURVEY FOR PRIMARY USERS OF 3rD-LIFE PROJECT

(Participant code #:)

A.1. Are you male or female:
- ○ female
- ○ male

A.2. Age:

A.3. What is your marital status?
- ○ married/ with partner
- ○ single
- ○ widow
- ○ divorced

A.4. How do you live?
- ○ alone
- ○ with spouse / partner
- ○ with children
- ○ both with children & spouse/ partner
- ○ with other family
- ○ with friends
- ○ others:_____

A.5. What is the highest level of education you completed?
- ○ Less than primary education
- ○ Primary education
- ○ secondary education
- ○ Higher Education

A.6. Are you attending evening courses, adult education programs or similar?
- ○ yes: what courses do you attend? _____
- ○ no

A.7. Have you retired or still working?
- ☐ retired as _____
- ☐ working as _____

A.8 Which languages can you speak?
1._____
2._____
3._____

A.9. Which language do you normally use?

B.10 With which persons do you   Siblings:_____

consider yourself having a close relation?	Children:_____
	Grandchildren:_____
	Friends:_____
	Others (Please define):_____

B.11. How far is your home from their?

- ❍ Same street? Who_____
- ❍ Same city? Who_____
- ❍ Another city/town but in the same province? Who_____
- ❍ Another country. Who & where?_____

B.12 With which frequency do you meet them?

Freq. Who	1. Home (H) X. Both 2. Outside	Every day	Once or twice a week	Once or twice a month	Once or twice every year	Never

B. 13 With which frequency do you communicate with your close social relationship (people you listed above) through/with/via

Freq.	Every day	Once or twice a week	Once or twice a month	Once or twice every year	Never
Telephone(landline)					
Mobile phone					
sms					
mms					
e-mail					
Social network sites (face, etc)					
mail					

tele-conference					
chat					

C.14. Please list the activities you rather do.

Sports:

Games:

Cultural:

Social:

Travel:

Charity/ Voluntary:

Religious:

Others:

C.15. What are the favorite activities that you do together with your family & relatives? Please name three.

C.16. What are the favorite activities that you do together with your friends? Please name three?

C.17. Are there any activities you enjoyed having done but don't/can't do anymore because of limitations or restrictions (time, financial, health, etc.) ?

◯ yes – what are they?

◯ no

C.18. Are there any daily life routines (shopping, banking,etc) you can't do anymore because of limitations or restrictions (time, financial, health, etc.)?

◯ yes – what are they?

◯ no

C.19. Are there any activities that you have never done, but wish/dream of doing ?

◯ yes – what are they?

◯ no

D.20 How frequent do you use the   Daily Weekly Several times a month Several times a year never

following technological devices?

Television	○	○	○	○	○
Radio	○	○	○	○	○
Desktop computer	○	○	○	○	○
Laptop	○	○	○	○	○
Tablet computer (iPad, etc)	○	○	○	○	○
Smartphone (over which you can use internet and various applications)	○	○	○	○	○
mp3 player (mobile music player)	○	○	○	○	○
e-book reader	○	○	○	○	○
other_____	○	○	○	○	○

D.21 How frequent do you use the following technological devices and services?	Daily	Weekly	Several times a month	Several times a year	never
Internet (general, information)	○	○	○	○	○
Internet (internet-banking, governmental forms, etc.)	○	○	○	○	○
Internet (social network sites like senior clubs, facebook, etc.)	○	○	○	○	○
Internet (online games)	○	○	○	○	○
Video game consoles (wii, kinect, etc.)	○	○	○	○	○
3D Video games (e.g. Sims, Warcraft)	○	○	○	○	○

D. 22 Please state how much you agree to the following statements.	Strongly agree	Agree	neutral	Disagree	Strongly disagree
I enjoy shopping online	○	○	○	○	○
I enjoy browsing (surfing) websites without any specific purpose	○	○	○	○	○
I feel anxious that online communications can potentially be seen, heard, or otherwise accessed by other people	○	○	○	○	○
I feel that the Internet has allowed me to keep in touch with many people	○	○	○	○	○

I feel anxious that my personal information may be available over the Internet	○	○	○	○	○
I like to look up information about businesses, services, and/or products on the Internet	○	○	○	○	○
I have had more good experiences than bad experiences using the Internet	○	○	○	○	○
I would prefer to communicate through writing a letter or a memo rather than an email	○	○	○	○	○
I feel uncomfortable using my credit card online.	○	○	○	○	○
I enjoy using the Internet to pass time and/ or to have fun	○	○	○	○	○
I would prefer to go online to conduct most of my banking	○	○	○	○	○
When searching for information, I would rather read books, magazines, and newspapers than browse the Internet	○	○	○	○	○
I only feel comfortable using online stores to browse or compare prices	○	○	○	○	○
I avoid using the Internet whenever possible	○	○	○	○	○
I enjoy using the Internet for instant messaging or other types of real-time communication	○	○	○	○	○
Overall, I enjoy using the Internet	○	○	○	○	○

5.2. INITIAL SURVEY FOR SECONDARY USERS OF 3rD LIFE PROJECT

(Participant code #:)

A.1. Are you male or female:
○ female
○ male

A.2. Age:

A.5. What is the highest level of education you completed?
○ Less than primary education
○ Primary education
○ secondary education
○ Higher Education

A.8 Which languages can you
1._____

speak?   2._____
                                         3._____

A.9. Which language do you
normally use?

B.10 With which persons between 60 Siblings:_____
and 75 years old do you consider   Children:_____
yourself having a close relation? Grandchildren:_____
                                   Friends:_____
                                   Others (Please define):_____

B.11. How far is your home from   ❍ Same street? Who_____
their?   ❍ Same city? Who_____
                                   ❍ Another city/town but in the same province? Who_____
                                   ❍ Another country. Who & where?_____

B.12 With which frequency do you meet them?

Freq. Who	1. Home (H) X. Both 2. Outside	Every day	Once or twice a week	Once or twice a month	Once or twice every year	Never

B. 13.1 With which frequency do you communicate with your close social relationship which are below 60
years old through/with/via

Freq.	Every day	Once or twice a week	Once or twice a month	Once or twice every year	Never
Telephone(landline)					
Mobile phone					

sms					
mms					
e-mail					
Social network sites (face, etc)					
mail					
tele-conference					
chat					

B. 13.2 With which frequency do you communicate with your close social relationship which are between 60 and 75 years old through/with/via

Freq.	Every day	Once or twice a week	Once or twice a month	Once or twice every year	Never
Telephone(landline)					
Mobile phone					
sms					
mms					
e-mail					
Social network sites (face, etc)					
mail					
tele-conference					
chat					

C.14. Please list the activities you rather do with your closest relationships between 60 and 75 years old.

Sports:

Games:

Cultural:

Social:

Travel:

Charity/ Voluntary:

Religious:

Others:

C.17. Are there any activities you enjoyed having done with your closest relationships between 60 and 75 years old, but you don't/can't do anymore because of limitations or restrictions (time, financial, health, etc.) ?

○ yes – what are they?

○ no

C.19. Are there any activities that you have never done, but wish/dream of doing with your closest relationships between 60 and 75 years old?

○ yes – what are they?

○ no

D.20 How frequent do you use the following technological devices?	Daily	Weekly	Several times a month	Several times a year	never
Television	○	○	○	○	○
Radio	○	○	○	○	○
Desktop computer	○	○	○	○	○
Laptop	○	○	○	○	○
Tablet computer (iPad, etc)	○	○	○	○	○
Smartphone (over which you can use internet and various applications)	○	○	○	○	○
mp3 player (mobile music player)	○	○	○	○	○
e-book reader	○	○	○	○	○
other_____	○	○	○	○	○

D.21 How frequent do you use the following technological devices and services?	Daily	Weekly	Several times a month	Several times a year	never
Internet (general, information)	○	○	○	○	○
Internet (internet-banking, governmental forms, etc.)	○	○	○	○	○
Internet (social network sites like senior clubs, facebook, etc.)	○	○	○	○	○
Internet (online games)	○	○	○	○	○
Video game consoles	○	○	○	○	○

(wii, kinect, etc.)
3D Video games
(e.g. Sims, Warcraft)

| D. 22 Please state how much you agree to the following statements.	Strongly agree	Agree	neutral	Disagree	Strongly disagree
I enjoy shopping online	○	○	○	○	○
I enjoy browsing (surfing) websites without any specific purpose	○	○	○	○	○
I feel anxious that online communications can potentially be seen, heard, or otherwise accessed by other people	○	○	○	○	○
I feel that the Internet has allowed me to keep in touch with many people	○	○	○	○	○
I feel anxious that my personal information may be available over the Internet	○	○	○	○	○
I like to look up information about businesses, services, and/or products on the Internet	○	○	○	○	○
I have had more good experiences than bad experiences using the Internet	○	○	○	○	○
I would prefer to communicate through writing a letter or a memo rather than an email	○	○	○	○	○
I feel uncomfortable using my credit card online.	○	○	○	○	○
I enjoy using the Internet to pass time and/ or to have fun	○	○	○	○	○
I would prefer to go online to conduct most of my banking	○	○	○	○	○
When searching for information, I would rather read books, magazines, and newspapers than browse the Internet	○	○	○	○	○
I only feel comfortable using online stores to browse or compare prices	○	○	○	○	○
I avoid using the Internet whenever possible	○	○	○	○	○
I enjoy using the Internet for instant messaging or other types of real-time communication	○	○	○	○	○
Overall, I enjoy using the Internet	○	○	○	○	○

5.3. RESULTS OBTAINED BY EACH USER GROUP FOR ATIS (SPAIN).
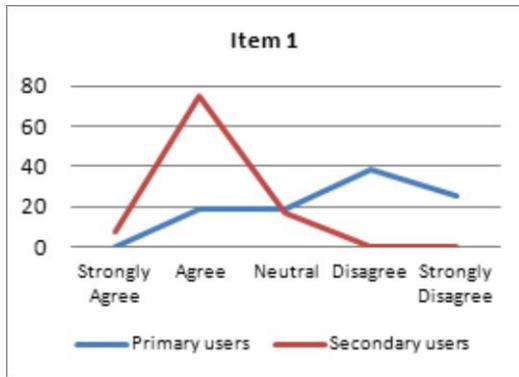
Answers to item 1 "I enjoy shopping online" (Spain).
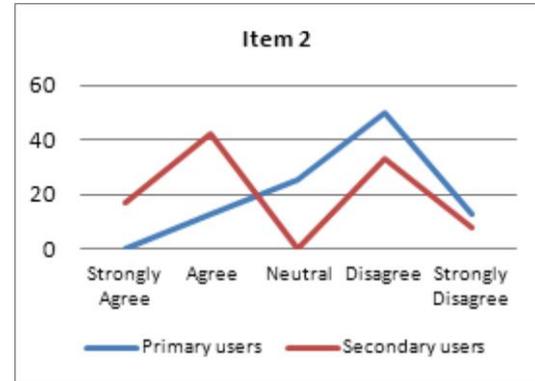
*Answers to item 2 "I enjoy browsing (surfing) websites without any specific purpose" (Spain).*
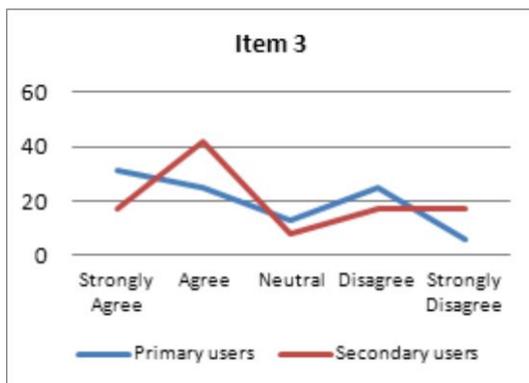
Answers to item 3 "I feel anxious that online communications can potentially be seen, heard, or otherwise accessed by other people" (Spain).
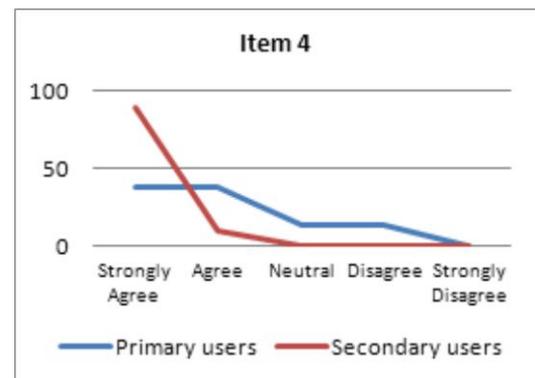
*Answers to item 4 "I feel that the Internet has allowed me to keep in touch with many people" (Spain)*
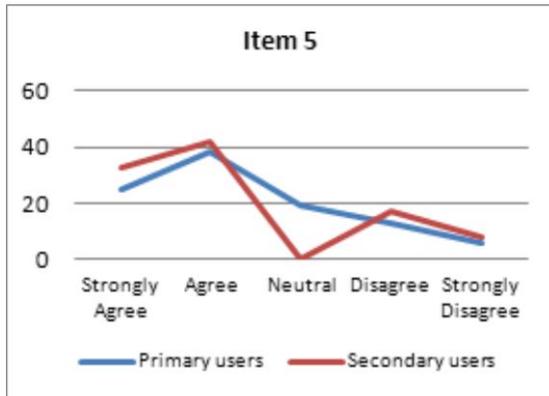
Answers to item 5 "I feel anxious that my personal information may be available over the Internet" (Spain).
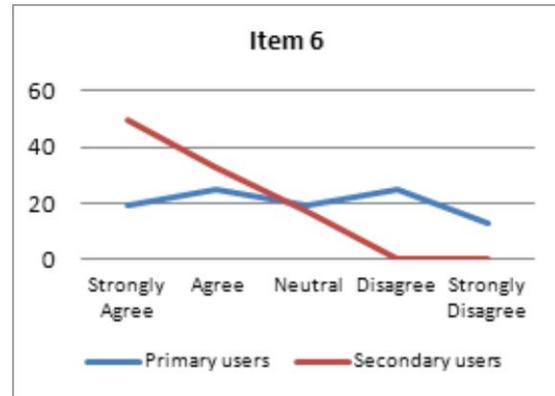
Answers to item 6 "I like to look up information about businesses, services, and/or products on the Internet" (Spain).
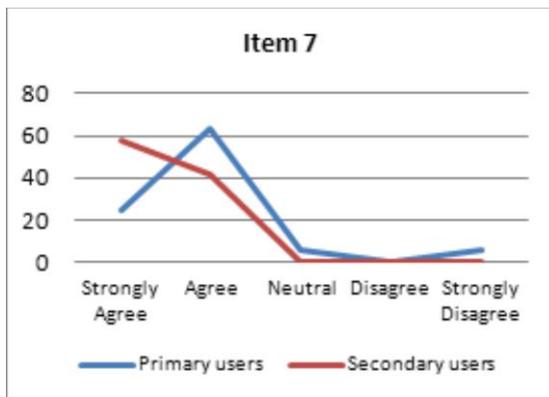
Answers to item 7 "I have had more good experiences than bad experiences using the Internet" (Spain).
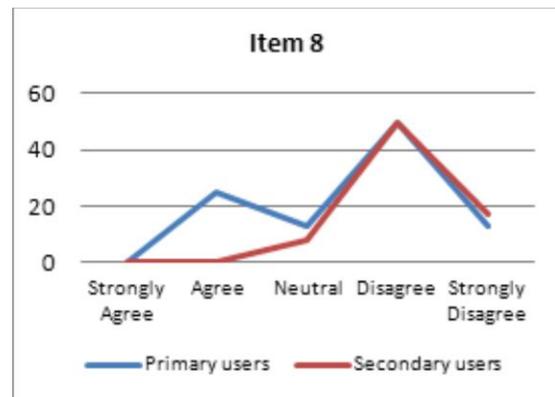
Answers to item 8 "I would prefer to communicate through writing a letter or a memo rather than an email" (Spain).
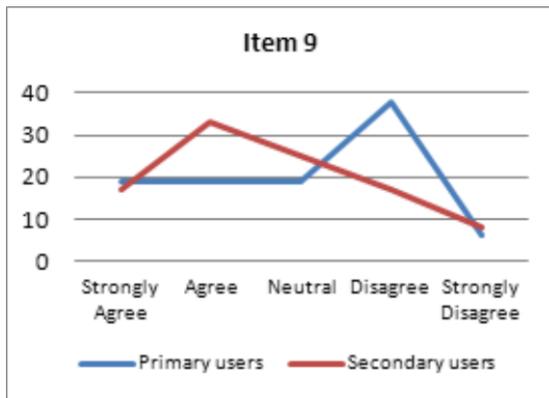
Answers to item 9 "I feel uncomfortable using my credit card online" (Spain).
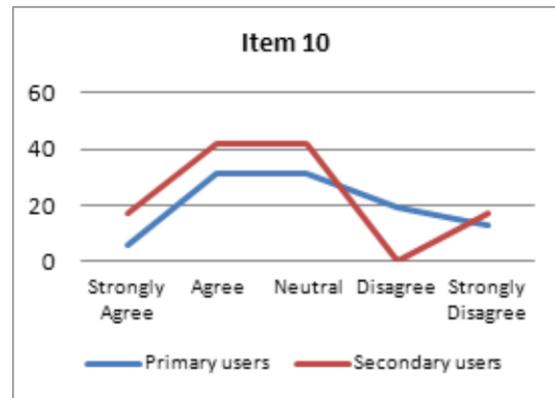
Answers to item 10 "I enjoy using the Internet to pass time and/or to have fun" (Spain).
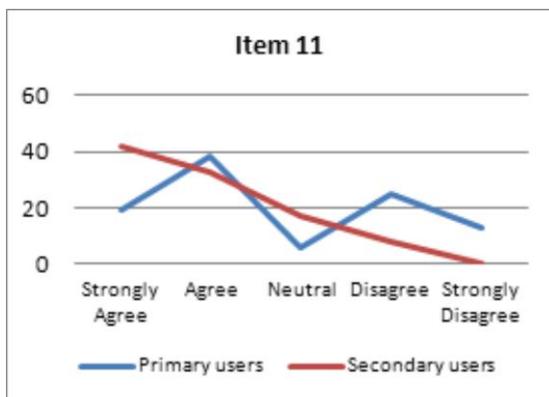
Answers to item 11 "I would prefer to go online to conduct most of my banking" (Spain).
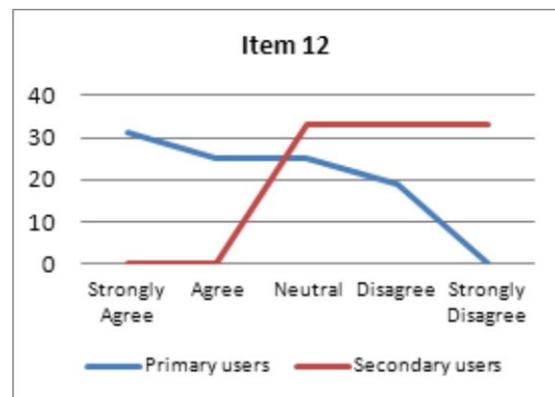
Answers to item 12 "When searching for information, I would rather read books, magazines, and newspapers than browse the Internet" (Spain).
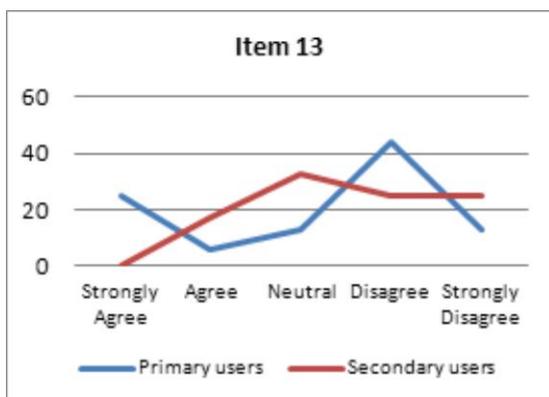
Answers to item 13 "I only feel comfortable using online stores to browse or compare prices" (Spain).
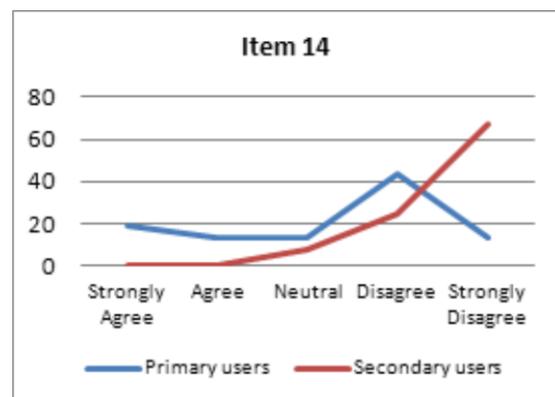
Answers to item 14 "I avoid using the Internet whenever possible" (Spain).
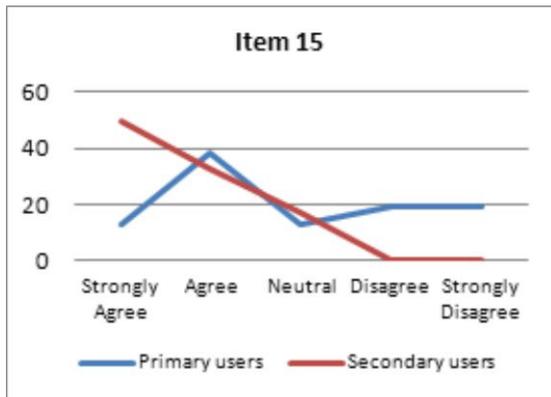
Answers to item 15 "I enjoy using the Internet for instant messaging or other types of real-time communication".
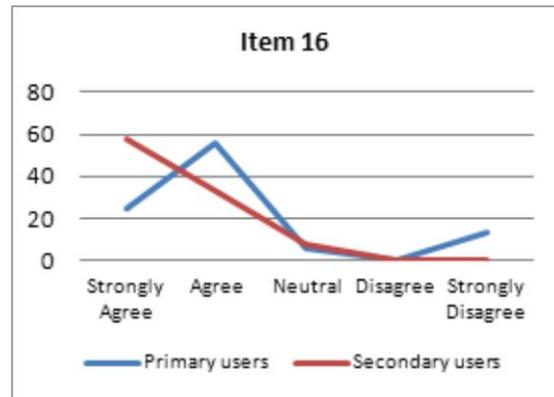
Answers to item 16 "Overall, I enjoy using the Internet".

5.4. RESULTS OBTAINED BY EACH USER GROUP FOR ATIS (AUSTRIA).

1) I enjoy shopping online
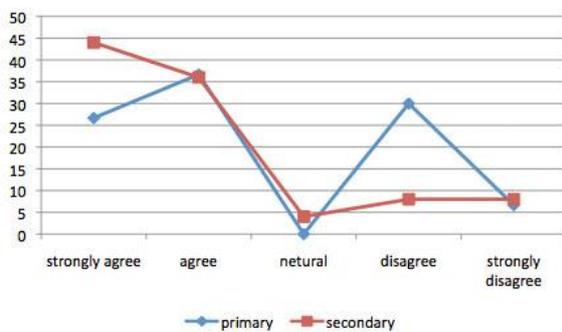
2) I enjoy browsing (surfing) websites without any specific purpose.
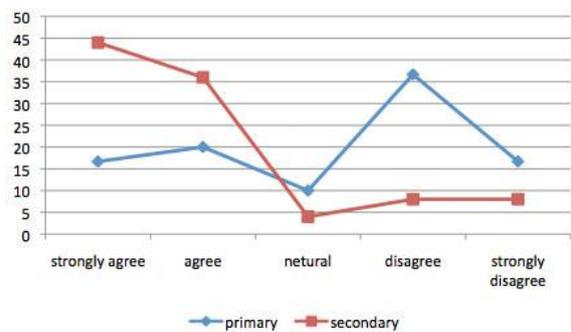
3) I feel anxious that online communications can potentially be seen, heard, or otherwise accessed by other people
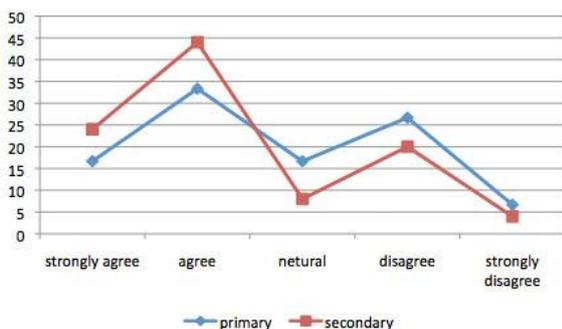
4) I feel that the Internet has allowed me to keep in touch with many people.
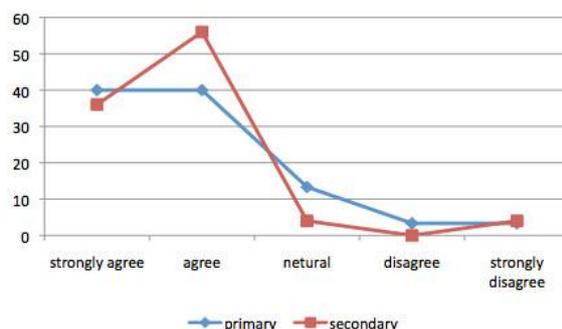
5) I feel anxious that my personal information may be available over the Internet.
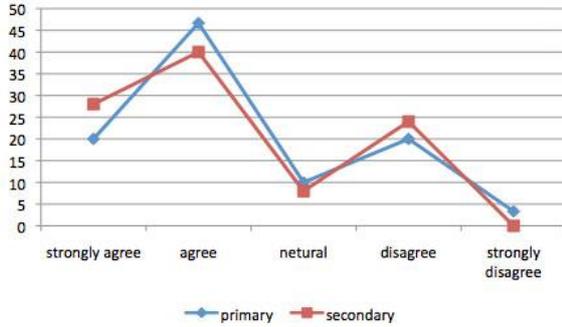
6) I like to look up information about businesses, services, and/or products on the Internet.
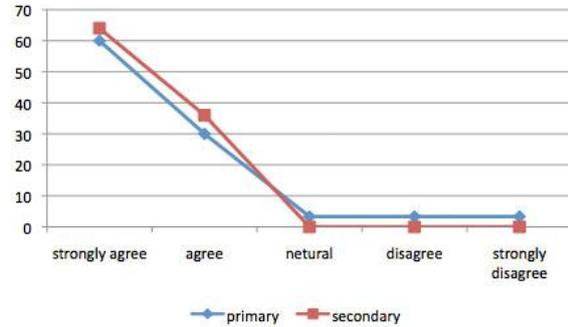
7) I have had more good experiences than bad experiences using the Internet.
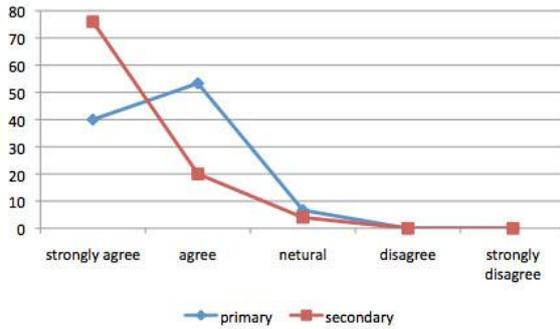

8) I would prefer to communicate through writing a letter or a memo rather than an email.
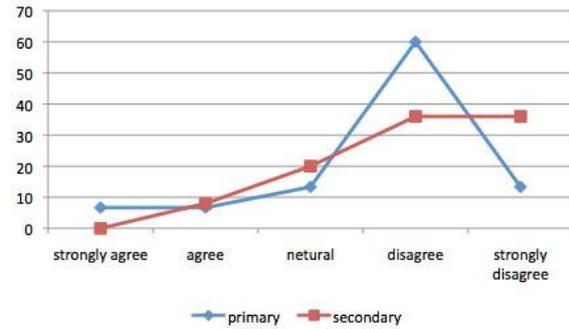

9) I feel uncomfortable using my credit card online.
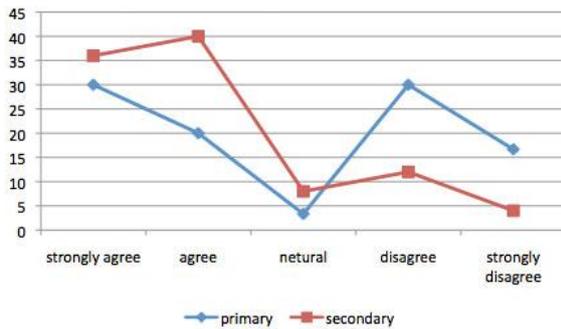
10) I enjoy using the Internet to pass time and/ or to have fun.

**11) I would prefer to go online to conduct most of my banking.**

primary — secondary

12) When searching for information, I would rather read books, magazines, and newspapers than browse the Internet.

primary — secondary

13) I only feel comfortable using online stores to browse or compare prices.

primary — secondary

14) I avoid using the Internet whenever possible.

primary — secondary

15) I enjoy using the Internet for instant messaging or other types of real-time communication.

primary — secondary

16) Overall, I enjoy using the Internet.

primary — secondary