Human-Computer Interaction and the Older Adult: An Example Using User Research and Personas

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ABSTRACT
This paper reports on the outcomes of the first phase of the eCAALYX project – an European project which aim is to develop a complete solution that improves the quality of life of the older adult with chronic conditions by monitoring his health and by improving the communication with his caretakers. Specifically, the authors are responsible for creating a TV user interface for older adults with chronic conditions.

The work described followed a multi-disciplinary approach strongly influenced by Human-Computer Interaction (HCI) methodologies. The main contributions of this paper are two-fold and materialize into i) a user research study that covers aspects such as perception, cognition, mental and psychosocial changes that occur with age and ii) an example-based description of the process of creating personas. John, the diabetic persona, is the example provided that abstracts the process followed to generate the remaining personas in the project.

Categories and Subject Descriptors
H.1.2 [**User/Machine Systems**]: Human factors; Human information processing. H.5.2 [**User Interfaces**]: User-centered design. H5.m [**Miscellaneous**]: HCI.

General Terms
Design, Experimentation, Human Factors.

Keywords
Human-Computer Interaction, User Research, Personas.

1. INTRODUCTION
Population is getting older. The United Nations predict that in 2050 the number of older adults in Europe will represent 38% of the population [1]. This demographic change is in fact a great triumph of civilization [2]. On the other hand, there will be fewer young adults to support an aging population. In this scenario, our healthcare systems will have to treat more patients, often suffering from (multiple) chronic conditions, using the same professionals and resources.

The growing number of older adults leads to the creation of new services and the adaptation of the existing ones to this specific type of audience. However, in order to design products for the older individual, it is important to understand and respect their characteristics. The older adult is usually less accustomed to technology and is likely to develop age-related conditions, namely related to perception and to cognition. Ignoring older adult's characteristics will probably result in a product with low acceptance level.

Human-Computer Interaction (HCI) is the discipline that studies the quality of the interaction between the human and technology [3]. And in that context, the main goal of HCI professionals is to create products that are useful, usable and used. Experimental research however, rarely reflects the demographics [4]. HCI is not an exception and not rarely grounds its research on younger individuals, often university students. In order to create adequate products for this audience, research ought to focus in the older adult, being that HCI provides us the right methods and tools.

This paper describes an experience using user research and personas in the context of the design and development of a system aimed at older adults. The paper reports the progress made on understanding the final user's needs and characteristics that will support the design of the system. This work was done within the context of the eCAALYX – "Enhanced Complete Ambient Assisted Living Experiment – project.

2. BACKGROUND ON: AGE RELATED CHANGES
The acceptance of a product or service depends, mostly, on its ability to solve a particular problem and on the facility of its integration into the user's life. Therefore, designing for the older adult requires the professionals to be knowledgeable into what concerns the older adult's characteristics. This section describes the physical, cognitive, psychological and social changes of this particular type of user. Our analysis mainly focused on the characteristics that are more relevant to the implementation of a user interface for the TV (see our case study in Section 4); nevertheless many points are general and can be applied to different systems.

The human is not a 'sum of physical parts'; as Carstensen and Hartel (2006) refer, humans are the sum of all that they have experienced, a reflection of the social and cultural environments where they have lived [5]. Therefore if one forgets the context of today's older adults, products will not achieve great acceptance.

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The elder did not grow up using computers or other devices, and what might seem like a very common technology to us might be very strange or even 'rocket-science' to the older adult of today.

2.1 Physical Changes

The aging process introduces significant changes to the human perceptual system. To understand those changes, a distinction should be done between perception and sensation. Sensation is the apprehension of simple stimuli's properties through the senses; perception is the interpretation of those sensations. Seeing the red color is a sensation; recognizing an apple is a perception [6]. Many problems of the older adult however, are a mix of sensation and perception limitations; therefore our focus will be on problems rather than on their causes.

The next section reports changes in vision and is followed by a section on hearing and another on motor changes.

1.1.1 Changes in Vision

Vision is one of the most relevant human sensory systems, since the human acquires information (mainly) using sight [3]. Therefore it is fair to conclude that if the user cannot see the interface, most probably he will have problems using it. Fisk (2009) explains that "if we live long enough, nearly all of us will have vision problems" [6]. Vision can be affected in multiple ways, this section introduces the most important changes: visual acuity, presbyopia, peripheral vision and dark adaptation.

Charness and Schaie (2003) define visual acuity as "a measure of the visual system's ability to resolve fine spatial detail" [7]. According to Burke and Laramie (2004) a visually impaired individual has a 20/40 visual acuity or lower and can read an eye chart at 20 meters while fully sighted person can read at 40[1] [8][9][6]. Recent studies revealed that a percentage of 92% of the individuals above 70 years wear glasses [7]. Although (near and far) acuity problems are so common, Fisk (2009) argues that the acuity of 20/40 – which most older adults have (> 80%) – is more than enough for most activities [6].

Presbyopia is characterized by a decrease in the competence of the eye to change its focal length [10][6]. In other words, it is the difficulty of changing focus between objects at different distances. Our eyes are designed to look at objects which are 6 meters away or farther; each time the eye focus closer objects, the crystalline lens in the eye have to bend into a more convex shape [7]. The problem, as the same authors conclude, is that as we grow older the crystalline lens become harder to bend. The normal eye experiences difficulties in focusing objects at a reading distance since 45 years of age [11]. Although presbyopia can increase the difficulty of some tasks, it can be corrected by wearing glasses [7]. Based on this, and if a system requires the interaction with close objects, it is important to consider that the older adult may have extra difficulties due to the use of glasses. One example would be changing the TV channel, when the elder would have to put on the glasses in order to be able to read the channels number on the TV remote.

Age-related changes also bring the decrease in peripheral vision [7][6]. As objects move away from central vision into the periphery, it becomes more difficult to resolve their details [7]. Driving is one activity in which peripheral vision plays a critical role by allowing the driver to see cars coming from other directions. Similarly, user interfaces employ pop-ups often appearing on the corners of the screen. When dealing with older adults however, that information by itself might not be noticed, therefore other strategies for signaling events, such as sound signals should be used.

The adaptation from a very well illuminated environment to a very poorly one reduces the sensitivity of the vision [7]. Recovering the visual sensitivity is known to be a slower process for the older observer [8]. The older eye only recovers part of its sensitivity in poorly illuminated environments [7], which means that if the environment is not correctly illuminated, some details will be missed by these observers.

1.1.2 Changes in Hearing

The success of user interaction with a system or environment can be affected by the user's ability to hear [6]. Therefore if there is the need to include auditory information in a system, age related changes in audition have to be considered in the design process. About 10% of the middle-aged adults suffer from hearing losses to a point that they inhibit their social interaction. At the age of 65, half of the men and 30% of the women exhibit the same symptoms. This difference is usually attributed to the distinct noise exposure at the workplace; nevertheless, this difference should be attenuated as more and more women engage in work activities that are detrimental to hearing [7].

As far as the volume is concerned, humans can hear sounds from 8 decibels (dB) (similar to a whisper) to 130dB. There are severe hearing damages when the individual's threshold is greater than 35dB. It is important to underline that this loss of sensitivity is especially pronounced for high-frequency sounds [7][6]. Systems depending on sound should enable their users to easily adjust the volume.

The audible frequencies also decrease with age. A young adult can normally hear sound frequencies up to 15000 vibrations per second. However, for an older adult sound vibrations greater than 4000 vibrations per second may be inaudible [6]. Citing Corso (1981), Charness and Schaie (2003) refer that complex tasks such as speech recognition and sound localization are affected by the inability to detect some frequencies [7]. Moreover, the hearing loss is worse for consonants than it is for vowels, which makes it very difficult to fully understand some words. The statement frequently used by the hearing impaired: "I can hear you, but I cannot understand what you are saying" is an example of this difficulty [8]. Similarly, the sentence "The thinner cat is red" may be heard as "The dinner hat is red", because of the listener's difficulty understanding consonants.

The intelligibility of speech is also conditioned by the background noise and architectural echo or reverberation [7].

Accent is also an influential factor that can improve speech intelligibility by helping the listener to cope with background noise and hearing deficits; however, accent is only useful if the user is familiar with it [6].

Finally it is imperative to understand that the hearing loss may be denied by the older adult because of the negative stereotype of people not hearing well [8]. This loss can create the feeling of social status loss or inability to compensate for his (hearing) problems, which would increase the problem even more.

[1] Visual acuity is a comparison coefficient. We could change the units of the example to feet and it would also be valid.

1.1.3 Motor changes

The human motor system also experiences age effects. Modifications occur throughout the whole body. This section concentrates in the problems that may occur when manipulating a TV remote. In this context, Fisk (2009) reports the increased response times, lesser ability to maintain continuous movements and difficulties in coordination [6]. Arthritis is also very common among older adults [12]; swelled fingers in pain will most likely reduce the speed and accuracy of the movement.

The changes expressed above can contribute to greater difficulties performing fine motor control actions. The following paragraph presents some of these difficulties as described in the literature.

Fisk (2009) discovered that older adults had difficulties double-clicking a mouse; however, when the time interval between clicks was increased, errors were eliminated [6]. Given these results one can conclude that the problem was not the complexity of the task, but the speed of movement. Helander et al. (1997) explained that declines in the spatial abilities were known to create difficulties using devices like the mouse [12]. This difficulty assumes greater importance as it can block the interaction with the user interface. When testing the usability of PDAs, older adults expressed their concerns about their ’fat fingers‘ preventing them from completing the task; the users ’feared‘ to push multiple buttons at the same time. Siek et al. (2005) concluded however that not many errors were registered in that task [13].

Physical changes are inevitable for the older adult. Since these changes can greatly impact the interaction of older adults with products, it is crucial not to forget them when designing a system. Cognitive changes also occur; these are introduced in the next section.

2.2 Cognitive Changes

Perceptual limitations are not the only ones that affect the older adult. Limitations in the cognitive ability might also create difficulties. Interacting with products usually requires the user to reason and choose over a set of options. Memory is crucial to this task; therefore its limitations should be explored in order to create an acceptable user experience. This section will start introducing memory considerations and then some reflections on attention.

1.1.4 Changes in Memory

There is a common belief that as we get older our memory gets worse. Memory is an ability that involves complex processes such as the storage and retrieval of information in the brain [14]. Like with other parts of our body, changes occur in the brain that affect the way older adults learn and assimilate information. However, although changes occur, not all memory functions are affected [15][6].

Working memory – or short-term memory – is "the capability to temporarily keep information active while we ’work on it’ or until we use it" [6]. This type of memory has an ephemeral character and a limited capacity [15][3]. This capacity is usually limited by normal aging [6]. Satre et al. (2006) also state that limitations in short-term memory can influence the learning process and affect language comprehension [15].

O’Neill (2002) documents that older adults may recognize this changes and try to cope with them by taking notes that will, for example, help them in the first usages of a product [14].

If short-term memory is our working-memory, long-term memory is a permanent storage of information, containing everything we "know" [6][3]. Long-term memory differs from working-memory in capacity (very big, if not unlimited), in retrieval time (much slower) and in occurrence of forget (very slow, if at all) [3]. This type of memory can be categorized according to different forms like semantic memory, prospective memory and procedural memory. As changes in memory occur differently in each form, they are described separately.

Semantic memory is responsible for storing factual information like the meaning of words, historical facts and general knowledge [6]. Its capacity declines minimally with aging. On the other hand, Satre et al. (2006) citing Salthouse (1996), refers that age causes a reduction in the processing speed [15]. Even though reaction time can be decreased doing exercises, age differences are most of the times noticeable. The "tip-of-the-tongue" phenomenon is an example of this slower access of information, in which the older adult tries to remember the correct word.

Prospective memory is characterized by remembering to do something in the future [6]. This form of memory can be divided in two types: "time-based" – remembering to do something later, like for example to take medication in 4 hours – and "event-based" – remembering to perform some action after the occurrence of an event, like for example to take medication after breakfast. The decline in prospective memory is more accentuated in the "time-based" type than in the "event-based". Being so, it is important to optimize for the "event-based" memory making use of the appropriate reminders.

Procedural memory is the name of the form of long-term memory that represents the knowledge of how to execute a certain task [6]. Procedural memory includes not only the activities we do without thinking, like tying up shoes, but also less automatic ones like doing a multiplication. Older adults may experience difficulties developing new automatic processes in some domains and remembering activities not executed for long time. "Automatized" activities however, are not likely to be lost.

1.1.5 Changes in Attention

Attention is our capability of concentrating on one task instead of a number of competing thoughts and stimulus [3][6][7]. Each second, the human body receives a massive amount of information through the senses, and each second, through selective attention, the human selects which stimuli to attend [7][3]. This selection is our mechanism for switching tasks back and forth and it is based on our level of interest or need [6][3]. Fisk (2009) states that "if we did not selectively attend to the stimuli coming into our senses, we would be overloaded". When required to execute more than one task at once – like for example driving and looking for street signs – older adults have shown more difficulty than younger persons [6]. According to the same author, in general, older adults would need more time to change between tasks.

Older adults will have more difficulty distinguishing between target and non-target stimulus if the number of distracters increases [16]. On the same subject, Fisk (2009) refers that older adults are usually "more affected by salient events such as flashing, high-intensity lights as well as stimuli that appear to pose an immediate ’threat’" [6].

To better design with the attention constraints in mind, it is important to require the minimum of search to perform a task, remove information that captures user attention as soon as it is not needed, and to remove elements that might capture attention, such as blinking elements [6][7].

2.3 Psychological and Social Changes

There are many myths about the psychological and social effects of aging. Stereotypes of the senile, mentally ill, depressed and isolated man; although inaccurate, these stereotypes are very common [17]. This section presents a short summary of the most relevant changes. Covered themes include the characteristic problems of the older adult, personality and self-acceptance, social networks and treatment issues.

Although some problems only arrive at a late stage in life, many are similar to difficulties in other stages of life [17]. Dealing with losses and limitations is one of the most relevant issues. Inevitably, aging brings the need to adapt to physical limitations and functional impairments. The individual is forced to choose the most important goals, to refine the means to achieve them and to find new strategies to deal with losses [18][17]. Losing loved ones is a problem that the older adult will encounter [5]. The older adult will have to deal not only with emotional ramifications but sometimes with the difficult task of building a meaningful social world [17]. However, facing loss in the context of one's life often creates a unique possibility of achieving reconciliation, healing or deeper wisdom [17] citing works on wisdom.

Wisdom takes us to our next subject: personality and acceptance of the self. The individual personality shapes according to the events and the decisions of one's life. However, age does not significantly change the core of the individual. When someone gets old, one is like what he was before, not an older person stereotype [5].

Although personality does not change much, the acceptance of the self seems to increase. People are increasingly sure about who they are, their competencies and their weaknesses [5]. These changes lead them to a better self-acceptance.

Social networks are a subject where older and younger adults differ. Younger adults are likely to grow large social networks with the objective of finding a mate; later in life, the focus changes to maintaining emotional balance [15][5]. Confronted with limited opportunities, the older adult invests in the most satisfying and humanly rich relationships [5][17]. This is also true for the relationship with their care takers, so it is important to consider and support this type of interaction when designing systems for this particular type of user.

Treatment is the last point we approach in this section. Optimism is related to lower distress, better coping with the disease and faster recovery periods [5]. The well-being of the older adult is strongly related with the quality of the relation with adult children [5] referring the work of Ryff et al. (1994).

3. USER RESEARCH AND PERSONAS

In order to design a good user interface it is crucial to conduct a thorough user research and analysis. There are several user research methods, including literature research, ethnographic research and surveys. However, regardless of the method or the combination of methods used, requirements, stated and implicit, need to be exhaustively uncovered. This will enable the design team to have a clear definition of the user profile, i.e.: characteristics, roles, needs, stories, etc. Once the design team has a clear understanding of whom it will be developing to, it can also define the design objectives, constraints, use cases, etc. Given that the information gathered and discovered on the requirements analysis and specification phases will guide the rest of the project, all information should be thoroughly documented by the end of this phase so that everyone involved in the project understands the solutions proposed and how they should be developed. .

For the work reported in this paper, most of the user research was based on the review of the literature, of which findings were partly described in the previous section. Some informal interviews were also carried out with the medical partners of the project. Once gathered and analyzed this information fed into the development of the personas.

Personas are made up of archetypes that express the motivations, expectations and goals of a particular user group when using an artifact [19][20]. As an HCI tool, personas improve the design process by moving the focus to the user [21]. One of the most important advantages of personas is to convey information across the team. In general, people have different ideas on who the final user is; with this technique, those ideas can be discussed to create a common vision, since having a blurred concept of the end user is half the way to design for every possible feature and therefore to create a product that is difficult to use.

Alan Cooper [22] coined the term personas when trying to describe a process of creating and evaluating software [23]. In that process, Cooper would question who was using a certain product and what did that particular user wanted to achieve.

When using personas, the intention is really to incorporate the persona character and try to reason on the persona's objectives, characteristics and difficulties. The information that fills the persona profile is usually based on ethnographic research, focus groups or demographics and therefore represents the real users and not the (designer's) self [19].

Besides a name and a picture, a persona profile also includes motivations, expectations and goals [24]. Redish (2007) argues that the picture and the name of the persona are of crucial importance as these have the power to turn a user profile into a persona. Personas usually assume the graphical form of posters; more original forms like collages with pieces of life from the group of users are also possible. Another possibility consists of creating an e-mail address that sends e-mails for the team [21].

4. THE eCAALYX PROJECT

The work presented in this paper was developed in the context of the eCAALYX project. eCAALYX is part of an effort of the European Commission's AAL Joint Program to create a complete solution that improves the quality of life of the older adult with chronic conditions by monitoring his health and by improving the communication with his caretakers. In this context, the authors of this paper are responsible for the design of the TV user interface. This TV system, placed at the older adult's home, should enable him to communicate with his caretaker, to check his health

condition and to remember his medical appointments and medication.

Specifically, eCAALYX's objective is to address problems caused by chronic conditions that can have severe consequences to the older patient's health condition. These include cardiovascular disease (heart-failure), chronic obstructive pulmonary disease (COPD), diabetes mellitus type 2, arthritis, dementia and chronic wounds. The objective is not only to detect and monitor risk situations, but also to educate the patient in order to avoid them.

The project is currently on its first year and the activities reported in this section were developed in the scope of the requirements analysis and specification phases. Given its potential, discussed in the previous section, the authors decided to take an approach based on user research and personas.

The following sections report on the process that led to the creation of personas. The example of John, the diabetic patient, is analysed in detail and illustrates the process that was followed for the remaining personas created in the context of the eCAALYX project. A review on related projects is followed by a more specific analysis of the diabetes disease that feeds into the development of John's persona. Finally, a discussion on how personas impacted and were used in the context of eCAALYX is presented.

4.1 Related Projects

eCAALYX will develop a telecare solution, but since other solutions have been already proposed that approached the remote health management of patients, we also looked at those. Chan et al. (2004) conducted an experiment in Hong Kong to evaluate the feasibility of a diabetes group care program using telemedicine in elderly community centers [25]. The study involved 22 older adults with type 2 diabetes [2]divided into three groups. Each of the groups received education regarding diet, glucose monitoring and management, foot care, as well as exercise prescription. The participants concluded that after the program they had a better understanding of their disease, felt better, happier and were more active. Results showed significant changes in the management of the disease.

Barnet (2006) studied the effectiveness of a different approach to remote health management [26]. Instead of being focused in education, as the previous example, it was aimed to improve the communication between the doctor and the patient. For a period of 24 months, 800 older individuals were divided into two groups: one to test the new treatment and other as control group. The elements of the treatment group received a messaging device to communicate with their caretakers. This device enabled them to communicate with a nurse that would help manage their health and medication, schedule medical appointments and assist with technology difficulties. The results of this research showed a significant decrease in the number of hospitalizations of the treatment group. This supports the thesis that a closer contact to caretakers can improve the management of the disease. On the other hand, the number of home visits also increased, which leads us to think that the worst problems were solved with home visits instead of hospitalizations.

Brown (2007) analyzed some studies that used the Internet as a channel and noticed changes in the patient's health and life habits [27]. Web sites are the most used technology to aid the management of the diabetic health. These systems give attention to different dimensions of the treatment like the management of weight, blood pressure or physical activity and the monitoring of blood glucose and cardiovascular disease risk. Since these systems hold updated information on its user, it is possible to create a personalized treatment for the patient. Web sites can also stimulate group discussions which enable its users to gain confidence and increase engagement by exchanging their stories.

Videoconference also creates an effective alternative to direct contact between the patient and the caretaker. It has resulted in a lesser need for physical encounters and an increased patient satisfaction [27].

Interactive voice response systems send automatic messages to its users. The patients then respond using their voice or pressing phone buttons. By increasing the caretaker's information on the patient's status, these systems are capable of reducing hospitalizations and office visits [27]. One important point referred by the author is that the number of home visits increased, which can be justified by the prevention of expensive hospitalizations and emergency room visits. Just like web sites, these systems are capable of quickly providing a personalized treatment. By doing so, they allow the older adult to learn more about his condition, which is crucial at the beginning when his knowledge is scarce.

The analysis of treatment approaches led us to notice some important points that were present. Communication, education and feedback are addressed, although in different ways, by every study.

4.2 From Problems and Goals to Personas

As reported in section 3, personas can be used to improve the understanding of the objectives, goals and needs of the final users. By creating a different persona for each actor, it is possible to focus on the characteristics of each of the different users at the same time. Specifically for this project, it becomes easier to focus on the needs of patients with different diseases.

To create the persona that represents the diabetic patient, John, the authors started by searching for the causes and characteristics of the disease itself. This was followed by investigation on the treatment that is applied to that disease, in order to understand the major issues that needed to be addressed.

Diabetes Mellitus or simply Diabetes is characterized by the inability to produce (type 1) or to respond to insulin (type 2). This inability prevents the body from keeping the right level of sugar in the blood [28][29]. When very high levels of glucose (sugar) are present for years in the blood, they can impact the blood vessels, heart, eyes, kidneys and nerves [29][28].

The regulation of sugar level in the blood can be done in different ways. Insulin injections are part of type 1 diabetes treatment from start. The purpose of insulin is to mimic the body's natural production to control sugar level. On the other hand, type 2 diabetes, with 90% of the cases, may also be treated with lifestyle changes, mainly exercise and diet [29][11][28]. The

[2] Diabetes type 2 is characterized by the inability to respond to insulin. By preventing the body from keeping the right level of sugar in the blood, this disease, has a severe impact on the body. Unlike type 1 diabetes, this kind of diabetes may also be controlled through diet and exercise (see Section 4.2).

recommended diet for the diabetic suggests regular meals and a reduced intake of sugar, salt and fat. Introducing changes to one's lifestyle is a difficult task [30]. If someone develops diabetes because is overweight, lifestyle should be changed as part of the treatment. In the same line of thought, the authors believe that in order to commit lifestyle changes, older adult should be very well informed of their ailment.

Another important detail on the treatment for diabetes is that the level of insulin injected will depend on the amount of food ingested and the amount of exercise taken. As one can predict, this balance is not always easy to handle. However, devices that measure the glucose in the blood can help patients manage this balance better by improving their knowledge of their body. Nevertheless, when one is learning to manage a new disease, it is normal to have doubts about the treatment, but also difficulties handling it. Changes will have to be made in one's life; adverse outcomes include limb amputations.

4.3 John: The Example of the Diabetic Persona

Within eCAALYX project, eight personas were developed representing primary users – older adults – as well as secondary users – caretakers and caregivers. This section illustrates the process followed for the creation of the eight personas by describing John's persona.

Figure 1 shows the persona template, which includes a name, a picture and information on background, goals and motivation. The background, introduces the reader to key points of the persona's personality.

At this point, the team had understood the major problems to address. However, a persona is not a disease description. To be effective, it has to capture the cause of the problems. Many chronic conditions are caused by incorrect lifestyle habits. If one does not understand the origin of the problems, it will be very difficult to 'get under the skin' of the persona. With this premises in mind, the team searched for relatives that suffered from diabetes. While not being a very scientific method this contact provided us with insight on the lifestyle of these individuals and helped us to create the diabetic persona.

One of the diseases eCAALYX has determined to address is Diabetes type 2. This type of diabetes is related to incorrect lifestyle habits; therefore, John is described as someone that really enjoys eating. To John, eating is a social activity that he feels as one of the pleasures of life that still has not been taken from him. Also, since "time-based" and "event-based" memory types are affected, John is described as someone who experiences difficulties remembering to take medication. The problem of loss, as described in Section 2.3, was also analyzed.

The section of goals and motivation of the persona presents some points that cause distress to the older adult and that can be improved. For instance, independence is a very important issue/need to the older adult. Because of his difficulty managing the disease, John has been hospitalized and deprived from this need. However, John wants to keep his independence, therefore that information has been included. As a last goal, the persona references the need to being remembered of medication and appointments, since this is something that cannot be changed.

In order to validate the generated personas, these artifacts were presented and discussed with the medical partners of the project. During these discussions, the doctors confirmed the relevance of the aspects included in the created personas, including John's. Nothing significant changed, however the conversations with the doctors enabled us to gain confidence in the results and insight into the general doctors' experience treating older adults.

John

[33]

Background

John is a 70-year-old man that suffers from a dangerous type of diabetes. He is a very social person and a good fork. John does not understand his disease and has problems handling it.

John also has problems remembering his medication and his medical appointments.

Goals and Motivation

John wants to be better informed so that he can act effectively and avoid staying at the hospital.

John wants to have a system that remembers him to take his medication and of his medical appointments.

Figure 1: Excerpt of the diabetic patient persona.

The personas were also used during the phase of requirements and feature discussion and specification. Since some features were more important for some personas than others, each (persona) included information on the system's answer to its case.

4.4 How Personas Fit in eCAALYX

The knowledge and understanding of the user that is developed during the process of creating a persona is as important as the persona itself. This information ultimately enables the team to

achieve a more clear and detailed vision of the user. Not just the 'general' user of the system, but also more specific ones such as Specifically, John has a problem controlling his appetite, therefore, in this sense, John is not equal to the general user and therefore features are filtered accordingly. John has to control his glucose levels. He balances amount of food, insulin doses and exercise. Therefore, the system should offer him information on how his glucose levels have been. Other patients might not need this information, but for John it is crucial.

The work reported in this paper refers to the first phase of the project, specifically the requirements analysis and specification phases. For this phase, different personas were created for each significant type of user. These personas are now being used as a baseline for the design and development of the low-fidelity prototypes of the eCAALYX system. For instance, the eCAALYX system features educational videos. And in this respect, John will benefit from videos that teach him how to have a better diet and how to exercise, while videos that explain how to react in case of a respiratory emergency (suited to COPD patients) wont be much useful to John.

Personas have been important not only as a communication tool, but also as a reminder for the overall project team that we are not merely designing for general users but for users with specific needs.

5. DISCUSSION

Personas are useful to keep everyone who is part of the design team focused. By having a description of the problems of a user with a specific chronic condition, the design team is able: i) to understand this user better and therefore fulfill his needs; and: ii) to evaluate the users' potential satisfaction with a certain product.

McGinn and Kotamraju (2008) suggest that personas should be created from statistical information, however, since we did not have a testing group from the beginning of the project, the personas presented in this paper were mainly designed based on user research [31]; similar approaches are proposed by [32]. Still, it is important to refer that, as briefly described in Section 4.3, the medical partners of the project – who have close contact with the end users – validated our proposal, by confirming the specificities included in the generated personas. Although this does not replace the contact with the real users or the limited possibility for the generalization of results, it does add confidence to the process and the personas constructed throughout. Personas are not static and are likely to change based on the feedback of the target audience. Recent negotiations established partnerships with users' organizations and, if needed, personas will be revised, as studies progress inside the project.

Another interesting point of discussion for this paper concerns the ease of use of technology by older adults. Experimental Research in Human-Computer Interaction rarely focuses on the older adult. However, this situation is likely to change due to the increasing number of older individuals, particularly in Europe. The challenge is great since the elderly normally experiences more problems (than younger adults) when using technological devices. Older adults did not grow up using computer or smartphones and are likely to have developed limitations in perception and cognition with age. One can argue that older adults of the future will handle technology more easily. While this assumption might be correct or at least partly correct, it is not possible to ignore older adult physical and cognitive characteristics. Despite their computer literacy, the authors believe that physical, cognitive and social characteristics, as the ones described in Section 2, ought to be considered in the design in order to create products that are actually useful and usable.

6. CONCLUSIONS AND FUTURE WORK

This paper described the application of personas and user research as tools to focus on the needs, problems and goals of different users. These techniques were applied to the first part of the development of eCAALYX. The objective was to create the user interface of a TV system, placed at the older adult's house that enabled the elder to communicate with his caretaker, to check his health condition and to remember his medical appointments and medication.

We have conducted user research to better understand our audience. Our results (see Section 2) cover aspects such as perception, cognition, mental and psychosocial changes that occur with age.

Based on user research, we created a set of personas to represent a type of final user in our design process. From those personas, we have chosen to present John the diabetic persona. In this context, we have described the process that led us to create this persona.

Currently, the project is at the beginning of the prototyping phase of the TV sub-system. The use of user research and personas has contributed to the conceptualization of our problem. Personas were especially useful when discussing features, to keep everyone on the same line of thought. Future work will detail on the effect of the use of personas on the entire process.

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