TESIS DOCTORAL

PREDICTORES DEL USO DE LOS DISPOSITIVOS DE TELEASISTENCIA

FACTORS PREDICTING TELECARE DEVICES USE

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ENGLISH SUMMARY

The research described in this dissertation is part of the work that I have carried out during the last five years at the Department of Experimental Psychology at the University of Granada and the Department of Industrial Engineering and Management at the University of Oulu, Finland. Our central goal in this dissertation was to explore the psychological predictors of Telecare systems use.

The exposition begins with the sociodemographic changes in the society, following with psychological and physical changes related with Aging as well as psychological factors related with technology use. Relevant studies are then discussed and issues in need of clarification are identified. Then, the goals of our research are discussed. Finally, we introduce the three research papers that comprise the present thesis (Study I to III). The first one is intended to explore the problem of erroneous calls in the telecare systems. We hypothesized that cognitive deterioration could explain this problem. Most of today telecare systems include verbal interfaces. Since verbal processing deteriorates faster with age than picture processing, we proposed to use graphic interface to enhance system interface use. Results confirmed that hypothesis, Graphic interfaces reduced the number of errors that user made. The second paper is intended to explore predictors of telecare system use. We studied the predicting value of some factors as Prior Knowledge, Ease of Learning, Repercussion of use, Self-Efficacy, Attention, Memory, Aesthetics, Attitude to Technology, Anxiety trait and State. Results showed that Ease of Learning, Negative emotions, Attitude to technology, State-Trait Anxiety are related to Telecare systems use. The study described in the third paper was tended to explore predictors of Telecare Pendant use. We hypothesized that Model TAM factors, Anxiety and Depression are related to Pendant use. Results showed that Perceived Usefulness, Perceived Ease of Use, State Anxiety and State Depression have a significant relationship with Pendant use.

CAPITULO 1. INTRODUCCIÓN

Las sociedades contemporáneas se enfrentan a dos retos importantes y que están relacionados: el envejecimiento progresivo de la población y la rápida difusión de las nueva tecnologías. El envejecimiento del ser humano, con su consecuente deterioro de las habilidades y la salud, tiene que ser compensado con los avances tecnológicos que ayuden a mejorar la vida y el confort de las personas mayores. Sin embargo, las habilidades, necesidades, aspiraciones y entornos de las personas mayores son muy variables y no siempre observamos una completa y satisfactoria adaptación de estas personas a las tecnologias que están siendo diseñadas para ellas. La importancia de este hecho se revela cuando consideramos el impacto que la tecnología tiene sobre la vida diaria de las personas mayores y que abarca un amplio espectro de actividades de la vida diaria, desde las tareas más básicas hasta aquellas actividades que enriquecen la vida. Es evidente que es necesario hacer todos los esfuerzos para que la tecnología cumpla satisfactoriamente su rol en la realización o el mejoramiento de estas actividades (Melenhorst, Rogers and Fisk, 2007; Proyecto Europeo orientado a entornos inteligentes para personas mayores (en adelante, SOPRANO), 2007).

En consecuencia, el objetivo principal de este trabajo de investigación ha sido el analizar y potenciar el uso de una de las tecnologías más importantes diseñadas para las personas mayores, los sistemas de Teleasistencia Domiciliaria. En concreto la presente ha consistido en la realización de tres estudios encaminados a proporcionar una descripción de diversas características personales y de la tecnología que potencialmente podrían influir en la aceptación y uso eficiente de los sistemas tecnológicos de teleasistencia.

La tesis se divide en 6 capítulos siendo el primer capítulo esta introducción. En el segundo se describen los cambios sociodemógraficos que ocurren en nuestra sociedad, en concreto el envejecimiento de la población y los cambios que se producen como consecuencia del mismo. También describimos los factores sociodemográficos (Edad, Sexo, Nivel Educativo, etc) que se relacionan con el uso de la tecnología así como los factores psicológicos relacionados con el uso de las TICs. En el tercero se define el concepto de Teleasistencia, los tipos de Teleasistencia que existen, su situación actual en el mercado así como su nivel de penetración en Europa y España. En el cuarto se justifican y explican los objetivos del trabajo de investigación, es decir, las hipótesis

de investigación que se van a comprobar en el mismo. En el quinto se ofrece una discusión sobre los resultados de la investigación y las hipótesis comprobadas. El sexto nos proporciona las conclusiones teóricas, metodológicas y prácticas de la investigación así como la posible investigación futura a realizar. Por último se incluyen los tres estudios de investigación realizados en el formato de artículos ya publicados o en proceso de publicación en revistas científicas afines a la temática que aquí se trata

CAPITULO 2. ENVEJECIMIENTO POBLACIONAL Y USO DE LAS TICs

Este capítulo se divide en 4 subcapítulos. El primero se refiere a los cambios sociodemógraficos que ocurren en nuestra sociedad y al envejecimiento de la población. El segundo revisa los cambios que se producen en el envejecimiento y podrían afectar al uso de la tecnología. El tercero tiene que ver con los factores sociodemográficos (Edad, sexo, Nivel Educativo, etc.) que se relacionan con el uso de la tecnología. Por último el cuarto trata de los factores psicológicos relacionados con el uso de la tecnología.

2.1. Cambios Sociodemográficos en España y en la Unión Europea

Se considera que una persona es mayor a partir de la edad de su jubilación (Prieto, Etxeberría, Galdona, Urdaneta y Janguas, 2009). El incremento en la esperanza de vida y la baja tasa de natalidad están originando un crecimiento acelerado en el porcentaje de personas mayores, que tiene como consecuencia un aumento del envejecimiento de la población. Este envejecimiento de la población está ocurriendo por igual en todos los países europeos con alguna diferencia en cuanto a la rápidez del mismo (SOPRANO, 2007; Goll, 2010).

En el caso español, el fenómeno del envejecimiento está siendo especialmente acelerado, como consecuencia de la mayor longevidad, ya que, en menos de 30 años se ha duplicado el número de personas mayores de 65 años. Este proceso se ve acentuado por la baja tasa de natalidad que se viene registrando desde hace algunas décadas, especialmente desde mediados de los años 70 (Fernández, Parapar y Ruiz, 2010).

En España hay entorno a 7 millones de personas mayores de 65 años, lo que supone casi el 17% de la población total, de las que aproximadamente un 25% son octogenarias. En este sentido, para el año 2050 el porcentaje de personas mayores de 65 años estarán por encima del 30% de la población (con casi 13 millones) y el número de octogenarios llegará a ser más de 4 millones, lo que supondría más del 30% del total de la población mayor (Fernández et al., 2010).

Por otro lado, estimaciones internacionales realizadas por la ONU muestran a España en el año 2050 como el país más envejecido del mundo, en el que el 40% de su población será mayor de 60 años (Fernández et al., 2010).

Dentro del contexto Europeo, en el año 2004 se realizó por parte del Eurostat una proyección para la Europa de los 25, donde desde 1950 hasta 2050 se distribuyó a la población en diferentes grupos de edad. En dicha proyección se aprecia un aumento en la estructura de la población de los grupos de edad más avanzada, de 65 a 79 años y de 80 o más años. Por lo que a partir de este estudio, se prevee un aumento desde el 9,1% que representaba este grupo de población en 1950 hasta casi el 33% previsible para el 2050 (ver tabla 1) (Fernández et al. 2010).

Tabla 1. Porcentajes evolución de los grupos de población estimados en la UE-25 para el período 1950-2050 (Fernández et al., 2010)

	2050	2025	2000	1975	1950
0-14	13,3	14,4	17,1	23,7	24,9
15-24	9,7	10,5	13	15,5	15,8
25-49	28,2	31,1	36,9	32,7	15,2
50-64	18,5	21,3	12,3	15,4	35
65-79	18,5	16,2	17,2	10,7	7,9
>80	11,8	6,5	3,4	2	1,2

Así el fenómeno del envejecimiento es más acentuado en España que en el resto de países Europeos. En función de estas estimaciones, la población de mayor edad en España, crecerá más rápido que la media del resto de países europeos. Más concretamente, existe una evolución en el porcentaje del crecimiento del grupo de población mayor de 65 años, donde a partir de la década de los 80, se produce una aceleración en el crecimiento de este grupo de población en comparación a la media de los países europeos (Fernández et al., 2010).

Por otro lado el incremento del número y proporción de personas mayores especialmente preocupa en sociedades donde estas personas viven en su casa y no en instituciones, así como, sus limitaciones físicas y psicológicas suponen un hecho social que puede generar graves problemas de asistencia. Por esta razón se está invirtiendo en tecnologías que permitan que estas personas mayores permanezcan en sus casas recibiendo un nivel de asistencia adecuado y aumentando su bienestar personal, su

calidad de vida, al mismo tiempo que se consigue un condiderable ahorro en gastos sanitarios y servicios sociales (SOPRANO, 2007).

Afortunadamente, los recientes desarrollos en la electrónica han incrementado el potencial de la Tecnología para ayudar a las personas mayores, a través, del uso de sensores, dispositivos a control remoto, etc. Sin embargo, aunque estos avances tecnológicos, que podríamos englobar en lo que denominamos Tecnologías de la Información y Comunicación (TICs), ofrecen grandes posibilidades para la integración y la participación de las personas mayores, su uso está siendo menor del deseado debido a diversas áreas de limitación relacionadas con el envejecimiento, tanto físicas como psicológicas, de las personas mayores a las que van dirigidas, y a la propia naturaleza (diseño) de la tecnología (software y hardware) empleada, que, a veces, no está especialmente diseñada para el estrato de la población a la que va destinada (SOPRANO, 2007). En la siguiente sección nos detendremos en la descripción de estas áreas.

2.2. Áreas del Envejecimiento

Una consecuencia de vivir más tiempo es también un incremento del riesgo para las personas mayores de sufrir discapacidad y perder su autonomía. Es de esperar que la población y la esperanza de vida de las personas mayores siga en aumento, por lo que, en futuro no muy lejano el número de aquellos que viven con algún tipo de discapacidad se incrementará (SOPRANO, 2007).

El Informe Portal Mayores (2009), muestra que la tasa de discapacidad debida a problemas de salud o de memoria y que son duraderos de las personas mayores no institucionalizadas en Europa se sitúa en el 27,9%, considerando problemas en la ejecución de alguna actividad, por lo menos en una de las doce consideradas básicas e instrumentales (comer, controlar esfínteres, usar el retrete, vestirse, bañarse, trasladarse, deambular, tareas domésticas, de movilidad, de administración del hogar y de la propiedad, como poder utilizar el teléfono, acordarse de tomar la medicación, cortarse las uñas de los pies, coger un autobús, preparar la propia comida, comprar lo que se necesita para vivir, realizar actividades domésticas básicas tales como fregar los platos, hacer la cama, etc., poder pasear, ir al médico, hacer papeleos y administrar el propio dinero) (ver Tabla 2).

Tabla 2. Tasas de Discapacidad en Europa, PORTAL MAYORES (2009).

	Porcentaje problemáticas de las actividades de la vida diaria en mayores de 65 años			
Países	Sin problemas	Problemáticas en al menos una actividad	No sabe / No contesta	Total
Alemania	74,7	25,2	0,1	100
Austria	71,7	28,2	0,1	100
Bélgica	70,2	29,8	0,0	100
Dinamarca	76,2	23,7	0,1	100
España	71,5	28,5	0,0	100
Francia	72,2	27,8	0,0	100
Grecia	77,8	21,7	0,5	100
Italia	72,4	27,6	0,0	100
Países Bajos	78,3	21,6	0,1	100
Polonia	52,5	47,5	0,0	100
Rep. Checa	76,2	23,8	0,0	100
Suecia	77,5	22,5	0,1	100
Suiza	84,7	15,3	0,0	100
Total	72,1	27,9	0,1	100

La progresiva disminución de las capacidades cognitivas y físicas de las personas mayores afecta a las mismas para su habilidad para manejar productos y servicios asociados en las tecnologías de la información. Entre ellas, el deterioro sensorial, como factor discapacitante, representa uno de los problemas más habituales durante el envejecimiento. La pérdida sensorial, se asocia a una variedad de consecuencias negativas, incluyendo la reducción del funcionamiento físico, el incremento de la dependencia, aislamiento social y una disminución de la calidad de vida (SOPRANO, 2007). Las principales deficiencias que perjudicarían el acceso de las personas mayores a las TIC son las limitaciones Perceptivas, Motoras y Cognitivas.

2.2.1. Área Perceptiva

En cuanto a la visión, en el ojo de las personas mayores, la pupila decrece en su diámetro absoluto, este decrecimiento provoca que la cantidad de luz que entra en la retina de las personas mayores se reduzca. Con respecto a la lente de las personas

mayores esta es más rigida lo que puede conducir a padecer presbicia, así como, a sufrir resplandores y a ver borrosos los objetos cercanos. Es importante mencionar también la degeneración macular, cuya incidendia está aumentando en el sector de los mayores. Esta tiene como consecuencia tanto un declive de la agudeza visual como una pérdida completa de la visión en cuanto al centro de su campo visual. Ante patologías como la diabetes, sus consecuencias se agravan considerablemente. Otra enfermedad de la visión que es importante resaltar es el glaucoma, que se entiende como un daño en la ruta del nervio óptico, lo que tiene varias consecuencias, la primera que se produzca una pérdida visual alrededor del campo visual, la segunda que surga la denominada visión de túnel y por último que se llegue incluso a la ceguera total (Carmichael, 1999; Jackson, Owsley y McGwin, 1999; Scialfa, Ho y Laberge, 2004; SOPRANO, 2007; Malamos et al, 2011)

En cuanto al procesamiento visual el nivel de agudeza visual de las personas mayores es más reducido, reduciéndose incluso más en condiciones de baja luminosidad. Con la edad el campo visual decrece en cuanto a su extensión. Así ante la complejidad de la visión periférica de las personas mayores, si comparamos las medidas clínicas de identificación de target contra el fondo blanco con las escenas de mundo real, estas tienden a ser más pronunciadas. Debido a dicho decrecimiento, para que un determinado estímulo pueda ser detectado debe estar en el centro del campo visual (Scialfa, Ho and Laberge, 2004; Ojel-Jaramillo and Cañas, 2006; SOPRANO, 2007).

Destacan también los problemas de la profundidad de la percepción. Dentro de una escena visual encontramos dos tipos de claves, claves monoculares relacionadas con las claves de profundidad y de movimiento y las claves binoculares orientadas a la capacidad de percibir objetos en tres dimensiones (Harwood, 2001; SOPRANO, 2007)

En resumen, las principales consecuencias de las limitaciones en la visión se refieren a la incapacidad de funcionar de forma efectiva, afectando pues a diferentes aspectos de la vida de las personas mayores, como por ejemplo, al de su seguridad (aumento del riesgo de caídas, a las actividades instrumentales y básicas de la vida diaria, al funcionamiento social y a los problemas de movilidad. Es necesario pues, a la hora de diseñar las TIC´s estos factores deberían ser tenidos en cuenta (Harwood, 2001; SOPRANO, 2007).

Por lo que se refiere a la audición, en la personas mayores se produce una pérdida de audición lo que interfiere en gran medida en las interacciones sociales de las mismas. Las personas mayores de 80 años pierden alrededor del 25% de las palabras de una conversación, son incapaces de seguir una conversación cuando un grupo habla a la vez. En cuanto a las posibles causas de esta pérdida destacan factores biológicos (infecciones, tumores etc.), factores traumáticos, factores hereditarios, así como, el mismo proceso de envejecimiento (Scialfa, Ho y Laberge, 2004; Ojel-Jaramillo y Cañas, 2006; SOPRANO, 2007).

Por otro lado, también desde un punto de vista biológico, destacan tres problemáticas auditivas relacionadas con el envejecimiento y sus correspondientes consecuencias para la persona mayor. La primera es la ampliación y endurecimiento de la aurícula, con lo que disminuye la capacidad para localizar las fuentes del sonido. La segunda se refiere al atrofiamiento de las paredes del canal externo con lo que el volumen timpánico es menor. La tercera y última se refiere al aumento del cerumen con lo que se afecta las tranmisión del sonido (SOPRANO, 2007).

Otras consecuencias de la pérdida de audición en las personas perder detalles de una conversación y confundirse a causa de esta, sufrir aislamiento y frustración, así como, una reducción del funcionamiento en la vida diaria y pérdida Psicosocial. Por tanto, podemos afirmar que las relaciones interpersonales es la principal área afectada por los cambios producidos en la audición, afectando pues a la habilidades de comunicación e inhibición de las conexiones sociales (SOPRANO, 2007).

Por lo que respecta al gusto, los estudios demuestran que a medida que envejecemos esta capacidad disminuye, sobre todo a partir de los 60 años, especialmente en los sabores salados. En cuanto al olfato, los resultados son contradictorios, ya que, existe una gran variabilidad interindividual en su deterioro, proponiéndose como principal hipótesis del mismo la atrofia de los bulbos olfatorios (Fisk, Rogers, Charness, Czaja y Sharit, 2004).

En lo que se refiere a la sensibilidad kinestésica, esta se deteriora con la edad y puede ser una explicación de porque los mayores se caen, ya que, con el deterioro de esta disminuye la percepción de la integración de los movimientos, produciéndose una pérdida del equilibrio (Fisk et al., 2004).

En general, los cambios mencionados anteriormente afectan por un lado a las actividades de la vida diaria de las personas mayores, así como, a su interacción con la tecnología, haciendo más difíciles estas (SOPRANO, 2007).

2.2.2. Área Motora

En terminos generales podemos entender la movilidad como el contínuo inmovilidad-movilidad. La pérdida de movilidad afecta principalmente a la calidad de vida, independencia y autonomía personal de las personas mayores, aumentando así su necesidad de asistencia. La movilidad aparece relacionada también con el risego de caídas y heridas, déficits de funcionamiento general y estados depresivos de las personas mayores, así como, aquellas personas mayores con problemas de movilidad tienen más probabilidad de morir antes que aquellos que no sufren este problema (Stalvey, Owsley, Sloane y Ball, 1999; SOPRANO, 2007).

En cuanto al tiempo de respuesta en tareas motoras, las personas mayores muestran un déficit a la hora de realizar tareas repetitivas, lo cual, parece ser compensado por una planificación avanzada por parte de la persona mayor (Ojel-Jaramillo y Cañas, 2006).

Por otro lado la evaluación de la movilidad desde un enfoque clásico se realiza a partir de estudio de las actividades básicas e instrumentales de la vida diaria de las personas mayores, tales como, vestirse, bañarse, comer o ir de compras, sus contactos sociales, ir al médico. Otro tipo de enfoques se centran en las consecuencias de la soledad y su relación con las caídas (Stalvey et al., 1999). Por último podemos decir que estos problemas de movilidad (tiempo de respuesta, etc) podrán afectar a la interacción con los dispositivos de asistencia y más concretamente a la utilización de sus botones o teclas, etc. (SOPRANO, 2007).

2.2.3. Área Cognitiva

En terminos generales según, la interacción con la tecnología puede verse interferida por el envejecimiento cognitivo (Czaja et al., 2006; SOPRANO, 2007). En cuanto a la Atención y el procesamiento de la información, las personas mayores procesan más lentamente la información. Existe una gran variabilidad tanto intra como interpersonal en función de factores, como la motivación general, la fatiga, la

familiaridad con la tarea. Un aspecto de los cambios en la atención relacionados con la edad es la cantidad de información que puede ser atendida en un determinado espacio de tiempo, las personas mayores tienen problemas a la hora de mantener su atención en largos períodos de tiempo. Por otro lado, cuando hablamos de atención dividida o simultánea y la selectiva o alternativa los mayores presentan un rendimiento menor que los jóvenes, sobre todo en tareas difíciles, es decir, son incapaces de filtrar la información irrelevante (Carmichael, 1999; Ojel-Jaramillo y Cañas, 2006; SOPRANO, 2007).

Por lo que respecta a la memoria trabajo, se define por Baddeley (2003) como "un almacén temporal y de manipulación de la información que se asume necesario para un amplio rango de complejas actividades cognitivas" p. 203, o bien según Fisk et al., 2004 como "la capacidad para mantener la información activa temporalmente mientras trabajamos en ella o la usamos" p. 18. En este sentido, sabemos también que esta función se reduce con la edad (Fisk et al., 2004; SOPRANO, 2007). Con respecto a la Memoria Episódica, las personas mayores presentan un déficit claro con respecto a los jóvenes (Verhaeghen y Marcoen, 1993; Ballesteros, Nilsson y Lemaire, 2009). Este déficit tambien se observa en la memoria semántica solamente cuando nos referimos a personas muy mayores (Ojel-Jaramillo y Cañas, 2006). En cuanto a la memoria procedimental también presentan un deterioro con respecto a los jóvenes (Hubert et al., 2009).

Por otro lado, con la edad el reconocimiento no se deteriora y el recuerdo si. Existe evidencia de que el envejecimiento normal produce el deterioro de la información que se almacena en la memoria a largo plazo, aunque, sabemos que con el reconocimiento se recuerda mejor que con el recuerdo (Carmichael, 1999, SOPRANO, 2007).

Por lo que se refiere a los procesos ejecutivos se produce un deterioro del juicio y la toma de decisiones aunque algunos autores comentan que también se mantiene con la edad. Esto nos permite afirmar que en el caso de las personas mayores factores como la experiencia y el afecto, son importantes en la realización de dichas habilidades (SOPRANO, 2007).

Por otro lado, en cuanto a las habilidades visoespaciales las personas mayores en este caso muestran pérdidas en la producción y reconocimiento de figuras o dibujos en tres dimensiones. Algunos estudios han demostrado que el rendimiento de las personas mayores en tareas visoespaciales relacionadas con la interacción con el ordenador, es menor que el de los jóvenes (Fisk et al, 2004; SOPRANO, 2007).

Finalmente, en lo que se refiere a las habilidades linguísticas las personas mayores las mantienen estables incluso para las personas muy mayores (por encima de 70), solamente aparecen deterioros específicos a la hora de recordar palabras o generación de listas, ya que, se sobrecarga la memoria a corto plazo (Fisk et al., 2004; SOPRANO, 2007).

Finalmente en cuanto a la inteligencia, podemos clasificarla en cristalizada y fluida. La inteligencia cristalizada se relaciona con el conocimiento adquirido durante la vida y la fluida se refiere a la manipulación de la información. Los datos nos muestran que la inteligencia fluida se deteriora con la edad y la cristalizada se mantiene (Carmichael, 1999)

En resumen, es necesario pues tener en cuenta todos estos déficits que se producen cuando una persona envejece, a la hora de diseñar la tecnología (SOPRANO, 2007). Hay que tenerlos en cuenta no solamente de una forma heurística, sino también desde el punto de vista contextual, con lo que se mejorará el bienestar de las personas mayores.

2.3. Variables sociodemográficas y uso de las TIC´s

Con respecto a la variables sociodemográficas y el uso de las TIC´s numerosos estudios han demostrado que las variables sociodemográficas más importante son la edad, el nivel educativo, el género y el nivel de ingresos. Así con respecto a la edad las personas mayores usan menos la tecnología que los jóvenes, así como, existe una relación entre las variables sociodemográficas nivel educativo y nivel de ingresos y edad y el acceso a las TIC´s (Ellis and Allaire, 1999; SOPRANO, 2007).

Según datos de SOPRANO (2007) en cuanto a las personas mayores de entre 55 y 74 años que usaron el ordenador en el último año, en primer lugar está Suecia con el 75% seguida de Dinamarca e Islandia con el 73%. En los últimos lugares (22 y 23)

aparecen Grecia y Bulgaria con el 8% y el 7% respectivamente. En el caso de España esta ocupa el puesto 16 con el 17% siendo la media Europea del 30% (EU 15 34% y EU25 32%) (Ver Tabla 3).

Tabla 3. Porcentaje de individuos entre 55 y 74 años que usaron un ordenador dentro del último año (SOPRANO, 2007)

	Porcentaje de individuos entre 55 y 74 años que Usaron un ordenador en el último año (2006)
SE	75
DK	73
IS	73
NO	63
NL	60
FI	54
LU	49
MT	47
BE	35
AT	35
EU15	34
EU25	32
IE	27
SK	22
HU	21
FR	20
SI	19
ES	17
LV	16
IT	15
PL	15
CY	13
LT	10
GR	8
BG	7

En España los usuarios del ordenador se caracterizan por tenen un alto nivel educativo y por ser principalmente hombres (Ver Figura 1 y 2) (SOPRANO, 2007).

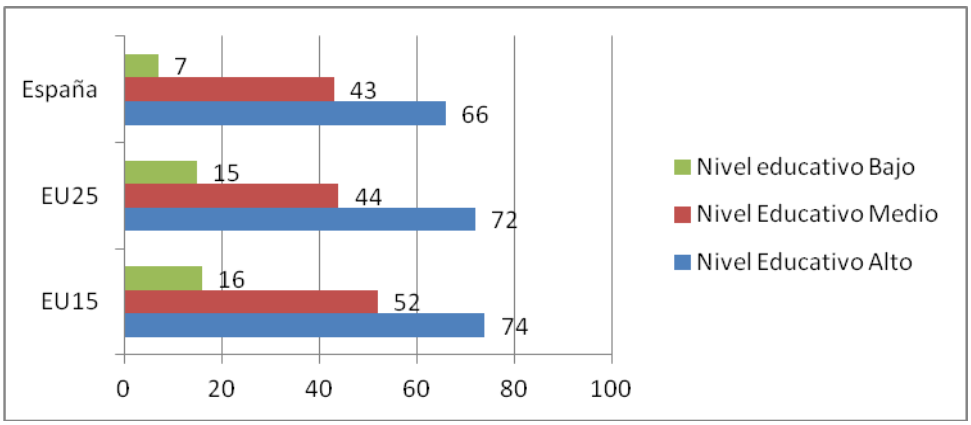

Figura 1. Porcentaje de individuos entre 55 y 74 años en 2006 que usaron un ordenador dentro del último año con respecto al nivel educativo (SOPRANO, 2007)

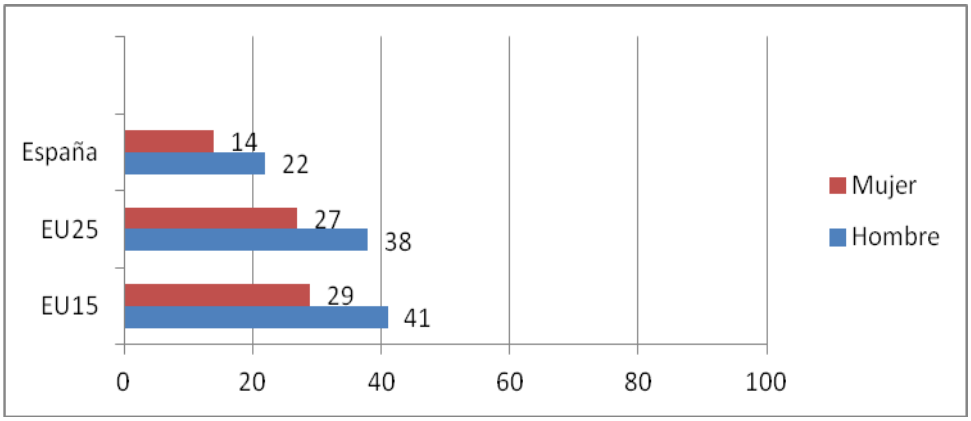

Figura 2. Porcentaje de individuos entre 55 y 74 años en 2006 que usaron un ordenador durante el último año con respecto al género (SOPRANO, 2007)

En cuanto al uso de Internet entre las personas mayores de entre 55 y 74 años el país lider es Suecia (69%), a continuación Dinamarca e Islandia (puesto 2 y 3 ambas el 68%) siendo Bulgaria y Grecia los países que ocupan los últimos lugares con el porcentaje más bajo, el 5 %. En España es el 13%, estando la media Europea esta un poco por debajo del 30% (EU15 28% y EU25 26%) (Ver Tabla 4). En cuanto al género en España, en el último año más hombres que mujeres usaron Internet (ver Figura 3). En lo que respecta al nivel educativo, el hecho de tener un nivel educativo alto se relaciona con un mayor uso de Internet (ver Figura 4) (SOPRANO, 2007).

Tabla 4. Porcentaje de individuos entre 55 y 74 años que usaron Internet dentro del último año (SOPRANO, 2007)

	Porcentaje de individuos entre 55 y 74 años que Usaron Internet en el último año (2006)
SE	69
DK	68
IS	68
IS	62
NL	54
NO	54
FI	48
LU	42
MT	39
BE	30
EU15	28
EU25	26
EA	23
IE	22
HU	16
SI	16
FR	15
LV	14
ES	13
SK	13
IT	12
PL	11
CY	9
LT	8
BG	5
GR	5

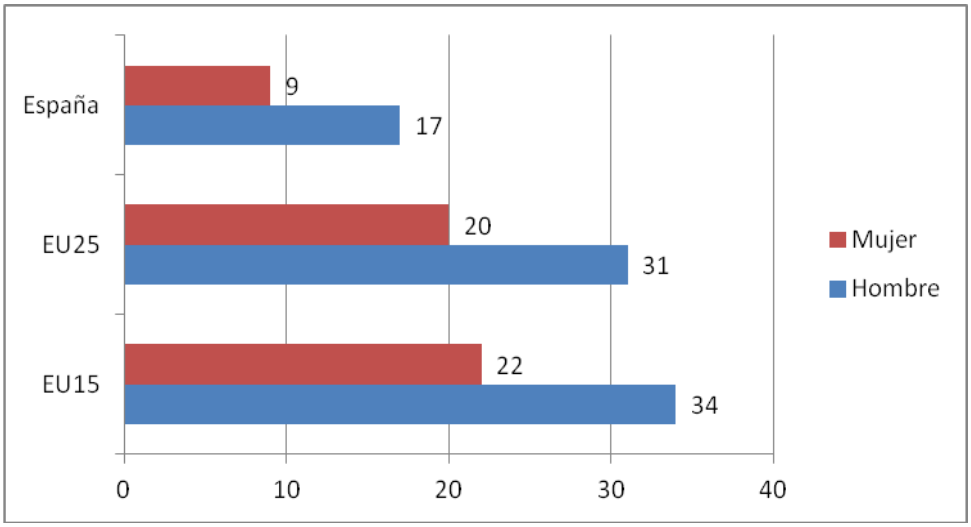

Figura 3. Porcentaje de individuos entre 55 y 74 años en 2006 que usaron un ordenador durante el último año con respecto al Género (SOPRANO, 2007)

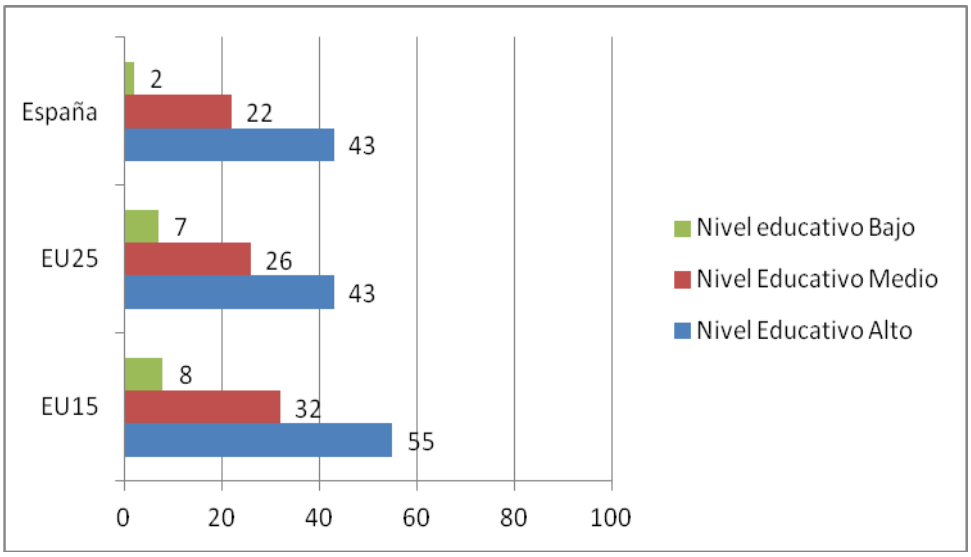

Figura 4. Porcentaje de individuos entre 55 y 74 años en 2006 que usaron un ordenador durante el último año con respecto al Nivel Educativo (SOPRANO, 2007)

En cuanto al uso de otros dispositivos (móvil, DVD, cámara digital, videocámara, fax, Ipod o reproductor de MP3, Blackberry, Palm u otr PDA), la encuesta Seniorwatch 2 (2008) nos ofrece los siguientes datos:

Tabla 5. Porcentaje de uso de diferentes dispositivos tecnológicos (Seniorwatch 2, 2008)

Dispositivo	Alemania	Italia	Francia	Polonia	Reino Unido	EU5
Teléfono móvil	77.4	70,7	86,2	68,8	83,8	77,4
DVD	56.4	70,7	58,4	51,2	84	64,1
Cámara digital	41.2	52.5	39	33.4	56.6	44.5
Videocámara	16.0	23	22.2	13.5	28.4	20.6
Fax	20.0	13.6	13.6	7.2	14.4	13.7
Ipod o Reproductor MP3	9.2	14	17.8	16.3	15.2	14.5
Blackberry, Palm u otro PDA	6.6	2.2	1.4	2.4	4.4	4.1

En general en Europa, el dispositivo que más utilizado por las personas mayores es el móvil (EU 77,4%) seguido del DVD (EU, 64,1%) y la cámara digital (44,5%) (Seniorwatch 2, 2008).

En conclusión, los factores sociodemográficos como la Edad y el nivel educativo influyen en un sentido negativo y positivo respectivamente en el uso de las TICs. Sería pues interesante investigar como estos factores sociodemográficos están influyendo en el uso de los dispositivos de Teleasistencia.

2.4. Factores psicológicos y uso de las TIC´s

Numerosas investigaciones han examinado los factores que influyen en la aceptación de la tecnología (Czaja et al., 2006, SOPRANO, 2007), así como, también hay muchos estereotipos que muestran que las personas mayores no están preocupadas por la tecnología y rechazan el uso del ordenador. Aunque esto tenga algo de verdad, las evidencias muestran que las personas mayores cada vez más usan más el ordenador (SOPRANO, 2007).

Ciertos estudios han identificado el rol de las barreras psicológicas, incluyendo factores como, las actitudes, la motivación, la emoción, la aceptación de la tecnología, como las principales barreras de las personas mayores para usar las TIC´s (SOPRANO, 2007).

2.4.1. Factores cognitivo-sociales.

Las actitudes hacia las TIC´s suponen un factor significativo en la relación de las personas mayores y las TIC´s (Umemuro, 2004; SOPRANO, 2007). Una actitud se puede definir como una evaluación que una persona hace de forma negativa o positiva sobre un determinado comportamiento (Kim, Chun y Song, 2008). Existe una controversia con respecto a si las personas mayores muestran actitudes negativas o positivas hacia las TIC´s, así, por ejemplo, para Umemuro (2004), las personas mayores muestran actitudes negativas hacia la tecnología (el ordenador), sin embargo, otras investigaciones muestran actitudes positivas de los mayores hacia la tecnología (SOPRANO, 2007). Por otro lado, nos preguntamos, si una actitud negativa hacia la tecnología puede cambiar con el paso del tiempo, Umemuro y Shirokane (2003) realizaron un estudio para comprobar si la actitud negativa de las personas mayores hacia el ordenador cambiaba después de un año de entrenamiento. Los resultados muestran que la actitud cambia después de varios meses en función del tipo de usuario, así los usuarios más seguros muestran cambios en su actitud con respecto a los usuarios más inseguros (Umemuro y Shirokane, 2003)

Por otra parte, otros estudios (SOPRANO, 2007) nos muestran las diferencias que hay entre las personas mayores que tienen una actitud negativa hacia la tecnología y las que si tienen actitudes positivas. La diferencia estriba sobre todo en si son usuarios o no de la tecnología, así los que no utilizaban la tecnología usuarios de la misma, mostraban más sentimientos negativos y no entendía la utilidad de la misma. A pesar de la controversia existente, podemos concluir la que la actitud es un factor muy importante a la hora de analizar que factores predicen el uso de la tecnología.

2.4.2. Factores motivacionales

Según Laguna y Babcock (1997) desde un punto de vista teórico nos preguntamos si la Ansiedad constituye un factor de diferenciación intergeneracional entre jóvenes y mayores sobre todo ante la ejecución de tareas que requieren una implicación cognitiva, como por ejemplo, el uso de la tecnología. Así las personas mayores ¿experimentarán más ansiedad que las jóvenes ante la ejecución de dichas tareas?, Según estos autores, existen diferencias significativas entre jóvenes y mayores ante la ansiedad que sienten ante el ordenador, en el sentido de que las personas

mayores presentaban niveles más altos de ansiedad que los jóvenes a la hora de utilizar el ordenador. Otros autores (Czaja et al, 2006) confirman esta misma tendencia. Además de las diferencias intergeneracionales es importante mencionar también que la Ansiedad hacia la tecnología constituye un predictor del uso de la misma (Czaja et al., 2006).

En relación a la Ansiedad es importante mencionar el concepto de Tecnofobia. Según Brosnan (1999) esta se define como una "conducta aversiva, afectiva y actitudinal en respuesta a la tecnología" p. 106. Existe pues una relación entre la ansiedad hacia la tecnología principalmente y el concepto de tecnofobia (Brosnan, 1999). Podemos considerar la Ansiedad y la Tecnofobia como dos factores importantes a la hora de entender el uso de la Tecnología.

2.4.3. Factores emocionales

Desde el punto de vista emocional, es importante mencionar las diferencias de género a la hora de la experiencia emocional en las primeras interacciones con la tecnología. Así a diferencia de los hombres las mujeres expresan un determinado miedo a la tecnología, cuyo origen puede ser la mala experiencia que estas tenían a lo hora de interaccionar con la misma, surge así el un constructo de género relacionado con la tecnología (SOPRANO, 2007). Otros estudios nos muestran que las personas mayores se sienten menos seguras y cómodas (Ellis y Allaire, 1999; Umemuro, 2004)

Emocionalmente pues, la principal barrera de las personas mayores a la hora de interactuar con las TIC´s lo constituye el miedo, un ejemplo de esto es el temor que sienten las personas mayores ante la tercera generación de Teleasistencia, así ante la utilización de camaras que monitorizan su actividad, se sentían observados por las mismas lo que provocó el rechazo a dicha tecnología (SOPRANO, 2007).

2.4.4. Factores relacionados con el aprendizaje

Con respecto al aprendizaje de las nuevas tecnologías por parte de los mayores, es importante analizar como el aprendizaje de las mismas puede afectar a la ansiedad hacia el ordenador, a la actitud, al apoyo social, a la expectativa de autoeficacia o al propio bienestar de las personas mayores (Cody, Dunn, Hoppin y Wendt, 1999; Shapira, Barak, y Gal, 2007). Por ejemplo, en el estudio de Cody et al. (1999) desarrollaron un

programa de entrenamiento en el uso de una WebTV, los resultados mostraron que el entrenamiento en la utilización de la misma, reducía su ansiedad, mejoraba su actitud e incrementaba su apoyo social. En otro estudio realizado por Laganá (2008), se desarrollo un programa de entrenamiento para las personas mayores en el uso de Internet y el ordenador. Los resultados mostraron que las personas mayores que participaron en el entrenamiento mejoran su actitud y su expectativa de autoeficacia hacia el ordenador. Umemuro y Shirokane (2003) realizaron un estudio en el que se les proporcionaba un entrenamiento a las personas mayores en el uso del ordenador durante 12 meses. Los resultados mostraron que la actitud de las personas mayores mejoraba después de este entrenamiento, es decir, la actitud cambia con la experiencia con la tecnología. Otros estudios (SOPRANO, 2007), muestran que con entrenamientos de 2 semanas, 12 horas, o con el cambio del sistema tecnológico se observan mejoras en las actitudes de las personas mayores.

Con respecto al bienestar, Shapira et al. (2007) encontraron que ante el entrenamiento en el uso del ordenador e Internet, se producía una mejora en el bienestar de las personas mayores, ya que, mejoraba su funcionamiento cognitivo, se incrementaba su sensación de control e independencia, así como, aumentaban sus interacciones interpersonales. Podemos concluir entonces, que la experiencia que tienen las personas mayores a través de un entrenamiento en el uso de la tecnología, es un buen instrumento para reducir el rechazo hacia la misma, así como, para incrementar su bienestar.

2.4.5. Factores relacionados con los modelos de aceptación de la tecnología.

La pérdida de aceptación, de usabilidad o incluso de utilidad, a menudo limita la difusión y uso de una tecnología (SOPRANO, 2007). A la hora de hablar de aceptación de la tecnología, entendida como el grado de utilización de la misma, es importante mencionar el Modelo de Aceptación de la tecnología (TAM). Existen numerosas investigaciones sobre este tema en los últimos años (Malhotra y Galletta, 1999; Adams, Nelson y Todd, 1992; Hossain y Prytubok, 2008; Sauter, 2008; Holden y Karsh, 2010; Schierz, Schilke y Wirtz, 2010). El modelo TAM se caracteriza porque explica el uso de la tecnología a través de factores como la Utilidad Percibida, la Facilidad de Uso Percibida, la Actitud y la Intención de uso (Holden y Karsh, 2010). Dentro de este

modelo es importante explicar dos de sus constructos a la hora de comprender porqué las personas aceptan o no una determinada tecnología (Davis, 1989). Según Davis (1989) el primero de ellos es la Utilidad percibida que se define como "el grado en el que una persona cree que usando un sistema en particular mejorará su rendimiento en el trabajo" p. 320. El segundo de ellos se refiere a la Facilidad de uso percibida y es definida como "el grado en el que una persona cree que usando un sistema en particular estaría libre de esfuerzo" p. 320.

Por otro lado además del modelo TAM, según Venkatesh, Morris, Davis y Davis (2003), es importante mencionar otros modelos relacionados con la Aceptación de la tecnología, como el modelo motivacional, que incluye dos constructos como la motivación extrínseca y la motivación intrínseca. El modelo de la teoría de la conducta planificada (TPB), donde aparecen la actitud hacia la tecnología, la norma subjetiva y el control conductual percibido. La combinación del TAM y este último modelo (C-TAM-TPB), cuyos constructos principales son, la actitud hacia la conducta, la norma subjetiva, el control conductual percibido y la utilidad percibida. Otro modelo es el de la utilización del PC (MPCU), donde encontramos el ajuste al trabajo, la complejidad, las consecuencias a largo plazo, el afecto hacia el uso, los factores sociales y las condiciones facilitadotas como constructos principales. Por último mencionar la Teoría de la difusión de la innovación (IDT), donde destacan, la ventaja relativa, la facilidad de uso, la imagen, la visibilidad, la compatibilidad, la demostrabilidad de los resultados así como la voluntariedad del uso, como sus principales constructos. Es importante pues tener en cuenta todos estos modelos a la hora de entender el porqué las personas usan o no una determinada tecnología.

2.4.6. Resumen

En resumen, los factores psicólogicos como la actitud, la motivación, las emociones negativas como el miedo, el aprendizaje, así como, la utilidad y la facilidad de uso de la tecnología son importantes a la hora de diseñar la tecnología. Así a modo de resumen procedemos a comentar las principales conclusiones de este apartado:

- Las Actitudes positivas de las personas mayores hacia las TIC´s conducirían a un intento de uso de las mismas.

- La Ansiedad es un factor determinante a la hora de utilizar las TIC´s. En los casos extremos puede aparecer el fenómeno de la Tecnofobia.

- Una experiencia emocional intensa puede aumentar o disminuir el uso de las TIC´s por parte de las personas mayores.

- Las personas mayores pueden cambiar de Actitud a la hora de utilizar las TIC´s y mejorar su disposición a aprender, así como, son capaces de aprender a utilizar las mismas.

- Es importante tener en cuenta los modelos de aceptación de la tecnología que nos ayuden a predecir la aceptación de la misma por parte de los mayores.

Por último en el contexto de esta Tesis, estas conclusiones nos servirán para investigar como estos factores están influyendo en el uso de los dispositivos de Teleasistencia.

CAPITULO 3. TELEASISTENCIA

El presente capítulo tiene como objetivo describir la situación de la Teleasistencia en Europa, para ello, cuenta con 4 subcapítulos. El primero nos ofrece una definición del concepto de Teleasistencia. El segundo nos permitirá conocer una clasificación de los tipos de teleasistencia. El tercero nos mostrará la situación de la Teleasistencia en Europa. Por último, el cuarto nos ofrecerá la situación de la misma en España.

3.1. Definición

Entendemos por el término Teleasistencia a la provisión de cuidados sociales a distancia apoyados por las TIC´s. Tiene su origen en la década de los 90 como un sistema de atención en la casa de las personas mayores ante situaciones de urgencia. A mitad de los años 90, la teleasistencia domiciliaria comienza a incorporar, modelos de atención centralizada y suministrada por colectivos de profesionales asistentes sociales, psicólogos, ubicados en un entorno físico común, surge así un tipo de teleasistencia social, que utilizan centros localizados denominados "call-centers" para recibir las llamadas, en los que los datos sanitarios y sociales del usuario aparecen recogidos en sistemas de informacion (Valero, Sánchez y Bermejo, 2007). Este modelo es el denominado Teleasistencia Domiciliaria definida como tal en el Programa de Teleasistencia Domiciliaria IMSERSO-FEMP de octubre de 1999 que describe el servicio en los siguientes términos (citado en Valero et al., 2007, pp.17-18):

"La Teleasistencia Domiciliaria es un servicio que, a través de la línea telefónica y con un equipamiento de comunicaciones e informático específico, ubicado en un centro de atención y en el domicilio de los usuarios, permite a las personas mayores o personas discapacitadas, con sólo accionar el dispositivo que llevan constantemente puesto y sin molestias, entrar en contacto verbal "manos libres", durante las 24 horas del día y los 365 días del año, con un centro atendido por personal específicamente preparado para dar respuesta adecuada a la necesidad presentada, bien por sí mismo o movilizando otros recursos humanos o materiales, propios del usuario o existentes en la comunidad."

Por otra parte encontramos la recomendación ETSI TR 102 415 V1.1.1 de agosto de 2005 [ETSI05] que define el término según el tipo de servicioo, el ámbito sociosanitario y la tecnología implicada (citado en Valero et al., 2007, p. 19):

"*La Teleasistencia incluye la prestación de un servicio de atención social o de salud a personas en su hogar en una comunidad, con el apoyo de sistemas basados en las Tecnologías de la Información y las Comunicaciones (TIC)*".

3.2. Clasificación

Un amplio espectro de aplicaciones y servicios surgen de estas definiciones de Teleasistencia. El proyecto ICT&Ageing (2010) nos ofrece una clasificación de la Teleasistencia en función de tres generaciones:

- Primera generación: usa un terminal fijo (teléfono) y otro móvil (un colgante) con un botón. Cuando la ayuda es requerida por el usuario este pulsa el botón y el call-center recibe la llamada e identifica al usuario y su dirección. A través de un protocolo establecido el diagnóstico inicial de la naturaleza y la urgencia de la necesidad puede ser realizado mediante voz , así como el personal responsable, cuidadores formales o informales, puede ser alertado dependiendo de la situación.

- Segunda generación: se añaden elementos pasivos o alarmas automáticas con el complemento de sensores de humo, agua o fuego. Una vez se activen se pondrán en contacto directamente con el call-center y se pondrá en marcha el correspondiente protocolo.

- Tercera generación: constituye el tipo de teleasistencia más avanzado. Mediante el funcionamiento de varios sensores (detectores de cierre de puertas o de apertura, detectores de ocupación de la cama, detectores de presión y de utilización eléctrica) este tipo de Teleasistencia recoge los datos de la vida diaria de la persona. Estos datos se muestran tanto al usuario como

al su cuidador o familiar y tienen como función poder evaluar la situación de dicho usuario.

Otras tendencias que son interesantes de mencionar en el desarrollo del mercado de Teleasistencia (ICT & Ageing, 2010) son éstas:

- Teleasistencia móvil: se trata de utilizar los sistemas GPS y los teléfonos móviles en lugar de los tradicionales servicios de teleasistencia, con la funcionalidad de atender a las personas mayores cuando están fuera de su domicilio.
- Videoteleasistencia: con el objetivo de incluir el seguimiento de su bienestar y su comunicación social, la videoteleasistencia proporciona la comunicación visual entre el usuario, familiar o cuidador y el call-center.

3.3. Situación de la Teleasistencia en Europa.

Con respecto a la primera generación o alarmas sociales, estas constituyen el mercado más maduro. La primera generación de la Teleasistencia es la principal en los países europeos tanto en su provisión como en su disponibilidad. Solamente en Eslovenia y Polonia la situación tiene un carácter menos maduro. Por último en Bulgaría, las alarmas sociales no están lo suficientemente extendidas ni siquiera en términos de actividades de pilotaje (ICT & Ageing, 2010).

Para la segunda generación de Teleasistencia, solamente el Reino Unido tiene una que puede estar cercana a considerarse como principal. Iniciativas gubernamentales como la Ayuda para la Tecnología Preventiva han permitido extender de alguna forma por casi todos los municipios la segunda generación, en paralelo a la administración de las alarmas sociales. El caso de Finlandia destaca por su amplia disponibilidad de los dispositivos en la muñeca. En otros países, bien existe la posibilidad de que sea importante en el futuro, pero su penetración en este momento parece poca o bien solamente aparece una actividad piloto (ICT & Ageing, 2010).

En cuanto a la Teleasistencia móvil, aparentemente muestra cierta actividad pero en líneas generales es algo lenta en aparecer. En Alemania, se ha llegado incluso a

ofrecer localización via GPS. Existen también servicios privados y no están intregrados en el sistema de servicios sociales. Por otro lado, el marco de trabajo de las aseguradoras no coincide con el de las alarmas móviles y podemos considerar su nivel de penetración en Alemania como bajo. Es necesario buscar un ajuste entre la primera generación y la logística móvil (ICT & Ageing, 2010).

Con respecto a la incorporación de la Videoteleasistencia. En Holanda, por ejemplo, existe el servicio denominado "screen to screen". En Finlandia aparece el concepto de CareTV. En Alemania aparecen paquetes de servicios de Teleasistencia donde se ofrece videoconferencia, un ejemplo, es el denominado SOPHIA. En Suecia, un gran número de municipos usan el servicio ACTION basado en videoconferencia (ICT & Ageing, 2010).

En lo que respecta a la tercera generación de la Teleasistencia, los pilotajes constituyen la principal actividad hasta el día de hoy. Algunos ejemplos de iniciativa europea en este tema es por ejemplo el Programa AAL de la Unión Europea, el cual está muy orientado a la tercera generación de la Teleasistencia. Por países, destaca el caso de Finlandia, y el sistema desarrollado por la empresa Vivago. En el caso del Reino Unido destaca el sistema "Just Checking" (ICT & Ageing, 2010).

Más concretamente y en lo que se refiere a los niveles de penetración de las alarmas sociales, estas están ampliamente disponibles en la mayoría de los Paises Europeos, aunque existe una variabilidad considerable entre países (ver Tabla 5).

Tabla 5. Penetracion Alarmas Sociales en Países Europeos (ICT & Ageing, 2010)

Alarmas Sociales			
Muy alta (14-16%)	Alta (6-10%)	Moderada (1-3%)	Baja (<1%)
Irlanda Reino Unido	Dinamarca Finlandia Suecia	Alemania España Francia Hungría Italia Holanda	Bulgaria Eslovenia Polonia

Las causas de estas diferencias varian también entre los países europeos, pero es importante evitar fáciles interpretaciones, así las evidencias sugieren que los principales factores se deben al particular contexto de cada país (ICT & Ageing, 2010).

Por otra parte para la segunda generación de Teleasistencia, solamente el Reino Unido alcanza el 1% de nivel penetración y la mayoría de los otros países se mantienen con niveles muy bajos, siendo Finlandia el más destacado (ICT & Ageing, 2010).

3.4. Situación de la Teleasistencia en España

A modo de resumen sobre la situación en España de la Teleasistencia sería interesante mencionar el análisis DAFO que realizaron Valero et al. (2007) (Tabla 6):

Tabla 6. Análisis DAFO Teleasistencia en España (Valero et al., 2007, p. 87)

Debilidades	Amenazas
Falta de integración entre las instituciones públicas: • Legislación parcelada de forma regional • Las competencias se reparten entre sanidad, educación y asuntos sociales Escasa difusión y formación: • Bajo conocimiento de la existencia del servicio • Dificultades administrativas a la hora de acceder al servicio • Reticencias al uso de las TIC´s relacionadas con lo problemas de diseño • Rechazo a la posible dependencia de un servicio de ayuda	Implantación de productos y servicios no maduros Falta de modelos de calidad del servicio Falta de procedimientos organizativos e interoperatividad con modelos actuales de servicio Reducida percepción de los beneficiarios del servicios por parte de usuarios
Fortalezas	**Oportunidades**
Aumento de la penetración de las TIC´s Mayor disposición de los profesionales a la provisión del servicio Mayores expectativas de acceso por parte de la sociedad:	Mejora en la calidad asistencial: • Reducción aislamiento • Acortamiento del período de internamiento u hospitalización • Disminución de errores de atención o terapéuticos

• Personas Mayores • Personas con discapacidad o en situación de dependencia	Reducción de costes sanitarios: • Automatizar la administración • Integrar aplicaciones • Aumentar la productividad • Compartición de recursos • Reducción de costes de servicios de comunicación Recuperación de inversiones: • Amortización de recursos

De este análisis se puede concluir que el factor humano es muy importante en el campo de la Teleasistencia. A continuación se resumen las conclusiones más importantes con respecto al factor humano (Valero et al., 2007):

- El éxito de la Teleasistencia se ve afectado por las personas implicadas, usuarios y los profesionales en cuanto a su formación, predisposición y su comportamiento.
- En comparación con la aceptación de la tecnología, la utilidad y el hecho de cómo proveer los servicios de teleasistencia constituyen una necesidad más importante.
- Los pacientes y familiares aceptan y se adaptan a la teleasistencia en mayor medida que los mismos profesionales.
- Existen dos formas de entender las barreras del éxito de la Teleasistencia, por un lado el sector privado reivindica que el problema esta en el modelo del beneficio económico, por otro, el sector público señala el tiempo y la incertidumbre con respecto al beneficio organizativo como los principales problemas.
- Hay que tener en cuenta todos los cambios significativos en el modelo de trabajo a la hora de planificar la provisión del servicio de Teleasistencia. Esta previsión preveerá cualquier tipo de impacto en la organización y las posibles soluciones planteadas.

- Es necesario tener en cuenta las necesidades de profesionales y usuarios como una forma de mejorar el éxito en la implantación de la Teleasistencia, hay que seguir un enfoque centrado en el cliente.
- Ante el éxito de la teleasistencia es necesario centrarse en aspectos como a confianza, seguridad, confidencialidad y satisfacción con el servicio del cliente, y no en aspectos relacionados con la tecnología o el coste.

Finalmente como conclusión, sería interesante mencionar que el mercado de la Teleasistencia en Europa es todavía inmaduro especialmente en lo que respecta a la segunda y tercera generación. Es necesario pues tener en cuenta cuál o cuales de estos factores humanos mencionados en Valero et al. (2007) están influyendo en el uso de estos sistemas: la predisposición y formación de los usuarios y profesionales, la forma de provisión de los servicios, la aceptación y adaptación de la teleasistencia al entorno residencial, la definición de un modelo ecónomico y la reducción de la incertidumbre en cuanto al beneficio de la Teleasistencia, la planificación adecuada de un modelo de trabajo, el enfoque hacia las necesidades del cliente (usuario y profesionales), así como, la confianza, seguridad, confidencialidad y satisfacción con el servicio. En el contexto de esta Tesis es importante, por tanto, añadir a los factores humanos anteriores los factores psicológicos que están influyendo en el uso de los dispositivos de Teleasistencia, para mejorar la aceptación por parte del mercado Europeo y Español.

CAPITULO 4. JUSTIFICACIÓN Y OBJETIVOS

Como se ha descrito anteriormente, la investigación en los factores psicológicos que se relacionan con el uso de las TIC´s se ha orientado sobre todo al estudio del ordenador. El objetivo principal de este estudio es profundizar en un mayor grado en los factores psicológicos que se relacionan con el uso de los dispositivos de Teleasistencia, principalmente los dispositivos de la primera generación o alarmas sociales. A continuación se describen los objetivos concretos en relación al trabajo de investigación desarrollado, que se presentan en forma de 3 anexos (a los que nos referiremos como estudios).

4.1. Efectos del diseño sobre el uso de los dispositivos de Teleasistencia.

Un primer objetivo del presente trabajo ha sido explorar los efectos del diseño de los dispositivos de Teleasistencia en el uso de los mismos. Para ello nos referiremos más concretamente a los efectos inducidos por el procesamiento del tipo de interfaz del dispositivo (gráfico o verbal). La revisión de la literatura nos muestra el llamado "Efecto de superioridad de los dibujos" que resalta la importancia de las imágenes en el almacenamiento a largo plazo, observando por ejemplo, la gran capacidad de recuerdo de dibujos presentados en breves períodos de tiempo (Paivio y Csapo, 1973). Dicho efecto de superioridad de los dibujos se explora a lo largo del estudio I, donde se evaluá el efecto de una interfaz gráfica frente a otra verbal sobre el uso del dispositivo fijo de teleasistencia, más concretamente sobre el número de errores que los usuarios cometen a la hora de utilizarlo.

4.2. Efectos de las variables sociodemográficas en el uso de los dispositivos de Teleasistencia.

En relación al efecto sociodemográfico en el uso de los aparatos de teleasistencia, Ellis y Allaire (1999) examinaron los efectos de la edad y la educación sobre el uso del ordenador y encontraron que la edad está negativamente asociada con el uso del ordenador. Czaja et al (2006) encontraron que la edad está también negativamente asociada con el uso de la tecnología y que la educación esta relacionada positivamente con el uso de la tecnología. Así el estudio II tiene como uno de sus

objetivos evaluar la influencia de la edad, sexo y nivel educativo en el uso de los dispositivos de Teleasistencia

4.3. Efectos de los factores cognitivos en el uso de los dispositivos de Teleasistencia

Diversos autores (Malhotra y Galletta, 1999, Czaja et al., 2006) señalan la importancia de los factores cognitivos a la hora de utilizar la tecnología. Un tercer objetivo de este trabajo ha sido explorar la relación de los factores cognitivos con el uso de los dispositivos de Teleasistencia. Para ellos nos vamos a referir más concretamente, a efectos relacionados con la atención, la memoria a corto plazo, la expectativa de autoeficacia, la utilidad percibida, la facilidad de aprendizaje, la facilidad de uso percibida y la actitud hacia la tecnología. Los Estudios II y III se ocupan de estos factores y de cómo poder utilizar su influencia como una variable predictiva en el uso de los sistemas de teleasistencia.

4.4. Efectos de la motivación y la emoción en el uso de los dispositivos de Teleasistencia.

Un cuarto objetivo trata de explorar la relación de aspectos motivacionales y emocionales con el uso de los dispositivos de Telesistencia, esto es, si la Ansiedad, la Depresión y las Emociones negativas predicen el uso de los dispositivos de Teleasistencia.

4.4.1. Efectos relacionados con la Ansiedad Estado-Rasgo

Ellis y Allaire (1999) estudiaron el efecto de la ansiedad ante el ordenador sobre el uso del mismo. Encontraron una relación negativa entre la ansiedad y el uso del ordenador. En relación con estos resultados, en el estudio II tratamos de explorar la relación entre la ansiedad rasgo o estado y el uso de los dispositivos de teleasistencia en función del tipo de usuario (según la media de llamadas realizadas). En el estudio III tratamos de comprobar la posible relación entre el uso del colgante y la ansiedad rasgo o estado.

4.4.2. Efectos relacionados con la Depresión estado-rasgo.

La depresión es uno de los trastornos más comunes en las personas mayores de más de 65 años, afectando a más del 15% de la población de personas mayores (Arnaert, Klooster y Chow, 2007). En el estudio III exploramos la posible relación entre la Depresión estado-rasgo y el uso del colgante de Teleasistencia.

4.4.3. Efectos relacionados con las Emociones.

Existe una substancial evidencia que apoya el hecho de que en la toma de decisiones el afecto tiene una gran importancia. Nuestras emociones se relacionan con nuestros pensamientos y comportamientos (Djamasbi, Strong y Dishaw, 2010). En consecuencia, en el estudio II planteamos que las emociones negativas como el miedo podrían predecir el uso de los dispositivos de Teleasistencia.

4.5. ¿Cuáles son los predictores del uso de los dispositivos de Teleasistencia? ¿Son diferentes las relaciones de estos predictores con respecto al ordenador?.

La investigación previa en los factores predictores sobre el uso de los dispositivos de Teleasistencia resulta muy limitada. En este sentido, en este trabajo se propone investigar la relación de muchos de los factores planteados para el estudio de otras TIC´s (Actitudes, Expectativa de Autoeficacia, Ansiedad, Depresión, Edad, Sexo, Nivel Educativo, etc.) con el uso de los dispositivos de Teleasistencia.

Es interesante también comprobar si muchas de las relaciones planteadas para el estudio de las TIC´s tienen el mismo sentido en los aparatos de Teleasistencia. Así por ejemplo nos preguntamos si las relaciones de las variables sociodemográficas (Edad, Sexo, Nivel Educativo) tienen el mismo sentido en los dispositivos de Teleasistencia, o si la relación de la Ansiedad y la Depresión con el uso de las TIC´s tiene el mismo sentido en los dispositivos de Teleasistencia. El estudio II investiga estas relaciones.

CAPITULO 5. DISCUSIÓN

A continuación, resumimos los resultados principales encontrados en los estudios experimentales de esta tesis.

5.1. Efectos del diseño sobre el uso de los dispositivos de Teleasistencia

En el estudio I, donde se exploraron los efectos inducidos por el procesamiento del Tipo de Interfaz, la fase experimental muestra claramente que la posible causa de las llamadas por error observadas en los dispositivos de Teleasistencia podría ser debida exclusivamente al diseño verbal de las interfaces de Teleasistencia. La comparación entre la ejecución de los usuarios y no usuarios con ambos tipos de interfaz revela dos aspectos importantes. En primer lugar, para ambos tipos de usuarios, la interfaz gráfica reduce el número de errores. En segundo lugar, las diferencias en el número de errores que se observaron entre ambos tipos de usuarios fueron reducidas enormemente con la interfaz gráfica. En otras palabras, los usuarios cometían menos errores que los no usuarios con la interfaz verbal, mientras que, el número de errores cometidos fue muy similar entre los participantes con la interfaz gráfica.

Podemos interpretar estos resultados según la teoría de la codificación dual de Paivio (1991). Así los usuarios cometen menos errores con la interfaz gráfica porque ellos entienden el significado de los botones mejor que con la interfaz verbal. Se accede al significado mejor con el dibujo que con la palabra porque existen dos tipos de representaciones del mismo (visual y verbal). Acceder al significado a través de la palabra, es más confuso, porque sólo tenemos un tipo de representación (verbal).

Sin embargo, otros modelos podrían explicar estos resultados. Por ejemplo, el modelo semántico-sensorial de Nelson (Nelson y Reed, 1976; Nelson, Reed, y Walling, 1976) prediciría que los usuarios cometen menos errores con la interfaz gráfica porque las características visuales de los iconos son más distintivas que las de las palabras y el acceso a su significado es más directo. Para acceder al significado de las palabras es necesario procesar sus características visuales y fonéticas.

5.2. Efectos de las variables sociodemográficas en el uso de los dispositivos de Teleasistencia.

En relación al efecto sociodemográfico en el uso de los aparatos de teleasistencia, Ellis y Allaire (1999) encontraron que la edad está negativamente

asociada con el uso del ordenador y la educación lo esta positivamente. Del mismo modo, Czaja et al. (2006) encontraron que el sexo esta asociado negativamente al uso de la tecnología**.** Sin embargo, en el estudio II no se encontró relación alguna entre la edad, el sexo y el nivel educativo y el uso de los dispositivos de Teleasistencia,

5.3. Efectos de los factores cognitivos en el uso de los dispositivos de Teleasistencia

En el estudio II no se han encontrado relaciones entre la atención, la memoria a corto plazo, la expectativa de autoeficacia, las emociones estéticas y el conocimiento previo con el uso de los dispositivos de Teleasistencia. Sin embargo si se han observado relaciones significativas con respecto a la facilidad de uso percibida, y la actitud hacia la tecnología. En el estudio III se encontraron relaciones significativas entre la utilidad percibida y la facilidad de uso percibida con respecto al uso del colgante de Teleasistencia.

5.3.1. Efectos relacionados con la Actitud

Malhotra y Galleta (1999) encontraron que la Actitud hacia la tecnología tiene una influencia positiva sobre el uso de la Tecnología. En esa línea, en el estudio II se ha encontrado una relación significativa entre la actitud y el uso de los dispositivos de Teleasistencia, más concretamente una actitud positiva hacia adquirir estos dispositivos. Así podemos interpretar que los usuarios que utilizan más el dispositivo tienen una actitud más positiva hacia él que aquellos que lo utilizan menos.

5.3.2. Efectos relacionados con la Utilidad Percibida.

Malhotra y Galleta (1999) identificaron que la Utilidad percibida tiene una relación positiva con el uso actual de la tecnología. En el estudio III se ha encontrado una relación significativa entre la utilidad percibida del colgante de Teleasistencia y el uso del mismo, así las personas que se sienten menos seguras, que consiguen más información de los Servicios Sociales y que contactan más con los Call Centers usan más el colgante, es decir, estas personas perciben el mismo como un instrumento de seguridad, información y contacto social profesionalizado.

5.3.3. Efectos relacionados con la Facilidad de uso percibida.

Hossain y Prytubok (2008) identificaron que la Facilidad de uso percibida tiene una relación positiva con el uso de la tecnología. En el estudio II se ha encontrado una relación significativa entre el vocabulario de la interfaz y el uso del dispositivo de teleasistencia, Así a tenor de estos resultados podemos interpretar que el vocabulario de la interfaz del dispositivo de Teleasistencia se adecúa más a los usuarios del grupo que utilizan más el dispositivo que a los que no lo utilizan tanto. De ahí que para los usuarios que llaman más sea más fácil entonces utilizar el dispositivo de Teleasistencia. En el estudio III se ha encontrado una relación significativa entre la facilidad de uso percibida y el uso del colgante. Así los usuarios que usan más el colgante lo hacen porque es más fácil para ellos en comparación a aquellos usuarios que no lo usan, cuya percepción de facilidad de uso es menor.

5.4. Efectos de la motivación y la emoción en el uso de los dispositivos de Teleasistencia.

En el Estudio II se han identificado relaciones significativas de las emociones negativas y el uso del colgante de Teleasistencia, así como, la Ansiedad Estado y Rasgo con el uso de los dispositivos de Teleasistencia. Con respecto al Estudio III se han encontrado relaciones significativas entre la Ansiedad Estado y la Depresión Estado y el uso del Colgante de Teleasistencia.

5.4.1. Efectos relacionados con la Ansiedad Estado-Rasgo

Ellis y Allaire (1999) encontraron una relación negativa entre la ansiedad y el uso del ordenador. En este sentido, en el estudio II se ha encontrado una relación significativa entre la Ansiedad Estado y Rasgo y el uso de los dispositivos de Teleasistencia. Así los usuarios que llaman más se sienten más ansiosos que los que no llaman y además tienen un rasgo de personalidad ansiosa. Con respecto al Estudio III se identificó una relación significativa entre la Ansiedad Estado y el uso del colgante. Así los usuarios que no utilizan el colgante se sienten más ansiosos que aquellos que si lo utilizan.

5.4.2. Efectos relacionados con la Depresión Estado-Rasgo

Djamasbi, Strong y Dishaw (2010) identificaron que el estado afectivo es un importante componente en la toma de decisiones. En el estudio III se encontró una relación significativa entre la Depresión Estado y el uso del colgante de Teleasistencia. Así los usuarios que no usan el colgante se sienten más deprimidos que los que si lo usan, por lo que, ante tal estado podrían decidir no usar el colgante.

5.4.3. Efectos relacionados con las Emociones

En el estudio II se ha identificado una relación significativa entre el miedo a la hora de llevar puesto el colgante de Teleasistencia durante la noche y el uso del mismo, así los usuarios que utilizan más los dispositivos se sienten peor durante la noche que aquellos que no lo utilizan. De este hecho podemos deducir que aunque se sientan peor al llevar el colgante puesto, los siguen llevando porque lo necesitan más que los otros usuarios.

Como hemos podido observar el uso de los dispositivos de Teleasistencia se ve afectado por factores de diseño como el tipo de Interfaz del dispositivo, factores cognitivos como la facilidad de uso percibida, la utilidad percibida y la actitud hacia la tecnología, así como, factores relacionados con la motivación y la emoción, como la Ansiedad Estado, la Ansiedad Rasgo, la Depresión Estado y las emociones negativas que producen los dispositivos de Teleasistencia, especialmente, el colgante. Es necesario pues utilizar este conocimiento para mejorar el uso de los dispositivos de Teleasistencia.

CAPITULO 6. CONCLUSIONS

As we have seen, Predictors of Telecare devices use are mainly related to design, cognitive, emotional, and motivational factors. Concerning design, graphic interfaces are better than verbal ones to improve usability of telecare devices. Thus, it would be interesting to develop interfaces taking into account better usability with graphic interface, as well as designer could use user modeling in order to adapt interface to Information Architecture of different users. Another benefit of Graphics interfaces will be the reduction of the number of false alarms as well. Concerning cognitive factors in the Telecare device use, we have seen that it is important to have a good attitude. Besides on the Telecare pendant use it is important to have a good Perceived Usefulness and Perceived Ease of Use to wear it. In addition, main profits of Telecare pendant are related to Security and Information and Professional social contact. Apart from that, Emotional and Motivational factors in the case of Telecare devices use are related to users who feel more Fear, Anxiety and have an Anxious personality trait, and to whom Telecare service could provide them more attention in order to improve their wellbeing. As for Telecare Pendant users who use it feel more anxious and depression. Therefore, Designers should take into account daily activities of users in order to assess User´s information architecture, attitude, perceived usefulness, perceived Ease of use, Anxiety, Depression and Negative Emotions to develop new telecare devices (fixed and wireless).

On the other hand, there are some differences and similarities between predictors of computer use or computer interest and predictors of telecare devices use. Thus, on differences, Education is a predictor of computer use in a sense that older adults with more education use the computer more (Czaja et al., 2006), however in telecare device use it is not a predictor. This entails that the use of Telecare devices is not mediated by demographic factors, which can means that the task of Telecare devices use presents less demands than the task of computer use. Besides, high levels of computer knowledge are related to high computer interest (Ellis y Allaire, 1999). However, computer knowledge is not related to telecare device use. Self-efficacy beliefs may be important in explaining computer interest (Laguna y Babcock, 1997), in telecare device use it is not important.

As for similarities, anxiety and attitude seem to be the most important factors, but in a different sense. Thus, with respect to Anxiety, users that use more the device, feel more anxiety. As for Attitude, all groups have a positive attitude to telecare device, contrary to what happens to computer attitude where people with more positive attitude use the computer more than those with more negative attitude.

Based on our results, we can establish some theoretical implications as a first step to build a model of telecare device use with type of interface, Emotional factors, Attitude, Perceived Usefulness, Perceived Ease of Use are, Anxiety and Depression as the main factors.

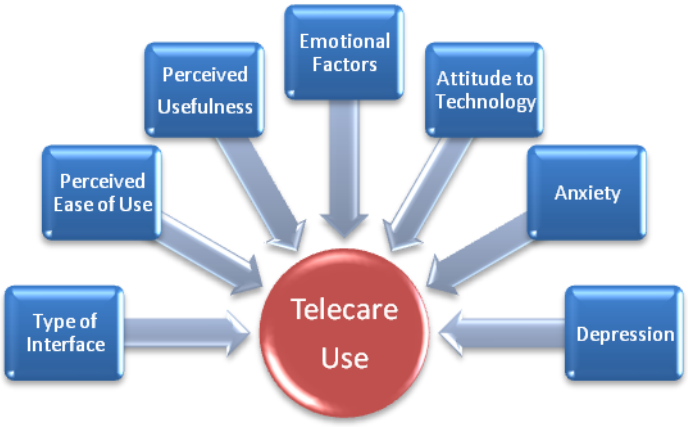

Figure 5. Telecare Use Predictors Model

Those results also point to some issues that should be exploring in further research. First, it would be important to study how positive emotions could help to improve Telecare use in elder people. In the study II we use questionnaire items to measure emotions but we could use as well appraisal model and emotional cards. If we accept Desmet´s Model (Desmet, 2002; Markussen, 2009), we should be able to distinguish between different product emotions involved in the Telecare Devices. However, can Appraisal process predict Telecare Device use of elder people? If we include positive appraisals into the design, can Telecare device use be improved?. It is necessary to understand what kind of evaluation is eliciting emotions (Markusssen, 2009). An ‘appraisal’ is conceived as evaluation or mental judgment of whether a

particular product is not relevant, beneficial, and harmful, to our well-being (Fridja 1986, quoted in Markussen, 2009).

On the other hand, as for practical implications we can use those Telecare Predictors factors within Telecare design process. This could be done by including those factors in design methodologies such as PERDA (Participatory Ergonomic Research and Development) (Väyrynen, Röning and Alakärppä, 2006). This design approach is user-centered which means that ergonomics have a key role within the design process (Väyrynen, Röning and Alakärppä, 2006). Opposed to technology-driven products appears the user-centered design of products that has many relations to user-drive products concepts (Väyrynen, Röning and Alakärppä, 2006).

Besides, the contextual system is emphasizes by PERDA, as shown in Figure 9. It mentions the importance to include additional components within the classical user-product-task system. Specifically, the product development within PERDA is carried out following the procedure of the 3 + 3 model (Figure 6). This procedure can combine both a development through Research and Development approach and an ordinary company-level design (Väyrynen, Röning and Alakärppä, 2006).

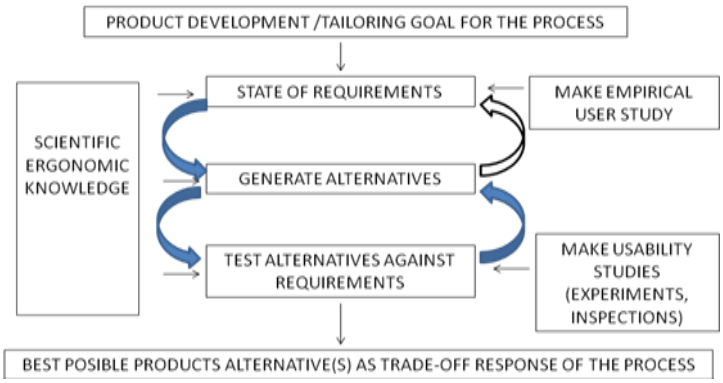

Figura 6. This 3+3 model is an essential part of the PERDA (Väyrynen, Röning and Alakärppa, 2006)

One the other hand, one main characteristic of PERDA is that it starts from the user´s needs. Ergonomics try to achieve the best match between the user and the product within the contextual task (see Figure 7) (Väyrynen, Röning and Alakärppa, 2006).

Furthermore, according to PERDA the interaction between the product and the user includes new elements such as the social context and the environment (Figure 8) (Väyrynen, Röning and Alakärppa, 2006).

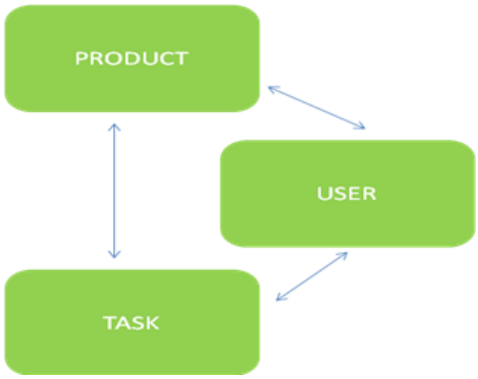

Figure 7. Basic Ergonomic System (Väyrynen, Röning, Alakärppä, 2006)

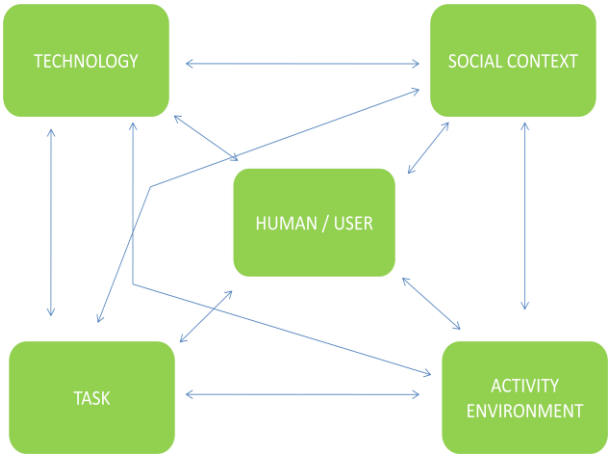

Figura 8. User Product Task System (Väyrynen, Röning, Alakärppä, 2006)

Therefore, we could combine PERDA as a design framework of Telecare devices and Predictors of Telecare devices to develop them. Thus we could use those ones as Heuristic requirements, that can improve design and the use and acceptance of this systems (see Figure 9).

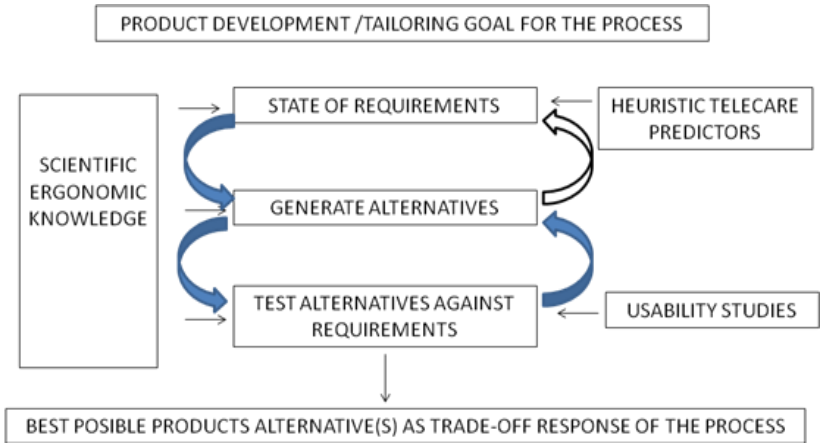

Figure 9. Heuristic design model based on Telecare Predictors.

As a way of Knowledge transfer the main Heuristic Requirements that we could include within PERDA would be related to Type of Interface, Perceived Ease of Use, Perceived Usefulness, Attitude to Technology, Emotional Factors, Anxiety and Depression. Specifically, Graphic Interface, Vocabulary of Interface, Usefulness of the Pendant, Attitude to buy telecare devices, fear to wear the pendant during night, Anxiety to Telecare devices, Anxious Personality Trait and Depression feelings. All of these factors would be specific heuristic requirements that should be taken into account by engineers to develop Telecare devices. The fulfillment of those within PERDA Design Process would increase the Acceptance and Use of Telecare Devices.

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STUDY I

Ojel-Jaramillo, J. M. and Cañas, J. J. (2006). Enhancing usability of Telecare Devices. Human Technology, volume 2 (1), April 2006, 103–118

Abstract

Demographic and sociological changes in the last 50 years have forced Western societies to create services to attend to elderly people in their homes, where they can live within familiar environments. Telecare involves a device plugged into a telephonic network that provides access to teams of professionals who can attend to the needs of the elderly in their homes. These devices have been designed according to the principles of universal design, but the great number of erroneous calls to telecare centers point to the necessity of enhancing the usability of the devices. One analysis of the cognitive functioning of elderly people showed that a possible cause of these errors could be the difficulty elderly people have when processing language. In our experiment, we tested the hypothesis that the numbers of errors could be reduced by using icons instead of words in the device interface. The results support this hypothesis.

Keywords: telecare, usability, elderly people, cognitive deterioration, universal design.

AGING AND SOCIETAL CHANGES IN CARE GIVING

Among the most important changes that have taken place in today's Western societies are those that result from the exodus from countryside to the cities, the new model of the nuclear family, the changing role of women, and the democratization of family relations. An important consequence of these social changes is that the family is no longer able to satisfy certain needs of its members, mainly because the role of the woman in the family has changed to encompass functions different from what has been traditional.

These social changes are especially relevant in relation to the phenomenon of aging. All around the world, but more so in the most developed countries, there is a constant increment of human life expectancy. This sociodemographic phenomenon means that society has to confront the challenges of helping elderly people, who experience a decreasing capacity to care for themselves, to carry out their daily life activities. For this reason, societies have developed social service systems to care for or assist the elderly. To face these challenges a new research field called gerontechnology arose, with a mission to develop products and services adapted to the phenomenon of aging. Gerontechnologists are interested in technologies that help to anticipate (and prepare for) the functional decline that is produced by aging. Therefore, gerontechnologies are designed to enrich the functioning of elderly people, especially in communication, education, and work. In few words, gerontechnology is a field of study in which professionals work to design technologies to compensate for the losses associated with aging. A central concern for gerontechnology research is to determine the characteristics that an interface of any device must have so that the difficulties derived from aging can be avoided.

Said in another way, the focus of the research is to determine what implications aging has for the design of an interface.

Telecare is a set of technologies that provide help to dependent, especially elderly, people by providing access to teams of professionals who can attend to the client's needs 24 hours a day, 365 days a year via a telephonic network. The goals of these technologies are (a) to provide a system that allows the elderly to obtain and to maintain a greater degree of autonomy and well-being in their homes; (b) to facilitate the permanence and integration of the elderly within their social and family environments, thus avoiding many unnecessary situations in which the elderly are uprooted and cared for in an institution; (c) to provide the elderly with security and prompt attention in cases of emergency; and (d) to support the family members who assume the role of supervising their loved one's care.

Telecare came about to solve the problems associated with previous technologies, such as telewarning, a system connected to the telephone that allowed a person to call for help in situations of emergency. This telewarning technology, developed in the 1980s in countries that were pioneers in this kind of social service for helping people in living alone at home (the Nordic countries, Great Britain, and Germany), and similar systems, like the so-called Hope Telephone, were intended to solve many communication problems, as well as to ease the sense of isolation and loneliness that often accompanied the elderly living alone. However, several problems could not be solved by the human operator who answered the call. A study conducted from 1987 to 1991 in France by Templier, Lanata, Baer, and Pasteyer, (1992) showed that 77% of the calls were not emergencies, but were registered as "error of manipulation" or "call to chat," meaning the caller initiated contact with the service for

reasons other than an emergency need and the operators couldn't determine if the call resulted from an error or the caller's simple desire to chat. Furthermore, other difficulties exist, such as falls, diseases, or suffering an assault, that are very frequent situations of vulnerability experienced by elderly people. For example, some studies (Lázaro del Nogal, 1997) have revealed that 25% of those who surpass age 65 experience fall throughout the year. In Spain alone, about 2 million falls and 90,000 fractures each year have been reported (Lázaro del Nogal, 1997). The falls have ominous effects on the person's autonomy, which can be mitigated with fast and diligent help. Nevertheless, there is empirical evidence (Instituto de Migraciones y Servicios Sociales, 1996) that shows that elderly people who fall at home often remain on the ground, far from the telephone, for more than one hour before being able to request aid. As a consequence, the gravity of the fractures increased and the period of hospitalization was greater, both of which increased the psychological upheaval of the person due to the fear of falls, isolation, and dependency. Therefore, to overcome the problems observed with the use of telewarning and similar systems, UNA (Union Nationale de l'Aide, des Soins et des Services aux Domiciles, n.d.) has elaborated a report with a set of deontological principles for designing new systems for care giving in France that have been applied in other countries as well. The report recommended eliminating systems that only transmit emergency calls from the elderly. Instead, government agencies should look for services that care for all aspects of the life of the dependent person. As a consequence of the application of these principles, a new system called telecare was designed.

Telecare hardware consists of an apparatus wired to the telephone network that has two terminals, one fixed (domiciliary unit, see Figure 1), and another one in the form of a pendant or bracelet (terminal wireless, see Figure 2).

Figure 1. Fixed Telecare Device

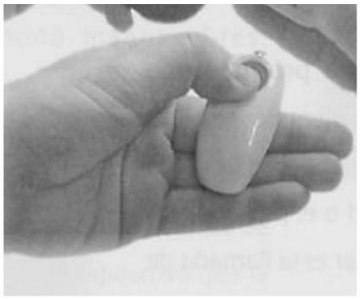

Figure 2. Wireless Telecare Device

Whenever users are in a situation of urgent help (e.g., they have fallen in the shower), need information, must request some service for themselves or their home, or simply want to know what is on their agendas for the day, they press the corresponding button. For example, telecare users may need to be reminded that they have appointments with their doctors, or that they have to take their medications. By pressing the appropriate button, a user gets in contact with the telecare center where a central computer contains all the sociosanitary histories (e.g., health, family, and environmental conditions) of the user. Special software allows the teleoperator to see on the computer screen immediately the relevant data about the user (data personal, clinical diagnoses, treatments, medicines that she/he takes, name of the health professionals who care for her/him, and contact information for his/her family, reference person, close friend, etc.). With this data, the teleoperator can decide whether to provide a solution to the caller's request with public resources or with private resources (external).

Within the telecare center, social workers, medical doctors, psychologists, and so forth, are available to assist the teleoperators.

THE DESIGN PROBLEM: ERRONEOUS CALLS

Telecare systems have proved to be a very successful tool for providing help to dependent people and for this reason they are being implemented rapidly in many societies. However, some problems have been detected that need solutions before we can say that telecare systems are truly useful tools. One problem is the enormous number of erroneous calls that have been observed. Erroneous calls are defined here to mean calls by seniors to the service centers for any reason other than what the call-button designation indicates: This encompasses issue of "unwanted calls" (including calls to chat), misdirected calls (caller needed a service other than what the designation button indicated), or calls made in error (button pushed accidentally and so the call was unintended). Figure 3 depicts the number and percentage of calls classified as erroneous received during 2002 and 2003 at the Andalusia Service of Telecare (located in Seville and providing services to users from the Andalusia region in southern Spain; Fundación Andaluza de Servicios Sociales [Andalusia Foundation for Social Services], 2004). We have to note that our definition of erroneous calls could not be more specific at this point because the data presented in the figure, and which motivated our research, was collected without enough details to allow us to know more about the origin and/or purpose of those erroneous calls. It should be noted also that the teleoperators have mentioned to us that sometimes they perceive users call by pressing any button when they just want to talk to someone. Therefore, the high number of the erroneous calls might also include those originated by loneliness. However, our research, because of the

existence of misdirected calls, was designed based on the hypothesis that some errors could have a cognitive explanation.

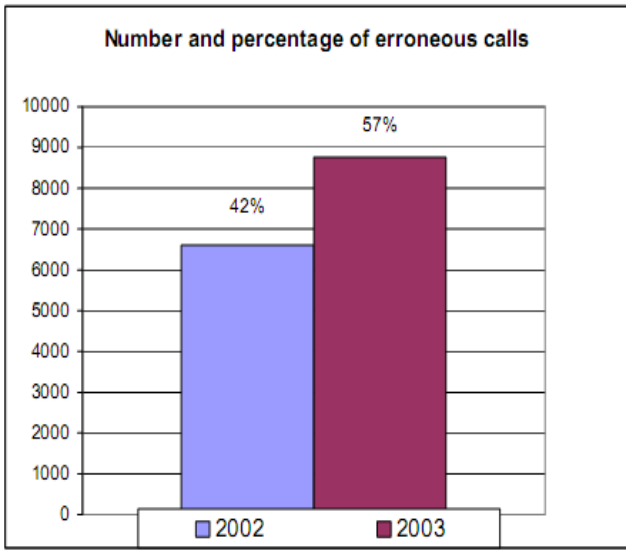

Figure 3. Percentage and number of erroneous calls throughout in 2001 and 2003, at the Andalusia Service of Telecare, Spain

As we can observe, there was an increase in the number of erroneous calls from 2002 to 2003. In 2002 the calls by error constituted 42% (6,607 of a total 15,375) of the calls that took place in the Center of Attention at the Andalusia Service of Telecare, and in 2003 those errors rose to 57% (8,769 calls of a total of 15,376). The problem this presents is that although the caller called in error, there is always the possibility that it is an emergency call, and perhaps resources are expended unnecessarily. For example, since the same operators handle all incoming calls, they may be busy with an error call when a legitimate call is not being addressed. They might also allocate resources (i.e., ambulances) automatically to attend those error calls, and those resources could be needed to attend to other users. These data reflect a situation that must be addressed by considering how telecare is designed from the point of view of human-machine interaction.

The telecare systems today are designed according to the principle of universal design. According to Ron Mace (2006), universal design, also known as design for all, can be defined as "the design of products and environments to be usable by all people, to the greatest extent possible, without the need for adaptation or specialized design" (1). According to Seminario Iberoamericano sobre Discapacidad y Accesibilidad en la Red ([SIDAR] Ibero-American Seminar on Disability and Accessibility on the Net, 2006), universal design is based on seven principles. The design must (a) be useful and valid for the diversity of people, and provide the same forms of use for all the users; (b) be flexible and accommodate the diversity of preferences and individual abilities; (c) be simple and intuitive; (d) communicate effectively the information that the user needs, considering the environmental conditions or the sensorial capacities of the user; (e) have tolerance for error, and diminish the negative consequences of involuntary and accidental actions; (f) demand little physical effort; and (g) have size and space accessible for using the device functions easily.

Apparently these principles, which were implemented in the Andalusia Service of Telecare, are not enough since erroneous calls continue. Therefore, we feel that research is needed to find design solutions to reduce the number of errors that the users of this system commit. And we believe that the solutions of design should be based on the analysis of the cognitive characteristics of users. This analysis has to be done within a psychological framework.

The Principle of Mutual Dependency

Cañas, Salmerón, and Fajardo (2005) have proposed a method for analyzing user interaction with artefacts. The method is based on the principle of mutual

dependency, which states that the human cognitive functions implied in the task will depend on the functions that are present in the interface and that the functions of the interface that help in performing a task will be those that are more appropriate to the human cognitive functions that are implied in the task. For example, the appropriate interface functions will be those that correspond to the structure and function of the human working memory. Therefore, according to this principle of mutual dependency, designers should consider that any modification, substitution, or introduction of a new function in the interface will result in a change in the human cognitive functions that intervene in the task. In addition, anything that is particular or constraining in the characteristics of the human cognitive functions that are present in some or in all users will set a limitation on the possible functions that are included in the interface. For example, users that have some limitations in their working memory functions would require interface functions that overlook or compensate for these limitations.

So, in summary, the concept of mutual dependency means that

(a) The functions of the interface that are optimal for performing a task will be those that are more adapted to the human cognitive functions that are implied in the task.

(b) The human cognitive functions implied in the task will depend on the functions that are present in the interface.

(c) Any modification, substitution, or introduction of a function in the interface will imply a change in the human cognitive functions of the users.

(d) Any limitation in the characteristics of the human cognitive functions present

in any or all of the users will imply limitations in the possible functions included in the interface.

The conceptual framework behind this principle is related to work being done by researchers around the world. For example, at the Center for Research and Education on Aging and Technology Enhancement (CREATE), in Florida, USA, research based on the principle of person-technology congruity is being conducted. The focus is to understand how older users' sensory/perceptual, cognitive, and psychomotor capabilities fit to the demands of new technologies designed for them (Czaja, Sharit, Charness, Fisk, & Rogers, 2001). Their principle of person-technology congruity is quite similar to our principle of mutual dependency.

Therefore, in line with the principle of mutual dependency, we began our research by analyzing the cognitive functioning of the users of telecare systems as the first step in finding solutions to the number of erroneous calls.

Deterioration of Elderly Cognitive Functioning

Different cognitive functions deteriorate with age. (For a recent review of this topic, see Fisk, Rogers, Charness, Czaja, & Sharit, 2004.) Visual functions start deteriorating at around age 40 (D. W. Kline & Scialfa, 1996). But the important problems appear around the age of 60, when people show a reduction of their field of vision, which means a stimulus must be in the center of their field of vision to be detected (Cerella, 1985). Hearing also diminishes with age.

Around 20% is lost between the ages of 45 and 54 years, reaching 75% between 75 and 79 years of age (Fozard, 1990; D. W. Kline & Scialfa, 1996). Feldman and

Reger (1967) found that people 80 years old miss about 25% of the words during conversations. In general, they are unable to follow a conversation in a group of people when everybody speaks at the same time, and this worsens in stressful situations (Corso, 1977). Speech deteriorates due to either a reduction in motor control or to a loss of the ability to listen to oneself or to others. Therefore, the ability to produce words declines with time, even as the time necessary to produce a word increases (Mackay & Abrams, 1996).

With age, response time in complex motor tasks gets longer (Light & Spiriduso, 1990; Spiriduso & Macrae, 1990). Elderly people show a smaller capacity to perform repetitive tasks that demand great speed, although with enough training they can deal with tasks like striking quickly with a finger (Krampe & Ericsson, 1996). Other evidence suggests that the decline that takes place in the accomplishment of tasks can be compensated for with advanced planning (Welford, 1985).

Attention is also affected by age. Vercruyssen (1996) indicated that elderly people have problems maintaining their attention for long periods of time. This author also suggested (p. 66) that tasks requiring fast and continuing searches are particularly tiring for them. With regard to selective attention, the ability to maintain the attention in the presence of distracters diminishes with age (Conelly & Hasher, 1993). Kane, Hasher, Stoltzfus, Zacks, and Connelly (1995) suggested that this happens because the elderly lose the capacity to inhibit responses to distracting items.

There is an impairment of episodic and procedural memory (Howard & Howard, 1996). This impairment is also observed in the semantic memory but it does not become important until an advanced age. Some studies show a small deficit in the ability to

recognize simple familiar items in tasks of (previously exposed) memory, but there is a significant deficit in the contents of the memory (Hoyer & Rybash, 1992). When the learning material contains histories, text, or interviews, this deficit also occurs in the recognition of significant forms Hertzog & Rogers, 1989; Hultsch, Masson, & Small, 1991; Stine & Wingfield, 1987). On the other hand, the memory of diverse movements of the fingers that are involved in the verbal memory and/or the memory of motor sequences does not show deterioration with the age Rybash, Roodin, & Hoyer, 1995). However, as indicated by Krampe and Ericsson (1996), a great amount of practice is necessary to maintain the ability at an expert level, as is the case of the better piano players.

Therefore, as this short review reveals, there are many cognitive functions that deteriorate with age that could explain the high number of erroneous calls. However, we want to address just one of them in this paper: The difficulty that elderly people have when processing language. Older adults maintain and could even improve knowledge of words and word meanings (cognitively), but they suffer deficits in the ability to produce the spoken and/or written forms of words (Burke & Shafto, 2004). They show problems producing well-known words. It has been suggested that older adults´ language abilities are affected by working memory limitations on the production of complex syntactic constructions (Kemper, Kynette, Rash, Sprott, & O'Brien, 1989). That would indicate that these limitations are ones of retrieval rather than comprehension. This phenomenon is related to the well-established distinction between knowing and remembering that explains phenomena such as the so-called feeling of knowing and tip-of-the-tongue (Koriat, 1998). Both phenomena could be interpreted by saying that you know something but you cannot retrieve it. However, it could be also a problem of word

recognition. According to Nelson's semantic-sensorial model (Nelson & Reed, 1976; Nelson, Reed, & Walling, 1976), words have an indirect access to meaning. When reading a word you have to go through a lexical process to recognize letter, phonemes, and so forth, before you access its meaning. On the contrary, pictures have direct access to meaning. Therefore, the language deterioration showed by elderly people could be due to both word recognition and retrieval. And if language deterioration is a factor for the telecare users, then that could explain the erroneous calls. The user interface of the telecare terminals provides labels in words only to indicate the function of each button: If the user is having difficulty with word retrieval, then she/he would have difficulty selecting the appropriate button to press for service.

There could be a simple design solution based on the fact that empirical research has found that aging does not affect the retention of pictorial stimuli (Rybarczyk, Hart, & Harkins, 1987). In a study conducted by Park, Royal, Dudley, and Morell (1988), picture recognition did not show an age-related decline until a week later. Winograd, Smith, and Simon (1982) have compared verbal and visual encoding by younger and older subjects to determine whether there would be a picture superiority effect that does not change with age.

The Picture Superiority Effect (PSE; pictures are recognized and remembered better than words) has been reported in a great variety of semantic tasks (e.g., Pellegrino, Rosinski, Chiesi, & Siegel, 1977) and episodic tasks (Kinjo & Snodgrass, 2000; Paivio & Csapo, 1973).

Winograd et al. (1982) found the PSE in both age groups. The finding of a PSE in older subjects indicated that nonverbal codes can be used effectively by people in all

age groups to facilitate memory performance. Rissenberg and Glanzer (1986) tested the hypothesis that the PSE in recall would decrease with age in two experiments with undergraduates, older adults with normal memory for their age, and older adults with significant memory impairment.

Although the results showed that the PSE declined with age, it was still present in older adults. Moreover, it could be re-established in older adults with normal memory by instructing them to verbalize overtly during the item presentation.

In the field of human-computer interaction, the well-known icon superiority effect has been demonstrated many times in interface design. For example, Arend, Muthig, and Wandmacher (1987) showed the superiority of icons over verbal commands in six different text editor tasks. Spence and Parr (1991) found that responses were faster with icons in a problem-solving task that required choices among multiple alternatives on several variables. Similar results have been found in traffic research. T. J. Kline, Ghali, and Kline (1990) found that the comprehension of text signs could be affected by visual acuity, which is a common problem among old people.

EXPERIMENTAL COMPARISON BETWEEN ICON AND VERBAL LABELS OF TELECARE FUNCTIONS

Based on the research presented above, our hypothesis was that we can reduce the numbers of errors by using icons to indicate the functions on the device interface instead of words. In order to test this hypothesis, we conducted a study in two phases. First, we surveyed a number of people to determine which icon best represented each element presented on the interface.

Then, in an experimental setting with a number of experimental subjects, some of them users of telecare systems and some nonusers, we presented the word and icon versions of those functions items to the test subjects, who then had to perform a simulation of a calling task.

Phase One: Icon Selection

The purpose of this phase of our study was to select the icons for the design of the graphical interface. The icons selected in this phase were then compared in the experimental phase with their verbal counterparts.

Participants

A sample of 72 subjects was selected (24 young adults, 24 adults, and 24 elderly adults, with an average age of 46 years) through a stratified sampling with the attributes of age and educative level. Age had three levels: young people (average age = 20 years old, range = 18-24 years), 24 adults (average age = 36 years old, range = 25-55 years) and 24 elderly adults (average age = 72 years, range = 56-92 years). All groups contained participants in equal numbers (25% each) possessing one of four educational levels: without primary studies, completed primary studies, completed secondary studies, and completed university studies. All subjects were native speakers of Spanish, the language of the testing.

Materials and Instrumentation

We selected four functions that could be found on the most popular telecare devices: Familia [Family], Emergencia [Emergency], Averias [Failures], and Información [Information]. The function Family is used when the user wants to contact a member of her/his family. Emergency means that something is happening (e.g., some

medical problem) that needs urgent attention. The function Failures relates to any problem with some home equipment (e.g., the refrigerator is not working). Finally, Information is used for getting some information about anything that interests the user (e.g., name and address of a doctor). All users of telecare devices are familiar with these categories. These functions are listed on the standard devices, but users can change them to any other function labels they like more.

Then we selected six icons for each of the functions from The Handbook of Pictorial Symbols (Rudolfh & William, 1974) that contains a collection of 3,250 icons. The icons were presented in a computer display by software developed in visual BASIC 6.0 especially for this study.

Procedure

At the beginning of the session, participants answered a set of questions regarding demographic data, such as age, gender, educational level, type and percentage of disability, and so forth. Percentage of disability is a measure used by the Spanish Administration to assign public resources to people with disabilities; it is assigned by a committee of professionals (medical doctors, psychologists, social workers, etc.). However, it should be noted that the measure includes not only the medical and psychological condition of the person, but also some social variables.

Then, we presented the participants with a booklet with forms in which the concepts for the functions were presented. The participants were to select one icon from the six options that best represented each function's concept. We must note that since this study was done in Spanish, it is possible that people in different cultures might select a different icon for the same word concept.

Results

We calculated the percentage of times that each of the six icons was selected for each interface element. Figure 4 shows the percentage of choices for the six icons for the interface elements. For example, for the concept Family, 55% of the participants chose icon number 6. The selected icons for each interface element can be seen in Figure 5. The icons that we selected for the experimental phase of the study were those that were chosen by the significant majority of the people.

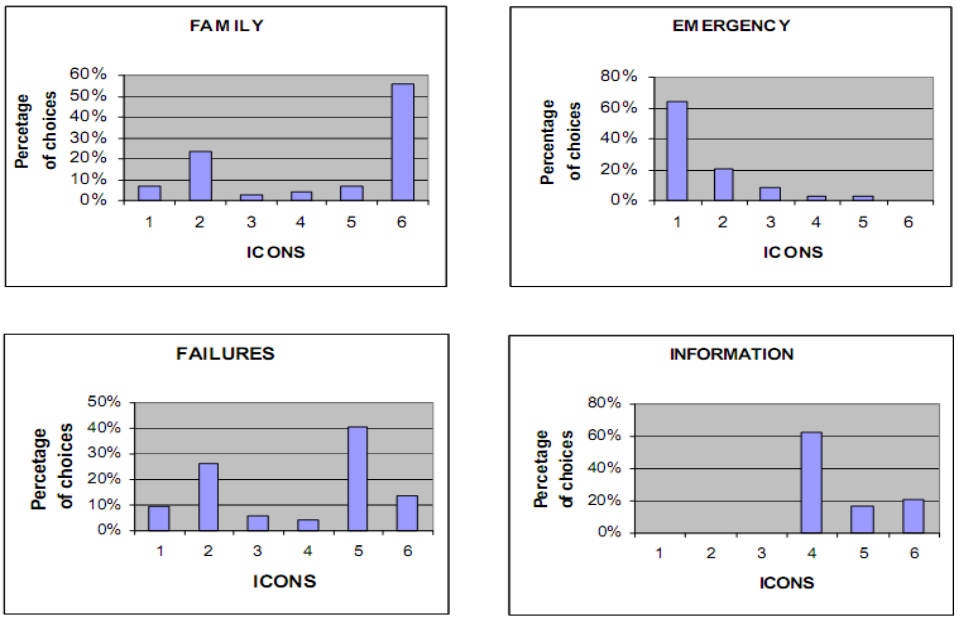

Figure 4. Percentage of choices for the six icons for the interface element.

Figure 5. Selected icons for each interface element

Phase Two: Testing the Icons

The second phase of our study was conducted to test the reliability of the icons in facilitating accurate use of the functions on the telecare interface. In this phase we compared the icons selected in the first phase to their corresponding word labels.

Participants

One hundred and twenty people participated in the experiment. Sixty of them were users of the Andalusia Telecare Service, with an average age of 76 years. The other 60 participants were nonuser control subjects, matched to the experimental telecare users on education level, gender, percentage of disability, and age. All participants were native Spanish speakers; the testing was conducted in Spanish.

Materials and Instrumentation

The stimuli were the four concepts used in the previous phase: Family, Emergency, Failures, and Information. Each icon and its corresponding verbal format were presented separately on a computer screen by the software designed to run this experiment. Due to the lack of personnel and the equipment in our laboratory to design new devices, it was not possible to use modified telecare devices in this study.

Procedure

The experimental session started by asking the participant demographic data about her/himself age, sex, educational level, and type and percentage of disability). The experimental trials consisted of presenting the four concepts in one of the two possible formats (icon or verbal) depending on the group to which the participant belonged. Both the users and nonusers groups were split into two subgroups, which then performed the

task either in the icon condition or the verbal condition. Therefore, there were four groups with 30 participants in each: the User-Graphical condition, the User-Verbal condition, the Nonuser-Graphical condition, and the Nonuser-Verbal condition.

Then a request to call situation was presented in a written format on the computer screen, he subject had to press a key on the computer keyboard to choose the concept (visually or graphically, depending on the subgroup) that would be appropriate for that call. For example, he participant saw a message in the center of the screen saying "Call a family member," which then disappeared and the four concepts (in either the verbal or graphic format) were presented. The concept options remained on the screen until the participant pressed one key with her/his choice.

Only one concept was presented in each trial. Therefore, each participant was involved in our experimental trials plus a practical trial in which a concept not related to the telecare devices was presented. The order of presentation of the four experimental concepts was random and different for each participant.

Design

The design was a 2 x 2 factorial design, with Type of User (User and Nonuser) and Type of interface (Graphical and Verbal) as the between-subjects factors. The dependent variable was number of errors. Response time was discarded as a dependent variable since it involved the motor ability of the user, which evidently could be different for both type of participants, since the two groups were not matched on motor ability.

Results

Figure 6 shows the results of this experimental phase. We performed an analysis of the covariance on the data with Type of Interface (Graphical or Verbal) and Type of User (User or Nonuser) as independent variables, and Gender and Educational Level as covariates. The dependent variable was the number of errors.

There was no main effect of Type of User, but Type of Interface showed a significant effect, $F\ (1, 119) = 10.72$, $MSE = 3.00$. On the other hand, the interaction was close to significance, $F\ (1, 119) = 3.40$, $MSE = 0.95$, $p < .07$. An analysis of the simple effects showed that the differences between users in the condition of Verbal Interface were significant, $F\ (1, 114) = 10.72$, $MSE = 0.28$, $p < .01$, whereas the differences in the condition of Graphical Interface were not, $F\ (1, 114) = 3.29$, $MSE = 0.28$, $p = 0.7$.

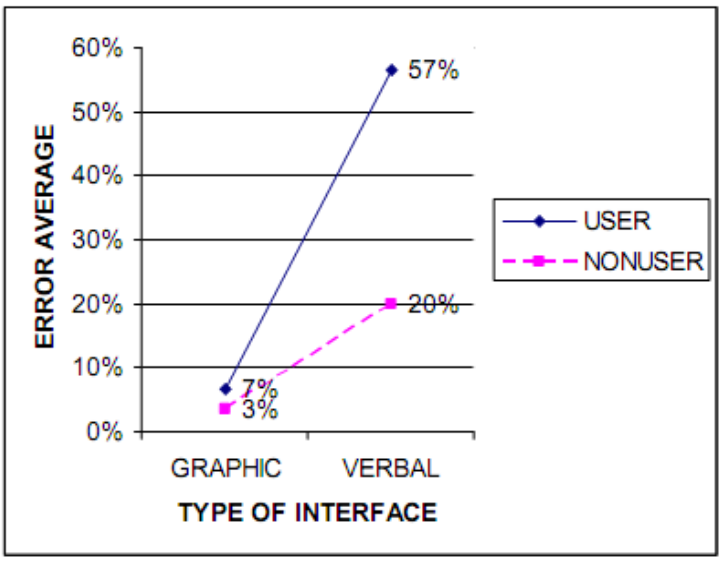

Figure 6. Error Average for users and nonusers of Telecare systems

Discussion

The results of the experimental phase show clearly that a possible cause of the calls in error observed in a telecare services could be due to the exclusive verbal design of the current telecare interfaces. The comparisons between the performances of users and nonusers with both interfaces revealed two important issues. In the first place, for both types of users, the Graphical Interface reduced the number of errors. Second, and more important, the differences in the number of errors that were observed between both types of users were reduced enormously with the Graphical Interface. In other words, users committed significantly more errors than the nonusers with the Verbal Interface, whereas the number of committed errors was very similar among participants with the Graphical Interface.

We can interpret these results within Paivio's (1991) dual coding theory. People commit fewer errors with a graphical interface because they understand the meaning of the buttons better than with a verbal interface. Meaning is better accessed with picture than with words and both types of cognitive representations (visual and verbal) of the icons allow an even better access to meaning. Accessing the meaning of words alone is more confused because words have just one cognitive representation (verbal). However, other models could also explain these results. For example, Nelson's semantic-sensorial model (Nelson & Reed, 1976; Nelson, Reed, & Walling, 1976) would predict that people commit fewer errors with the graphical interface because the visual characteristics of icons are more distinguishing than those of words and the access to their meaning is direct. To access the meaning of words it is necessary to process their visual and phonetic characteristics.

GENERAL CONCLUSIONS

The main conclusion that could be reached from the results of this experiment is that the principle of universal design must be complemented by an analysis of the cognitive functioning of the users if we want to improve telecare system design. Although we have only tested a single hypothesis that refers to the graphical or verbal characteristics of the interface, we found results that could point to an important cause of erroneous calls. Therefore, it seems reasonable that if we look deep into the cognitive analysis of user interaction with telecare systems, as suggested by the principle of mutual dependency, we should be able to find other potentially important variables. This analysis could be based on empirical research done in cognitive psychology with elderly people, as well as with cognitive theories, such as Shallice and Cooper's (2000) theory that has been developed to explain the erroneous conduct of people. In practical terms, we must say that this research will solve an important economical problem at the Telecare Services, since erroneous calls mean an important loss of resources.

It is important to note also that although there could be other possible no cognitive explanations (e.g., accidental physical pressure on the telecare device) for the large number of erroneous calls observed by telecare providers, the cognitive functioning of elderly people may also play a significant role in this scenario. Therefore, we believe that it is worth the effort to explore hypotheses based on the analysis of the cognitive functioning of elderly people.

Finally, it is also important to say that a possible flaw in our experimental design was that we did not make any evaluation of the cognitive ability of our participants. Therefore, even if the participant were matched on four control variables

(educative level, gender, percentage of disability, and age), the participants in the User group could be more cognitive deteriorated than participants in the Nonuser group. The participants in the User group were people that had requested the installation of telecare devices, and that could mean that they are less able to live by themselves.

The only criterion related to cognitive ability that we could have used to judge cognitive ability was the percentage of disability, but it comprises medical, psychological, and social variables. However, the Andalusian Service of Telecare requires that potential users have a minimum of psychophysical conditions to operate the device. It could be interesting to repeat this study with some assessment of the participants' cognitive ability to test this factor's effect more appropriately.

ENDNOTE

1. Although all new units of telecare devices delivered to clients contain specific terminology related to call destinations at the telecare service center as the speed dial options, clients are free to rename or alter this terminology for their convenience. This unit shows the speed dial options preferred by a particular user.

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STUDY II

Ojel-Jaramillo, J. M., Cañas, J. J., and Cándido, A. (2011). Factors Predicting the use of Telecare Systems: Psychological viewpoint. Manuscript Submitted to International Journal of Human Factors and Ergonomics, IJHE.

Abstract

Telecare is a type of information and communication technology (ICT) that provides help to dependents, especially elderly people, by providing access to teams of professionals who can attend to the client's needs 24 hours a day, 365 days a year via a telephonic network. Previous studies have shown that design and motivational factors are related to use of telecare by older people. In this study, we examined how sociodemographic, motivational, design, cognitive, and attitudinal factors are related to telecare device use. A questionnaire and the State-Trait Anxiety Inventory were administered to a sample of 96 telecare users. The results showed that factors related to the vocabulary of the telecare device interface, discomfort caused by the pendant device during the night, attitudinal factors, situational anxiety, and the anxious personality trait are predictors of whether or not a person will use the telecare device.

Keywords: Aging, Telecare, Anxiety, STAI, Self-Efficacy, Attention, Esthetics, Memory, Learning, Attitude

Introduction

In today´s Western societies have taken place important changes that resulted from the new model of the nuclear family, the exodus from the countryside to the cities, the democratization of family relations and the changing role of women. Family can no longer satisfy certain needs of its members as consequence of all of these social changes, mainly because the role of the women in the family has changed to encompass non-traditional functions. Concerning Aging, these social changes are especially important. In the most developed countries, human life expectancy is continually increasing. This socio-demographic phenomenon means that society has to confront the challenges of helping elderly people, who experience a decreasing capacity to carry out their daily life activities and to care for themselves (Ojel-Jaramillo and Cañas, 2006).

Telecare is a type of information and communication technology (ICT) that provides help to dependents, mainly elderly people, by providing access to teams of professionals (psychologists, social workers) who can attend to the client's needs 24 hours a day, 365 days a year via a telephonic network. Telecare devices consist of an apparatus wired to the telephone network that has two terminals: One is fixed (domiciliary unit, Figure 1) and the other is in the form of a bracelet or pendant (terminal wireless, Figure 2) (Ojel-Jaramillo and Cañas, 2006).

Figure 1. Fixed Telecare Device

Figure 2. Wireless Telecare Device

The goals of telecare are to: (a) provide a system that allows the elderly to obtain and maintain a greater degree of autonomy and well-being in their homes; (b) facilitate the permanence and integration of the elderly within their social and family environments, thus avoiding situations in which the elderly are uprooted and cared for in an institution; (c) provide the elderly with security and prompt attention in cases of emergency; and (d) support family members who assume the role of supervising their loved one's care (Ojel-Jaramillo and Cañas, 2006).

Telecare was devised to solve the problems associated with previous technologies, such as telewarning, which was a system connected to the telephone that allowed a person to call for help in emergency situations. Telewarning technology was developed in the 1980s in countries that were pioneers in developing social services to help elderly people continue to live alone at home (i.e., the Nordic countries, Great Britain, and Germany). Similar systems, such as the Hope Telephone, were intended to solve communication problems and to ease the sense of isolation and loneliness that often accompanies the elderly living alone (Ojel-Jaramillo and Cañas, 2006).

In general, data on the use of technology by older adults have shown that factors, such as demographic factors, perceived benefits of technology, attitudes, self-efficacy, influence technology adoption (Czaja et al., 2006; Laganá, 2008). Previous studies of motivational and emotional factors that affect technology adoption indicated that older people are less comfortable and confidence to successfully use of technology (Ellis and Allaire, 1999; Umemuro, 2004; Czaja et al., 2006). With regards to specific cognitive abilities and use of ICTs, several studies (Umemuro, 2004; Czaja et al., 2006) have shown that cognitive abilities such as memory, spatial abilities and field independence are important to the successful technology interaction. Czaja et al. (2006)

reported that fluid intelligence and crystallized intelligence were important predictors of the use of technology. Therefore, variables such as cognitive abilities, computer self-efficacy, computer anxiety, and technological acceptance influence the relationship that older people have with technology, and they can be used as predictors of technology use (Davis, 1989; Laguna and Babcock, 1997; Ellis and Allaire, 1999; Sharit et al., 2003; Czaja et al., 2006). However, the specific predictors of telecare device use are not yet known.

The acceptance problems and none-usage of telecare systems can be regarded partly because of designs don´t respond to the needs of elderly people. Telecare use may hurt on psychological well-being of elderly users (Fisk, 1998; McCreadie and Tinker, 2005). Demiris et al. (2000) developed a questionnaire to assess patients' impressions of risks and benefits of home telecare. Results showed that the main concerns of telecare users are privacy and confidentiality about their personal data, reliability of the required equipment, as well as, a positive attitude towards home telecare. Rahimpour et al. (2008) conducted several focus group studies of users' perceptions of a home telecare system, the findings from this study suggested that telecare self-efficacy and anxiety are likely to be important factors in use of the technology. However, there could be many other reasons for non-usage and non-acceptance of telecare systems.

Several cognitive functions deteriorate with age (Fisk et al., 2004). According to Kline and Scialfa (1996) visual functions begin to deteriorate at around age 40. Hearing also diminishes, around 45 or 54, 20% is lost, and the value reaches 75% between 75 and 79 years of age (Fozard, 1990). Feldman and Reger (1967) reported that people 80 years have problems during conversations; they miss about 25% of the words. Besides, there is an increase of response time for complex motor tasks (Light and Spiriduso,

1990; Spiriduso and Macrae, 1990). Elderly people can´t respond efficiently to repetitive tasks, although it can be overcame with any training (Krampe and Ericsson, 1996).

Spatial and temporal disorientation indicates cognitive impairment in the elderly population and mental status examination, (O´Keeffe et al., 2001). With spatial orientation, for example, older people required more time to form a cognitive map of the environment than young individuals (Iaria et al., 2009). With respect Attention, Vercruyssen (1996) this can be maintained for long time periods by the older people. Vercruyssen also suggested that fast searching tasks are particularly tiring for the elderly. As for selective attention, distracters strongly affect the older adults´ attention (Conelly and Hasher, 1993).

Concerning episodic and procedural memory, they diminish with the age (Howard, 1996; Salthouse, 2010). Semantic memory impairment also occurs but it is important for advanced age elderly. Some studies have reported a small deficit for familiar recognizing task and important deficit for memory contents (Hoyer and Rybash, 1992). Besides, according to Reuter-Lorenz & Silverster (2005) aging is more detrimental to the processing components of working memory than to the components responsible for information storage. In one study, the older adults suffered more from increased sentence complexity than did that of young adults on working memory accuracy. Older adults had greater processing costs than maintenance costs compared to young adults. In addition, many reports exist of reliable age differences in working memory tasks that emphasize maintenance plus executive processing operations (Reuter-Lorenz & Silverster, 2005).

Although older adults maintain and can improve knowledge of words and word meanings (cognitively). According to Burke and Shafto (2004), they suffer deficits in the ability to produce the spoken and/or written forms of words and they have problems producing well-known words. Working memory limitations on the production of complex syntactic constructions affect older adults´ language abilities (Kemper et al., 1989). Thus, these limitations have to do with retrieval rather than comprehension. According to Koriat (1998) this phenomenon is related to knowing and remembering that explains feeling of knowing and tip-of-the-tongue phenomenons. Those ones can be described be saying that one knows something but cannot retrieve it, but the problem could be also a difficulty of word recognition. According to Nelson's semantic-sensorial model (Nelson and Reed, 1976; Nelson et al., 1976, Salthouse, 2010), words have an indirect access to meaning, specifically recognize letters process. In contrast, pictures have direct access to meaning. Therefore, problems with both word recognition and retrieval could explain the language deterioration exhibited by elderly people (Ojel-Jaramillo and Cañas, 2006).

As for emotional changes that affect the elderly, according to Charles and Cartensen (2010) older persons don´t need be a part of a large group, although loneliness consequences diminish. Subjective feelings, facial, physiological activity associated with specific emotions is the same in old age as it is in youth, although the social roles change qualitatively and quantitatively and negative emotions become more infrequent because of aging (Charles and Cartesen, 2010).

With these issues in mind, we designed a study to examine some of the factors that might predict telecare use, such as demographic factors (e.g., age, education, and attitudinal variables), cognitive factors related to cognitive deterioration, and anxiety in

the context of technology. We developed an exploratory questionnaire and administered it to a sample of 96 telecare users to probe different aspects of cognitive abilities, motivations, and emotional factors that might affect the use of a specific telecare device (a fixed device and a pendant device). We also administered two versions of the State-Trait Anxiety Inventory to explore state anxiety and trait anxiety of the respondents.

Method

Phase one: Questionnaire development and validation

The purpose of this phase of our study was to develop by means of several sources and validate an instrument to measure constructs related to the cognitive abilities, motivations, and emotional factors that might affect telecare use among the elderly. The questionnaire consisted of items corresponding to the following factors: orientation(2), working memory (1) (they were adapted from (Lobo et al., 1979; Folstein, Folstein and McHugh, 1975; Kane and Kane, 1993; Bermejo, 1993)), prior knowledge (4 items), ease of learning (3), use repercussion (4), memory demand (2) (they were adapted from (Clegg et al., 1988)), attention (1) (it was adapted from (Ballesteros et al., 1992)), Technology Attitude (10) (it was adapted from (General attitude toward computer scale, GAT-C in Korukonda and Finn, (2003)), aesthetics (3) and self-efficacy (3) (Appendix A).

Participants

A sample of 96 telecare users was selected (average age 80.99 years, SD = 5.95) using a variable sampling scheme that included (sex (male, female) and level of education (without education, basic education, medium education, university

education). All participants were from Granada, were native speakers of Spanish (the language of the instrument), and were users of Andalusia Telecare Service (ATS).

Procedure

A researcher visited telecare users at their home. He introduced the goal of the visit and then administered the questionnaire items to the participants. The visit took approximately 40 minutes.

Results

Cronbach´s alpha was 0.46 in the first version of the questionnaire (33 items). . Table 1 mainly shows the results of mean, variance of each item and Cronbach´s alpha of item deletion. According to results there are no items to be deleted, only item 29 could be deleted but it would increase Cronbach´s alpha very weakly (0.02). As for construct validity, factor analysis, the principal components method, and varimax rotation, found ten factors as we proposed (Table 2). These results indicated that the questionnaire was a reliable tool for assesing telecare predictors.

Table 1. Item Analysis

	Mean if deleted	Var. if Deleted	StDv. If Deleted	Itm-Totl Correl.	Alpha if deleted
ITEM1	84.865	74.888	8.654	0.001	0.458
ITEM2	84.917	74.618	8.638	0.042	0.456
ITEM3	84,833	75.410	8.684	-0.162	0.461
ITEM4	85.240	75.453	8.686	-0.087	0.465
ITEM5	82.969	67.093	8.191	0.184	0.433
ITEM6	82.271	69.427	8.332	0.186	0.436
ITEM7	85.719	74.890	8.654	-0.003	0.458
ITEM8	85.135	75.346	8.680	-0.076	0.464
ITEM9	85.500	76.083	8.723	-0.168	0.469
ITEM10	81.979	74.145	8.611	0.044	0.456
ITEM11	84.417	72.264	8.501	-0.004	0.476
ITEM12	83.969	61.218	7.824	0.350	0.388

ITEM13	83.740	62.547	7.909	0.314	0.399
ITEM14	85.563	72.913	8.539	0.105	0.450
ITEM15	84.792	67.623	8.223	0.183	0.434
ITEM16	85.490	75.292	8.677	-0.075	0.472
ITEM17	85.333	75.139	8.668	-0.071	0.474
ITEM18	84.729	70.906	8.421	0.058	0.461
ITEMN19	85.656	74.559	8.635	0.044	0.456
ITEMN20	85.729	75.031	8.662	-0.033	0.459
ITEMN21	85.677	73.864	8.594	0.172	0.451
ITEMN22	84.729	74.177	8.613	-0.020	0.468
ITEMN23	84.146	72.791	8.532	0.105	0.450
ITEMN24	82.240	68.891	8.300	0.297	0.423
ITEMN25	82.719	67.598	8.222	0.292	0.418
ITEMN26	82.979	67.229	8.199	0.230	0.425
ITEMN27	82.531	67.853	8.237	0.295	0.418
ITEMN28	82.354	70.750	8.411	0.178	0.439
ITEMN29	83.906	74.085	8.607	-0.049	0.480
ITEMN30	82.708	68.519	8.278	0.233	0.427
ITEMN31	84.969	70.843	8.417	0.079	0.456
ITEMN32	83.510	70,104	8.373	0.096	0.453
ITEMN33	82.354	73.645	8.582	0.003	0.465

Table 2. Factor Analysis

	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7	Factor 8	Factor 9	Factor 10
ITEM1	0.852	0.014	0.018	0.046	-0.022	0.092	0.016	0.008	0.040	0.009
ITEM2	0.837	-0.097	0.136	0.154	-0.103	0.178	0.018	0.002	0.131	0.011
ITEM3	0.594	-0.446	0.175	0.148	0.007	0.136	0.026	0.007	0.072	0.217
ITEM4	0.413	0.022	0.032	0.145	-0.157	0.243	0.028	0.179	0.461	0.150
ITEM5	0.008	0.080	0.056	0.877	0.008	0.037	0.009	-0.131	0.164	0.019
ITEM6	0.095	0.056	0.051	0.873	-0.019	0.119	0.053	0.097	0.095	0.053
ITEM7	0.019	0.003	-0.102	0.257	-0.147	0.247	0.026	0.372	0.401	0.050
ITEM8	0.323	-0.010	-0.006	0.304	0.099	0.019	0.572	0.054	0.311	0.047
ITEM9	0.256	0.099	-0.046	0.246	-0.383	0.357	0.023	0.192	0.020	0.076
ITEM10	0.017	-0.064	-0.023	0.003	0.068	0.017	0.116	-0.804	0.023	0.075
ITEM11	0.438	0.0024	0.070	0.106	0.083	0.258	0.094	0.124	0.409	0.479
ITEM12	0.049	0.084	-0.143	0.060	0.026	0.752	0.007	-0.053	0.011	0.120
ITEM13	0.123	0.158	-0.058	0.038	0.059	0.766	0.085	0.022	0.105	0.207
ITEM14	0.086	0.456	-0.317	0.042	0.113	0.282	0.323	0.242	0.115	0.061
ITEM15	0.083	0.417	-0.088	0.138	0.047	0.284	0.064	0.145	0.157	0.528
ITEM16	0.015	0.068	-0.003	0.096	-0.782	0.082	0.008	0.032	0.253	0.103
ITEM17	0.119	0.046	0.121	0.061	-0.788	0.000	0.073	0.045	0.108	0.003
ITEM18	0.013	-0.056	0.105	0.190	-0.228	0.044	0.402	-0.405	0.234	0.404

ITEMN19	0.061	0.847	0.072	0.051	-0.010	0.016	0.042	0.175	0.111	0.065
ITEMN20	0.230	0.759	0.196	0.050	-0.154	0.019	0.111	-0.039	0.025	0.026
ITEMN21	0.072	0.841	0.027	0.067	0.0456	0.174	0.021	-0.027	0.010	0.021
ITEMN22	0.215	0.177	0.258	0.112	0.116	0.172	0.023	0.030	0.668	0.067
ITEMN23	0.187	-0.265	-0.071	0.061	0.118	0.078	0.069	-0.136	0.288	0.647
ITEMN24	0.064	-0.098	-0.586	0.008	0.026	0.014	0.013	-0.547	0.241	0.118
ITEMN25	0.058	-0.040	-0.811	0.101	0.034	0.061	0.051	0.017	0.056	0.063
ITEMN26	0.140	-0.035	-0.717	0.047	-0.004	0.070	0.050	0.155	0.126	0.065
ITEMN27	0.218	-0.257	-0.704	0.087	0.133	0.036	0.051	0.057	0.040	0.037
ITEMN28	0.057	-0.142	-0.486	0.080	-0.036	0.038	0.003	-0.077	0.557	0.031
ITEMN29	0.039	0.075	0.039	0.072	0.372	0.170	0.388	-0.003	0.346	0.047
ITEMN30	0.074	0.011	-0,665	0.135	-0.003	0.076	0.153	-0.306	0.105	0.122
ITEMN31	0.095	-0.020	0.001	0.008	-0.026	0.076	0.787	0.114	0.023	0.050
ITEMN32	0.268	-0.040	0.058	0.076	0.200	0.167	0.292	-0.419	0.193	0.349
ITEMN33	0.005	-0.565	-0.297	0.090	-0.156	0.052	0.061	0.149	0.177	0.158
Expl.Var	2.676	3.185	3.129	1.994	1.807	1.859	1.549	1.837	2.008	1.450
Prp.Totl	0.081	0.097	0.095	0.060	0.055	0.056	0.047	0.057	0.061	0.044

Phase two: Telecare predictors assessment

Participants

Participants were the same 96 users of ATS that participated in the questionnaire development and validation phase.

Materials

The questionnaire included items about sociodemographic data, prior computer knowledge, spatial and temporal orientation, ease of learning, self-efficacy, use repercussions, memory demand, aesthetics, working memory, visual attention, and attitude towards technology. In addition, the State-Trait Anxiety Inventory (STAI) was administered to the telecare users. Each participant was asked to think about telecare devices (fixed and pendant) when filling out the questionnaire.

Procedure

We performed a survey to recruit participants for our study. Based on user profiles, ATS personnel contacted 96 users to schedule a home visit to administer the questionnaire. An ATS worker accompanied the researcher on the home visit. During the home visit, the ATS worker introduced the researcher and the reason for the visit. The researcher then administered the STAI and the questionnaire (Appendix A). Finally, both the ATS worker and the researcher thanked the user for his/her collaboration. The visit took ~60 minutes.

Results

Before conducting the main analyses, we ran several correlational analyses to test whether age (65–80; 81+ years), sex (male, female), or level of education (without education, basic education, medium education, university education) had any predictive relation on the results. We found that none of these variables was significantly correlated with the data from the questionnaires.

Participants were grouped according to the average of number of calls they made per year to ATS: 0 calls, 1–5 calls, > 6 calls. For these groups, we performed non-parametric Kruskal-Wallis tests on the questionnaire items and the STAI items. For all of the analyses, results were considered to be statistically significant at $p < 0.05$.

Only three items from the questionnaire and the Anxiety Inventory, STAI-State and STAI-Trait showed significant results in terms of the number of calls made by participants (Table 3). The “vocabulary of interface device” item (Easy of Learning category) showed significant differences in terms of the number of calls made by participants.

Table 3. Significant Items and Anxiety Inventory

ITEMS	H	Df	P
9. Vocabulary of interface Device	5.965003	2	0.0507
14. Physical discomfort during night	10.55936	2	0.0051
33. Attitude to buy technology	6.546549	2	0.0379
STAI-State	16.1263	2	0.0003
STAI-Trait	11.21183	2	0.0037

Note. * $p < .05$

There was a main effect of groups of calls (H = 5.96, df = 2, p = 0.05). An analysis of the simple effects showed that differences between the 0 calls group and the > 6 calls group were significant (U = 368, P = 0.012). Response means of the 0 calls group, 1–5 calls group, and >6 calls group were 1.43, 1.31, and 1.16, respectively.

The rating in the "physical discomfort during night" item (Use repercussions category) varied significantly in terms of number of calls made by participants. There was a main effect of group of calls (H = 10.56, df = 2, p = 0.05). An analysis of the simple effects showed that differences between the 0 calls group and the > 6 calls group were significant (U = 295, p = 0.00), as were the differences between 1–5 calls group and the > 6 calls group (U = 362, p = 0.03) (Figure 3).

The "attitude to buy technology" (Attitude about technology category) item also showed significant differences in terms of the number of calls made by participants. There was a main effect of group of calls (H = 6.55, df = 2, p = 0.04). An analysis of the simple effects showed that differences between the 0 calls group and the 1–5 calls group were significant (U = 413.5 p = 0.05), as were the differences between the 1–5 calls group and the > 6 calls group (U = 376, p = 0.01) (Figure 3).

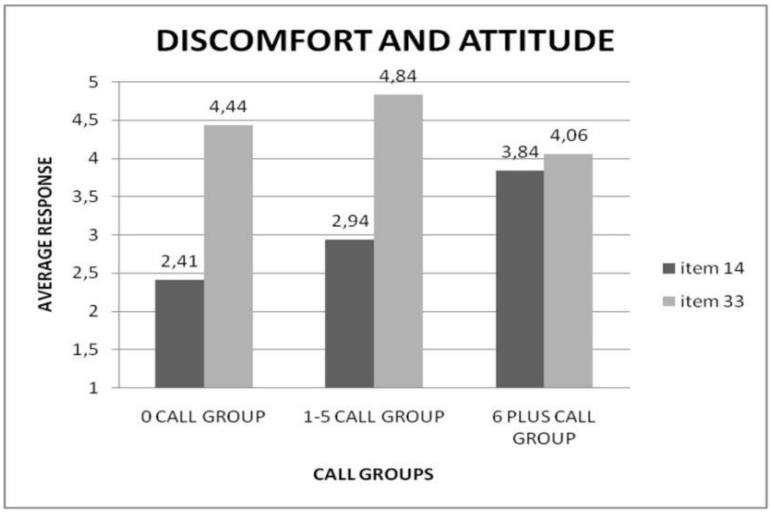

Figure 3. Level Pendant device´s discomfort during night and Attitude to buy technology by group of calls

The STAI-state data showed significant differences in the number of calls made by participants. There was a main effect of group of calls (H = 16.13, df = 2, p = 0.00). An analysis of simple effects showed that differences between the 0 calls group and the > 6 calls group were significant (U = 230, p = 0.00), as were the differences between the 1–5 calls group and the > 6 calls group (U = 288.5, p = 0.03) (Figure 4).

Finally, the STAI-trait also showed significant differences in terms of the number of calls made by participants. There was a main effect of group of calls (H = 11.21, df = 2, p = 0.00). An analysis of simple effects showed that differences between the 0 calls group and the > 6 calls group were significant (U = 287.5, p = 0.00), as were the differences between the 1–5 calls group and the > 6 calls group (U = 309, p = 0.01) (Figure 4).

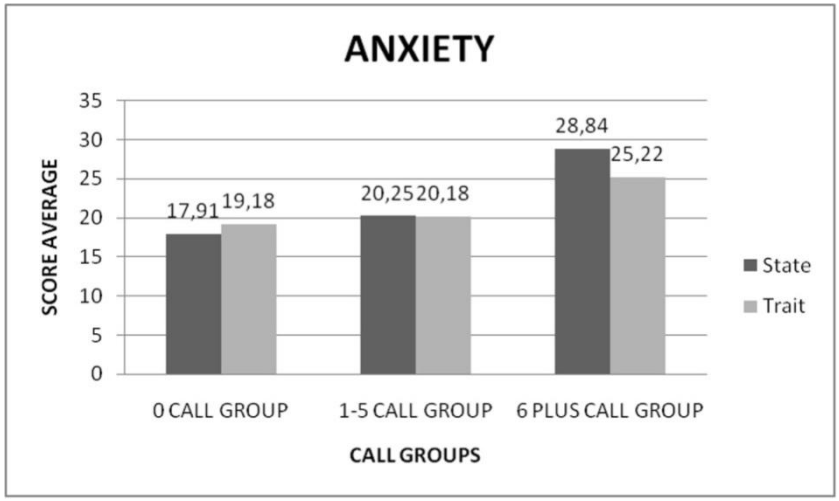

Figure 4. Situational Anxiety and Trait Anxiety by group of calls

Conclusions and General Discussion

According to the questionnaire and STAI results, sociodemographic factors (i.e., age, sex, or level of education) did not appear to have any relationship with telecare use in our study. However, cognitive, emotional, and motivational factors such as ease of learning, use repercussions, attitude about technology, state anxiety, and trait anxiety did predict telecare device use. Cognitive factors such as prior computer knowledge, spatial and temporal orientation, self-efficacy, memory demand, aesthetics, working memory, and visual attention did not predict telecare device use. Therefore, these results show that factors related to elderly cognitive deterioration (i.e., orientation, attention, working memory, and memory demand) were not related to telecare use.

Several trends in telecare use were detected in the results. The telecare device was easier to use for those who called more times than for those who called fewer times because the vocabulary of the telecare interfaces was more suitable to those who called more. We recommend that designers adjust the vocabulary of their telecare devices to

satisfy vocabulary requirements of all of types of telecare users. We also detected that use repercussions were related to emotional factors, in that users who called more frequently felt worse about wearing pendant devices during the night. We can interpret that it is because they use it more than others users. According to Charles and Cartensen (2010), strong emotions remain and physiological, facial and subjective feelings as well, results on Use Repercussions confirm that trend. We recommend that designers assess emotional responses during the night of their pendant telecare device users to try to solve this problem. As for attitude, we found that those who used the device more frequently had a better attitude than those who used it less. We recommended that designers assess such attitudes and incorporate them into the design process.

The STAI revealed the presence of two trends: anxiety towards telecare devices (state anxiety) and the anxiety trait. In the first, users who called more frequently felt more anxiety about telecare devices. In the second, users who called more frequently scored higher in terms of the anxiety trait than users who called less frequently. This finding corroborates the importance of anxiety as a predictor of telecare device use, which was identified previously in qualitative research conducted by Rahimpour et al. (2008).

Finally, we found some differences and similarities between predictors of computer use or computer interest and predictors of telecare device use. In terms of differences, education was a predictor of computer use in the sense that older adults with more education used the computer more (Czaja et al, 2006), whereas education was not a predictor of telecare device use. According to Ellis and Allaire (1999), age is negatively associated with computer interest or computer use, but it is not associated with telecare device use. High levels of computer knowledge are related to high

computer interest, but computer knowledge is not related to telecare device use. According to Laguna and Babcock (1997) Self-efficacy beliefs may be important in explaining computer interest, but they are not important in explaining telecare device use. As for similarities, anxiety and attitude seem to be the most important factors but in a different sense. An anxious user who uses the telecare device more frequently feels more anxiety about telecare devices. As for attitude, all the groups have a positive attitude toward telecare devices, however, in computer use there are users who have a positive attitude and users who have a negative attitude.

In future studies, reasons for rejection of the pendant device should be evaluated in order to improve system use. It would be useful to assess how emotional and motivational factors affect use of the pendant device.

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Appendix A

List of items in the exploratory questionnaire (response codes are shown after each item or group of items).

SOCIODEMOGRAPHIC

Age:

Sex:

Level of Education:

PRIOR KNOWLEDGE

1. Have you ever taken a computer course?

2. Have you ever used a computer?

3. Do you know any computer programs?

4. Have you ever used a cell phone?

(Response code: yes, no)

ORIENTATION

5. What day of the week is today? What is the current date? What is the current month? What is the current season? What is the current year?

6. What is the place where we are? What is the floor where we are? What is the city where we are? What is the province where we are? What is the country where we are?

(Response code: 0 - incorrect, 1 - correct)

EASE OF LEARNING

7. Do you understand the meaning of the button of the wrist device?

8. Do you understand the meaning of each button of the table device?

9. Do you believe that your vocabulary is similar to the fixed device´s vocabulary?

(Response code: yes, no)

SELF-EFFICACY

I feel confident:

10. Using the device.

11. Solving any device problem.

12. Learning to use another device.

(Response code: 1 - not at all, 5 - very much)

USE REPERCUSIONS

I feel discomfort thinking about:

13. Having a shower with the device.

14. Sleeping with the device during the whole night.

15. That a stranger will see me carrying the device.

16. Carrying the device during the whole day.

(Response code: 1 - not at all, 5 - very much)

MEMORY DEMAND

17. Do you need to think for a long time before pressing the device button?.

18. Do you need to read for a long time before pressing the device button?

(Response code: 1 - not at all, 5 - very much)

ESTHETICS

19. Do you see yourself as handsome or pretty with the device?

20. Do you think that the table device is beautiful?

21. Do you think that the wrist device is beautiful?

(Response code: yes, no)

WORKING MEMORY

22. Repeat the last three words that I have told you (my blue jacket).

(Response code: one word = 1, two words = 2, three words = 3)

ATTENTION

23. Read these numbers, 6 8 0, then focus your attention on each one. After that, say them in the reverse order.

(Response code: one number = 1, two numbers = 2, three numbers = 3)

ATTITUDE ABOUT TECHNOLOGY

24. Technology can save people a lot of work.

25. Technology can help solve society´s problems.

26. Technology can increases control over your own life.

27. Technology increases our leisure time.

28. Technology helps to save lives.

29. Men are better with technology than women.

30. Technology helps my life be more independent.

31. I feel threatened by technology.

32. Technology is frustrating.

33. I advise my friends to buy technology.

(Response code: 1 - strongly agree, 5 - strongly disagree)

Biographical notes:

Jose Manuel Ojel-Jaramillo Romero is a European PhD student working as a researcher at the Institute of Innovation for Citizen Welfare. He graduated with a bachelors and a masters degree in Psychology from the University of Granada, and has been for 3 months a Visiting Scholar at the University of Oulu, Finland. José Manuel has extensive experience in the field of Technology and the Elderly, especially in issues related to ergonomics and the dependent elderly. He also has published several scientific papers related to psychological factors that explain the use of telecare devices.

José J. Cañas is BA in Psychology from the University of Granada, Spain, and PhD in Experimental Psychology from the University of South Florida, USA. He is currently Professor of Ergonomics at the University of Granada. His teaching and research activities have been focused on the psychological aspects of the interaction between humans and artefacts. He has conducted research projects on mental models, complex and dynamic problem solving and psychological aspects of interface design for the disabled. He has published several books on Ergonomics, and his research has been published in prestigious journals such as “International Journal of Human-Machine Studies", or "Ergonomics”.

Dr. Antonio Cándido is Professor of Psychology, an expert on Motivation, Emotion and Associative learning and teaches at the University of Granada. Research belongs to the CTS 176 of the Department of Experimental Psychology and Physiology, dedicated to studying human learning. Currently he coordinates the Excellence Research Project on the determinants of risk behavior in driving scenarios. He also participates in various research projects focusing on associative learning and

motivational and emotional aspects of substance addiction. He is a member of the Association for Psychological Science and The Spanish Association of Experimental Psychology

STUDY III

Ojel-Jaramillo, J. M., Cañas, J. J. and Cándido, A. (2011). An Analysis of Telecare Pendant Use: An extension of the Technology Acceptance Model TAM with Anxiety and Depression. Manuscript under review in Journal of Telemedicine and Telecare.

Abstract

Telecare hardware consists of an appliance, wired to the telephone network that has two terminals. One terminal is connected to the network through a cable and this usually has the form of a telephone terminal. The other terminal is wireless and has the form of a pendant. Users interact with the system to get help in urgent situations, to obtain information, to request some service for themselves or their home, or to find out their daily agenda. To do all of this they only have to press a button. However, despite the obvious usefulness of a telecare system, private and public institutions have manifested concern about the erratic use of this system. It has been found that potential users either do not use the system properly or even do not use it at all. For this reason, we have conducted a study aimed at finding an explanation for this erratic use of telecare systems. By using a questionnaire specially designed for the purpose, we have found that Perceived Usefulness, Perceived Ease of Use, State of Anxiety and State of Depression are predictors for telecare pendant use. From a theoretical point of view, our results were consistent with the Technology Acceptance Model (TAM), and we extended this to include emotional factors such as anxiety and depression.

Keywords: Telecare, TAM, Anxiety, Pendant, Depression

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Introduction

The term “home telecare” was originally coined in the 90s to refer to a system of care for people who were at home and needed help in emergency situations. The system provided a readily available service based mostly on existing communication technologies. Thus, from their origin, telecare systems were positioned as key elements to be used as "telealarms" (Valero et al, 2007).

Today telecare systems consist of a device wired to the telephone network (fixed device, see Figure 1), and a wireless terminal inserted into a pendant or bracelet (terminal wireless, see Figure 2). Whenever users are in need of urgent help, for example, they have fallen in the shower, need information, ask service for their home or want to know daily agenda, they press the button (Ojel-Jaramillo and Cañas, 2006).

Figure 1. Fixed Device

Figure 2. Wireless device

Pendant terminals potentially overcome the problem that people might have if they fall where a pull cord is out of reach and therefore they are unable to obtain help by using the fixed device. For that reason, nowadays pendant terminals are reasonably well

established as standard accessories to telecare phones in the United States and Europe (Fisk, 2003). However, despite the intentions and the obvious usefulness of pendant terminals they have not completely replaced pull cords, apparently because the majority of older people do not like wearing pendant devices (Fisk 2003). This explanation has been confirmed in a survey conducted by the present authors with 96 telecare users of the Andalusia Telecare Service provider. Our results show that 98.1% of Andalusia users never or hardly ever wear the telecare pendant (see Figure 3).

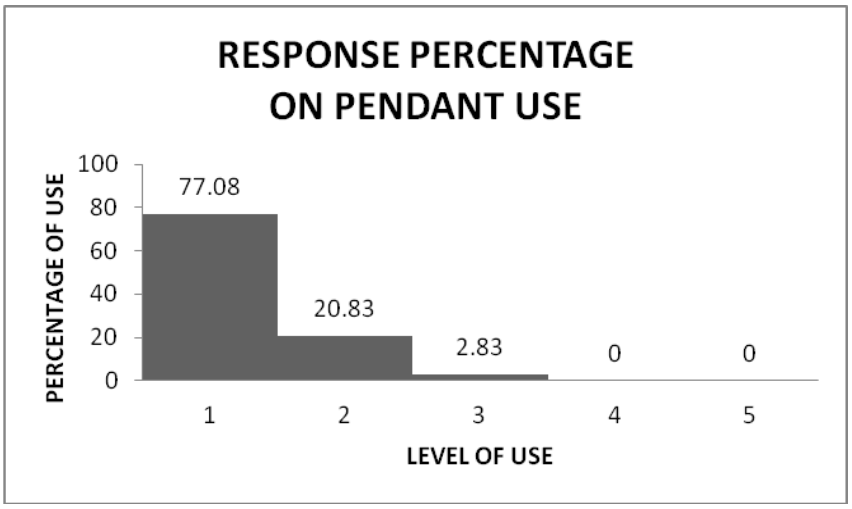

Figure 3. Response percentage on pendant use

To our knowledge, the user acceptance of pendant terminals has not been the focus of extensive research. Therefore, we conducted the present study to find an explanation of this user rejection by exploring possible predictors of pendant use. Our approach was theoretically based on the model known as the Technology Acceptance Model (TAM) of user acceptance of technology (for example Venkatesh and Davis, 1994; Venkatesh and Davis, 2000; Venkatesh, Morris, Davis and Davis, 2003; Sauter,

2008; Holden and Karsh, 2010; Pan and Jordan-Marsh, 2010; Schierz, Schilke and Wirtz, 2010). The model assumes that technology acceptance is explained by the beliefs of the use consequences (Sauter, 2008). Perceived Usefulness and Perceived ease of use are really important factors within TAM model (Davis, 1989). According to Davis (1989) Perceived Usefulness is— "the degree to which a person believes that using a particular system would enhance his of her job performance" p.320, and Perceived Ease of use is—"the degree to which a person believes that using a particular system would be free of effort" p. 320. Other important factors within the TAM model are Attitude to Technology, and Intention of Use (Davis, Bagozzi and Wharshaw, 1989). Malhotra and Galletta (1999) found that Perceived Usefulness, Attitude to Technology, and Intention of Use have a positive influence on Technology Actual Use. Hossain and Prybutok (2008) found a positive influence of Perceived Ease of use on RFID Technology use.

We believe, however, that emotional factors might also be involved in user acceptance of pendant terminals. According to Djamasbi, Strong and Dishaw (2010) affect is an important component of rational decision. There is a framework for our thoughts and behaviour provided by affective states. Therefore, we thought that affective states, would probably influence whether people choose to adopt a particular technology, in this case Pendant Telecare.

Specifically on older adults, epidemiological studies show that anxiety disorders are more spread in elderly people than younger adults (Wolitzky-Taylor et al., 2010). Within older adults, anxiety disorder are more spread in residential environments (Byrne and Pachana, 2010). On the other hand, in people over 65 depression it is one of the most common disorders, affecting up to fifteen percent of the older population (Arnaet, Klooster and Chow, 2007), it is possible to hypothesize that anxiety and

depression could affect technology use by older users. In favour of this hypothesis, the studies conducted by Ellis and Allaire (1999) and Czaja et al. (2006) have shown that computer anxiety is negatively associated with technology use. Rahimpour et al. (2008) conducted several focus group sessions on users' perceptions of a home telecare system and found anxiety probably one of the most important dimensions in regard to a person's use of home telecare.

Therefore, based on the TAM model and the empirical data described above, we conducted our study to explore the predictive values of TAM factors, anxiety, and depression on telecare pendant use. Specifically, we proposed the following hypotheses:

H1: "Perceived Usefulness" of using telecare pendant has a significant positive influence on use of this technology.

H2: "Perceived Ease" of using telecare pendant has a significant positive influence on use of this technology.

H3: Attitude towards using telecare pendant has a significant positive influence on use of this technology.

H4: Intention to use telecare pendant has a positive significant influence on use of this technology.

H5: There will a significant relationship between use of telecare pendant and anxiety.

H6: There will a significant relationship between use of telecare pendant and depression.

To test these hypotheses, we needed a questionnaire that included TAM factors. Therefore, in the first phase of our study we developed and validated such a

questionnaire, and it was given to Telecare users together with anxiety and depression scales in the second phase of the study.

METHOD

Phase one: Questionnaire development and validation

The purpose of this phase of our study was to develop and validate an instrument to measure constructs related to TAM model based on Malhotra and Galletta´s instrument (1999). The questionnaire consisted of items corresponding to these factors: Perceived Usefulness (six items), Perceived Ease of Use (six items), Intention of Use (six items), Attitude toward using (four items), Intention to use (six items) and Actual Use (two items) (see Appendix A).

Participants

A sample of 60 telecare users was selected (average age 78.83 years, SD = 5.22) through a random sampling. All participants were from Granada and native speakers of Spanish, the language of the instrument.

Procedure

A researcher proceeded to visit telecare users at their home. First, he introduced the aim of the visit, and then he proceeded to provide the questionnaire items to the participants. The visit took approximately forty minutes.

Results

Concerning reliability for the first version of the questionnaire (22 items) Cronbach´s alpha was 0.93. Table 1 shows results that did not suggest the deletion of any item, only item 12 would increase Cronbach´s alpha but it was very weak (0.01).

Table 1. Item Analysis

Item	Mean if deleted	Var. if deleted	Itm-Totl Correl.	Alpha if deleted
1	42.92	155.41	0.66	0.92
2	42.87	158.65	0.59	0.92
3	43.07	152.53	0.79	0.91
4	42.97	152.07	0.75	0.92
5	42.83	151.51	0.78	0.91
6	42.89	155.57	0.68	0.92
7	43.18	156.92	0.68	0.92
8	43.38	157.94	0.75	0.92
9	42.80	153.03	0.64	0.92
10	42.82	153.85	0.77	0.92
11	43.35	153.03	0.80	0.91
12	41.15	192.79	-0.70	0.94
13	42.73	158.90	0.49	0.92
14	43.18	150.95	0.83	0.91
15	42.57	152.08	0.71	0.92
16	42.68	149.02	0.82	0.91
17	43.27	151.03	0.78	0.91
18	42.87	155.15	0.72	0.92
19	43.47	169.85	0.19	0.92
20	40.93	171.36	0.03	0.93
21	41.07	166.10	0.27	0.92
22	43.47	158.35	0.66	0.92

As for Construct Validity, Factor Analysis, Principal components method, Varimax rotation, found four factors instead of the five factors proposed for TAM model (see Table 2). Besides in the factor Perceived Ease of user were loaded some items of Perceived Usefulness and Intention of use.

Table 2. Factor Analysis

ITEM	Factor 1	Factor 2	Factor 3	Factor 4
Item1	0.66	0.20	0.33	0.07
Item2	0.13	0.04	0.82	0.18
item3	0.83	0.15	0.28	0.05

Item4	0.77	0.00	0.41	-0.07
Item5	0.52	0.20	0.17	0.35
Item6	0.26	0.03	0.72	0.36
Item7	0.74	-0.10	0.43	-0.20
Item8	0.85	-0.20	0.24	0.09
Item9	0.22	0.13	0.87	0.07
Item10	0.56	0.14	0.66	0.00
Item11	0.88	-0.04	0.16	0.21
Item12	0.39	0.00	0.54	0.38
Item13	0.10	0.01	0.23	0.85
Item14	0.75	-0.05	0.25	0.48
Item15	0.36	0.08	0.54	0.51
Item16	0.45	0.20	0.60	0.42
Item17	0.76	0.05	-0.04	0.39
Item18	0.67	0.08	0.11	0.53
Item19	-0.03	-0.52	0.16	0.53
Item20	0.17	-0.87	-0.11	-0.11
Item21	-0.16	-0.80	-0.21	0.04
Item22	0.58	-0.38	0.13	0.22
Expl.Var	6.95	2.06	4.20	2.70
Prp.Totl	0.32	0.09	0.19	0.12

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax

Phase two: Assessment of factors predicting pendant wearing

The purpose of this second phase of our study was to assess the value of the TAM factors, anxiety, and depression, for predicting pendant wearing.

Material

We used the 22 questionnaire items developed in the previous phase of the study along with some sociodemographic questions, STAI Anxiety Inventory (State-Trait), and IDER test (State-Trait Depression Index).

Participants and Procedure

A different sample of 60 telecare users was selected (average age 77.13 years, SD= 5. 06) through a random sampling. All subjects were from Granada and native speakers of Spanish, the language of the instruments. They were tested at home. Firstly the researchers introduced the aim of the visit to them. Then, participants proceeded to answer the questionnaires. The visit took approximately forty minutes.

Results

First, we performed a cluster analysis on the TAM questionnaire items with the aim of identifying two groups that might show differences in responses to those items. We excluded items 12 and 13 (actual use) from the analysis, since they are the items that we tried to predict. The results showed that only six items showed significant differences (see Figure 4). Group 1 scored lower than Group 2 on all those items. Those items were:

1. Item 5 (It is easy for me to wear the telecare pendant, $F(1, 58) = 36{,}57$, $p < 0.001$

2. Item 9 (I feel less alone wearing the telecare pendant, $F(1, 58) = 68{,}77$, $p < 0.001$

3. Item 10 (Wearing the telecare pendant I get information about Social Services), $F(1, 58) = 8{,}25$, $p < 0.01$.

4. Item 15 (I try to wear the telecare pendant to feel myself less alone).

$F(1, 58) = 57{,}05$, $p < 0.001$.

5. Item 16 (I try to wear the telecare pendant to get information about Social Services). $F(1, 58) = 7{,}07$, $p < 0.001$.

6. Item 18 (I try to wear the telecare pendant to contact telecare call center), F (1, 58) = 4,07, p < 0.05

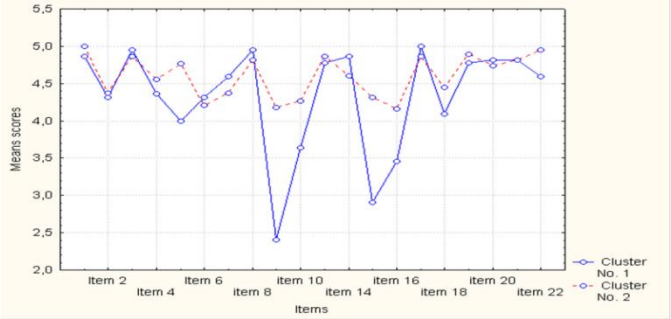

Figure 4. Items that showed differences

Then, we performed two analyses to compare Groups 1 and 2 on items 12 and 13, respectively, to test the relations of the responses to the TAM items that showed significant differences and the actual use of the pendant. Although the differences did not become significant, Group 2 showed a tendency to score higher on item 12 (Mann-Whitney U-Test = 344, p = 0.257), and in item 13 (Mann-Whitney U-Test = 323, p = 0.180) (see Figure 5). Therefore, we could deduce that Group 2 actually used the pendant more often than Group 1, and the reason seemed to be because it is easy to use, they could feel less isolated wearing it, and they could get information from Social Services by using it.

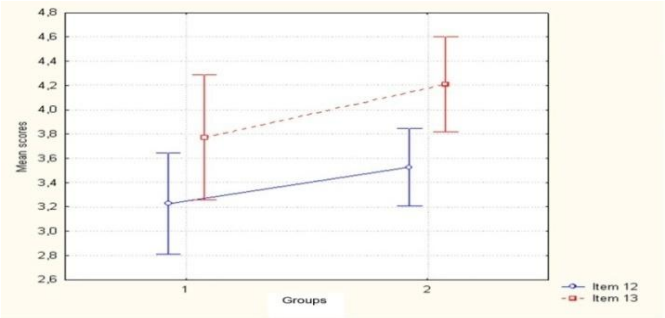

Figure 5. Pendant use items

The same analysis was conducted to compare Groups 1 and 2 on the State-Trait Anxiety and State-Trait Depression questionnaires. The results showed significant differences in State Anxiety (Mann-Whitney U-Test =226, $p<0.01$), and State IDER ($U=287$, $p<0.05$) (See Figure 6 and Figure 7). Participants who belonged to Group 2 were less anxious and less depressed than participants from Group 1.

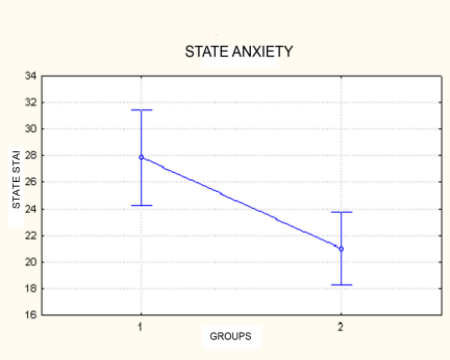

Figure 6. State Anxiety by groups

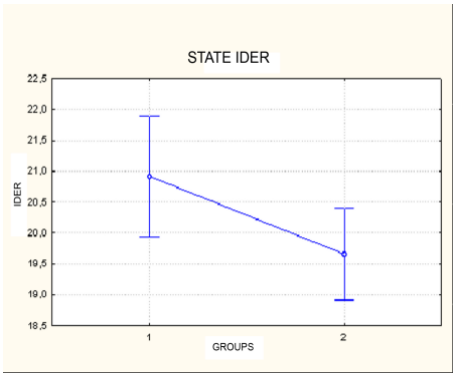

Figure 7. State IDER by groups

General Discussion and Conclusions

The main aim of the present study was to determine whether TAM factors, anxiety, and depression, are predictors of telecare pendant use. First, according to our results on TAM factors, hypotheses H1, H2, and H4 have been confirmed. TAM explains the acceptance of technology by means of the beliefs about the consequences of that usage, Perceived Usefulness, Perceived Ease of Use, Attitude to Technology and Intention of Use (Davis 1989, Holden and Karsh, 2010). In our study, Perceived Usefulness, Perceived Ease of Use and Intention of Use of the telecare pendant have a significant relationship with pendant use. Thus, people who do not wear the device think that it is not useful for their loneliness problems, for getting information from

Social Services, for contacting the telecare call center, and it is not comfortable to wear. Second, the predictive value of anxiety and depression was also confirmed. According to Ellis and Allaire (1999), anxiety is negatively associated with technology use, and Rahimpour et al. (2008) suggested that anxiety is probably one of the most important dimensions in a person's use of home telecare. In our study we have found a significant relationship between anxiety and pendant use; more precisely, people who do not wear the pendant feel a higher state of anxiety. Regarding depression, it is clear that our affective states have influence on both our behaviour and our rational decision making (Djamasbi, Strong and Dishaw, 2010). Supporting that idea, in our study we found that a state of depression has a significant relationship with pendant use. People who do not wear the pendant feel a higher state of depression. Thus, we think that pendant rejection could demonstrate an avoidance response to the pendant due to anxiety and depression produced by the device being seen as useless.

Concerning the limitations of our study, we think that it would be interesting to conduct further research into this topic to explore possible appraisal that occurs during pendant use, in order to assess the possible influence of emotional appraisal in pendant use. In that regard, we think that it would be interesting to use Desmet´s appraisal model (Desmet, 2003) and the Laddering Method to specify possible concerns that influence possible appraisal (Desmet, 2001).

Finally, there are some practical implications of our results. In order to improve the design and acceptance of the telecare pendant, designers could take into account TAM factors such as Perceived Usefulness, Perceived Ease of Use, Intention of Use, as well as State of Anxiety, and State of Depression. To assess those factors, researchers could use our questionnaire, STAI, and the IDER tool.

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APPENDIX A. TAM Scale.

Perceived Ease of Use

1. To learn to use the Telecare pendant is easy for me.
2. I find the Telecare pendant very comfortable
3. It is easy for me to contact Telecare call center through Telecare pendant
4. It is easy for me to become an expert in the Telecare pendant use.
5. It is easy for me to wear the Telecare pendant.
6. To wear the Telecare pendant does not disturb my daily activities.

(Response code: 1- Strongly disagree, 5- Strongly agree)

Perceived Usefulness

7. To wear the Telecare pendant improves my quality of life.
8. I feel more secure wearing the Telecare pendant.
9. I feel less alone wearing the Telecare pendant.
10. Wearing the Telecare pendant I get information about Social Services
11. To wear the Telecare pendant can save lifes

(Response code: 1- Strongly disagree, 5- Strongly agree)

Actual use

12. How much time do you wear the Telecare pendant?

(Response code: Less than an hour – 20 hours or more)

13. How often do you wear the Telecare pendant?

(Response code: 1-Very seldom, 5-Very often)

Intention of use

14. I try to wear the Telecare pendant to help me feel more secure.

15. I try to wear the Telecare pendant to help me feel less alone.

16. I try to wear the Telecare pendant to get information about Social Services.

17. I try to wear the Telecare pendant in an emergency.

18. I try to wear the Telecare pendant to contact Telecare call center.

(Response code: 1-Strongly disagree, 5-Strongly agree).

Attitude toward using

19. The idea of wearing the Telecare pendant to me is …

(Response code: 1-Very useless, 5-Very useful;

20. The idea of wearing the Telecare pendant for me is …

(Response code: 1- Very negative, 5-Vey positive)

21. The idea of wearing the Telecare pendant for me is…

(Response code: 1-Very annoying, 5-Very beneficial)

22. The idea of wearing the Telecare pendant for me is …

(Response code: 1-Very bad, 5-Very good)