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USABILIDAD Y EXPERIENCIA DE USUARIO DE INTERVENCIONES PSICOSOCIALES BASADAS EN LA TIC DIRIGIDAS A PERSONAS MAYORES CON DETERIORO COGNITIVO: EHCOBUTLER Y GRADIOR

Presentada por:

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Dr. José Miguel Toribio Guzmán

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FACULTAD DE PSICOLOGÍA

LÍNEA DE INVESTIGACIÓN: NEUROPSICOLOGÍA

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“En la vejez no nos deben preocupar las arrugas del rostro, sino las del cerebro”.

Santiago Ramón y Cajal

A mis padres,

Jorge Fernando y María Dolores

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Resumen

El incremento a nivel mundial de personas mayores y el riesgo de que desarrollen deterioro cognitivo leve (DCL) y luego demencia, requieren de intervenciones que prevengan la enfermedad y dependencia, o que les permitan permanecer activos a pesar de sus enfermedades o discapacidades. Los tratamientos no farmacológicos se destacan por no tener efectos secundarios y reducir la inversión en medicamentos e institucionalización. Dentro de estos, se encuentran las intervenciones psicosociales a las que se han incorporado las Tecnologías de la Información y la Comunicación (TIC) por promover su accesibilidad, eficacia, rentabilidad e innovación. En ese sentido, ehcoBUTLER y GRADIOR son dos intervenciones psicosociales basadas en las TIC, que se enfrentan al reto de estar adecuadamente adaptados a las personas mayores con deterioro cognitivo. Por lo que en esta tesis se propuso evaluar y explorar su usabilidad y experiencia de usuario (UX) en dicha población.

Se comenzó por realizar una revisión sistemática con el fin de identificar las medidas e instrumentos para evaluar en adultos mayores con DCL o demencia la usabilidad y UX de intervenciones cognitivas basadas en las TIC, así como determinar las características y funciones de estas. De los 10 estudios seleccionados, se encontró que la eficiencia y eficacia fueron las medidas más utilizadas para recopilar datos objetivos de la usabilidad, mientras que los cuestionarios y escalas lo fueron para recabar la UX o datos subjetivos de la usabilidad. La mayoría eran programas de ordenador con ejercicios o juegos serios no solo cognitivos, sino también de otras áreas. Algunos estudios aclaraban que la pantalla era táctil.

Se prosiguió con evaluar la usabilidad y UX de ehcoBUTLER mediante dos estudios. En el primero, se realizó una encuesta a 313 personas (35 usuarios finales, 80 cuidadores informales, 149 cuidadores formales y 49 personal de administración/gestión). Los participantes consideraron ehcoBUTLER principalmente interesante y útil. Además, tenían disposición a pagar por él, pero una tarifa baja o que fuera gratuito para los usuarios. En el segundo estudio, se llevaron a cabo grupos focales a 49 sujetos (13 con DCL, 13 con demencia leve, 12 cuidadores informales y 11 profesionales de la salud). Los participantes mostraron aceptabilidad hacia su apariencia y uso. No obstante, desearían recibir una formación previa, aplicaciones más intuitivas y personalizadas, contenidos *offline*/USB, añadir otras actividades y que fuera de bajo precio o gratuito para los usuarios.

Los estudios anteriores también permitieron recabar información sobre GRADIOR, porque este conforma el módulo cognitivo de ehcoBUTLER. En ambas publicaciones los participantes mostraron aceptabilidad hacia GRADIOR por parecerles útil, pero por ser pensionistas no estaban dispuestas a pagar por él o lo harían si tuviera un costo pequeño. Por otro lado, dieron mayores puntuaciones positivas a otros módulos de ehcoBUTLER.

Para continuar ampliando el conocimiento sobre la usabilidad y UX de GRADIOR, se comparó la percepción de 41 adultos mayores con DCL/demencia leve con la de 41 personas con esquizofrenia, porque estos también son un grupo significativo de usuarios con deterioro cognitivo y problemas de dependencia. Se utilizó el Cuestionario de Experiencia de Usuario para dicho fin. Los participantes valoraron positivamente GRADIOR en su impresión general, usabilidad y UX. Los adultos mayores con DCL/demencia presentaron mayores puntuaciones positivas que las personas con esquizofrenia. Ambos grupos coincidieron en dar puntuaciones más bajas en Controlabilidad.

En conclusión, los resultados indican que ehcoBUTLER y GRADIOR están adecuadamente desarrollados y adaptados a las capacidades, necesidades y preferencias de los usuarios, aunque se necesita mejorar su usabilidad y UX. Aspectos clave para lograrlo son herramientas más intuitivas, multidominio y personalizadas según el tipo de usuario. Además, para implementarlos eficazmente se requiere superar la brecha de inversión. También se necesitan más estudios que incluyan a adultos mayores con DCL/demencia y a partes interesadas en la evaluación de la usabilidad y UX de intervenciones psicosociales basadas en las TIC, para adaptarlas apropiadamente en beneficio de todos. Los hallazgos encontrados pueden contribuir al desarrollo y mejora de otras intervenciones psicosociales basadas en las TIC para personas con deterioro cognitivo. Una adecuada usabilidad y positiva UX en dichas intervenciones promueve su aceptabilidad, adherencia y efectividad del tratamiento.

Palabras clave: DCL, demencia, intervenciones psicosociales, intervenciones cognitivas, TIC, usabilidad, experiencia de usuario

Organización de la Tesis

De acuerdo con el RD 99/2011 del 28 de enero, por el que se regulan las enseñanzas oficiales de doctorado, la Comisión de Doctorado y Postgrado de la Universidad de Salamanca establece la modalidad de Tesis por Compendio de Artículos/Publicaciones como posible formato de presentación de Tesis Doctoral. La presente Tesis Doctoral se presenta bajo esa modalidad.

Las publicaciones incluidas en este compendio son:

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Índice

Capítulo 1: Introducción

1.1 El envejecimiento, deterioro cognitivo leve y demencia

La esperanza de vida ha incrementado a nivel mundial, debido a la mejora en la atención y servicios sanitarios, condiciones de vida (Organización Mundial de la Salud [OMS], 2022) y avances tecnológicos (Woessner et al., 2021). Así como ha aumentado la esperanza de vida, también lo ha hecho la cantidad de adultos mayores (Gauthier et al., 2022). Se estima que las personas de 65 años o más alcancen los 994 millones en el 2030 y los 1.600 millones en el 2050 (Organización de las Naciones Unidas [ONU], 2022). Proveerles cuidados, dado su declive cognitivo y físico, representa un desafío no solo a nivel familiar, sino también gubernamental (C. Bai & Lei, 2020; Bruna Rabassa et al., 2018; Woodhead & Yochim, 2022).

Las personas mayores también pueden presentar aislamiento social y sentimientos de soledad. Su participación y círculo social tienden a reducirse por el fallecimiento de seres queridos, jubilación, disminución de ingresos económicos, vivir solos y tener problemas de salud (C. Bai & Lei, 2020; Courtin & Knapp, 2017). La inactividad acelera el declive en su funciones (OMS, 2020) y percibir dicho declive también les afecta emocionalmente (Franco Justo et al., 2017). Es fundamental promover un envejecimiento saludable y activo mediante actividades sociales, físicas, mentales, culturales, entre otras, que prevengan la enfermedad y dependencia, o que les permitan permanecer activos a pesar de sus enfermedades o discapacidades (Bruna Rabassa et al., 2018; OMS, 2020).

La demencia es una enfermedad neurodegenerativa con diversos síntomas: deterioro de la memoria, desorientación, apatía, ansiedad, agitación, depresión, impulsividad, alucinaciones, delirios, trastornos del sueño, problemas de lenguaje y físicos. Estos son los síntomas comunes entre los diferentes tipos de demencia. A medida que avanza la enfermedad, se compromete significativamente su capacidad para vivir de forma independiente (Gauthier et al., 2022; Gauthier et al., 2021). Mundialmente hay más de 55 millones de personas con demencia, cuya cifra incrementa diariamente y se estipula que en el 2030 sean 78 millones (Gauthier et al., 2021).

El deterioro cognitivo leve (DCL) suele ser una etapa de transición entre el declive cognitivo del envejecimiento normal y la demencia (Petersen et al., 2014). Su prevalencia a nivel mundial oscila entre el 15,56% (W. Bai et al., 2022). En el DCL hay una (la memoria) o más funciones cognitivas afectadas (como el lenguaje, habilidades visoespaciales y funciones ejecutivas). Si bien preservan la independencia en las

activades básicas de la vida diaria, tienen dificultades en las actividades instrumentales (Petersen et al., 2014). También es común que presenten depresión, apatía, irritabilidad, ansiedad, agitación y alteraciones del sueño (Martin & Velayudhan, 2020).

En las fases avanzadas de demencia, las personas pierden su autonomía y requieren una asistencia a tiempo completo de familiares, cuidadores y profesionales. Por lo que los tratamientos que prolonguen el tiempo en estadios tempranos (como el DCL o la demencia leve) resultan beneficiosos (Gauthier et al., 2022). Las intervenciones dirigidas a las personas con DCL o demencia no solo deben estar orientadas a prevenir o retrasar el progreso del deterioro cognitivo, sino también a mejorar los síntomas (Kasper et al., 2020; Livingston et al., 2017).

El tratamiento para el deterioro cognitivo se ha centrado en ser farmacológico (Steinbeisser et al., 2020). De hecho, se ha reportado que la medicación utilizada en personas con demencia sigue siendo la misma desde hace aproximadamente tres décadas (Gauthier et al., 2022). Los riesgos de la polifarmacia (Buckley et al., 2022), así como los efectos secundarios y costos de los medicamentos han impulsado a innovar en las intervenciones dirigidas a esta población (Gauthier et al., 2022).

En ese sentido, los tratamientos no farmacológicos han pasado a un primer plano por no tener efectos secundarios, reducir el consumo y coste de los medicamentos e institucionalización. Además, permiten intervenir de manera personalizada en un formato individual o grupal (Gauthier et al., 2022; Shao et al., 2022; Steinbeisser et al., 2020). Las intervenciones psicosociales forman parte de los tratamientos no farmacológicos y son una de las más utilizadas (Duan et al., 2018; Gauthier et al., 2022).

1.2 Intervenciones psicosociales en personas con deterioro cognitivo leve o demencia

Las intervenciones psicosociales están dirigidas a promover la calidad de vida, mantener/mejorar el funcionamiento y reducir/compensar los retos cognitivos, sociales, emocionales y/o comportamentales de una condición o enfermedad (Charras & Dramé, 2019). Pueden consistir en actividades físicas, cognitivas, recreativas, ocupacionales o terapias como la reminiscencia, Snoezelen, e incluso una combinación de estas (Charras & Dramé, 2019; Stoner et al., 2021). Es decir, las intervenciones pueden ser de un solo dominio o de multidominio. Las de un solo dominio tienen un enfoque específico que contiene uno o más componentes para tratar un único dominio. En cambio, las intervenciones multidominio utilizan una combinación de estrategias y tienen

más de un componente para abordar diferentes dominios (Hafdi et al., 2021; Ozbe et al., 2019).

Tanto las intervenciones multidominio como las de domino único son beneficiosas para las personas con demencia o DCL, siempre que estén adaptadas a la sintomatología y déficits (Charras & Dramé, 2019; Oyebode & Parveen, 2019). Además, su efectivad es mayor si tienen larga duración, varias sesiones y su formato de presentación es acorde a las necesidades y preferencias del individuo (Chow et al., 2021).

Ante la creciente población de personas mayores con deterioro cognitivo y limitaciones por su condición (física y cognitiva) y lugar de residencia (ciudades grandes, zonas rurales o de difícil acceso), las nuevas tecnologías tienen un papel facilitador para que reciban servicios que fomenten su independencia y autonomía, reduciendo a la vez la carga de los cuidadores (Gauthier et al., 2022; Robillard et al., 2018). Las tecnologías hacen posible que se recojan los datos objetivamente durante la intervención, proporcionando retroalimentación en tiempo real a los pacientes o profesionales (Ge et al., 2018). Automatizan actividades y procesos, lo que conlleva una mayor eficacia y reducción de costes. Además, facilitan la comunicación entre los profesionales y pacientes (Ahmad et al., 2022). Otra de sus ventajas es que presentan las intervenciones de manera innovadora y dinámica, promoviendo la motivación del usuario, la implicación en su salud y adherencia al tratamiento (Ahmad et al., 2022; Cho et al., 2022; Cohavi & Levy-Tzedek, 2022).

Por tanto, las tecnologías han sido incluidas en varias intervenciones psicosociales (Pinto-Bruno et al., 2017). Se les suele llamar intervenciones basadas en las Tecnologías de la Información y la Comunicación (TIC), porque son intervenciones que utilizan cualquier tipo de tecnología para mantener o mejorar el área cognitiva, conductual, social y/o emocional (Domenicucci et al., 2022).

1.2.1 Intervenciones psicosociales basadas en las TIC

Entre las TIC utilizadas para realizar intervenciones psicosociales en adultos mayores con trastornos neurocognitivos se encuentra el ordenador, Tablet, teléfonos inteligentes y realidad virtual (Domenicucci et al., 2022). La forma en que promueven la independencia, autonomía y calidad de vida varía de unas a otras (Pinto-Bruno et al., 2017).

Por ejemplo, CIRCA es una aplicación en la que personas con demencia interactúan con fotos, vídeos y música en un ordenador con pantalla táctil, a manera de reminiscencia. Se encontró que mejoró su cognición y la comunicación con sus

cuidadores (Astell et al., 2018). Otro ejemplo, es una tecnología de realidad virtual en la que individuos con DCL o demencia leve realizan tareas relacionadas con los entornos que les presentan. Se reportó que mejoró su bienestar mental y no progresó su deterioro cognitivo (Riaz et al., 2021).

Un estudio integró sensores de movimiento para que adultos mayores con DCL realizaran juegos parecidos al Tetris, que tenían fondos de escenas culturales como tiendas tradicionales y carteles de películas clásicas. Los participantes se mostraron motivados e interesados en hacer constantemente la intervención que promovía su salud cognitiva, física y emocional (Chang et al., 2022).

Por otro lado, DMN es una aplicación para Tablet con lista de tareas, calendario, notas y alarmas para personas con deterioro cognitivo, entre ellas con DCL. La DMN mejoró su satisfacción con la vida y funcionamiento en las actividades cotidianas (Chudoba et al., 2020). De manera similar, ReaCT es una aplicación para Tablet con calendario, notas, recordatorios, listas de verificación y de contactos para personas con demencia, en la que también pueden acceder sus cuidadores. Se consideró que apoyaba la autogestión en la vida diaria de estos pacientes (Oksnebjerg et al., 2019).

Otra investigación se centró en presentar actividades recreativas y de ocio a personas con demencia, mediante una unidad portátil y con altura adaptable compuesta por una pantalla táctil, cámara web, micrófono y altavoces. El sistema permitía hacer videollamadas, correos electrónicos y acceder a aplicaciones gratuitas como juegos, películas, música, videos de ejercicio, redes sociales. Se concluyó que sistemas con múltiples funciones son más beneficiosos y rentables, en comparación con tener aplicaciones por separado que requieren que se configuren y aprendan a usar cada una de ellas (Lazar et al., 2016). De hecho, adultos mayores con o sin deterioro cognitivo han mostrado interés en tecnologías que promuevan su cognición, comunicación con el círculo social, ocio y salud en general (LaMonica et al., 2017; Van Dijk, 2020). EhcoBUTLER es una TIC que va en esa línea.

1.2.1.1 EchoBUTLER: plataforma TIC de estimulación psicosocial

EhcoBUTLER es un proyecto financiado por la Unión Europea (Programa Horizonte 2020, acuerdo de subvención: 643566). Consiste en una plataforma TIC en desarrollo compuesta por cinco módulos. Cada módulo se centra en un área distinta (social, emocional, cognitiva, estilo de vida saludable, tiempo libre y ocio) y tiene diferentes aplicaciones correspondientes. Su finalidad es promover un envejecimiento saludable y activo, especialmente a nivel social en personas mayores con DCL.

EhcoBUTLER tiene un diseño ergonómico heredado de Butler, una plataforma con actividades recreativas y terapéuticas para adultos mayores con poco o ningún conocimiento informático, que tuvo una adecuada usabilidad y aceptabilidad en dicha población (Botella et al., 2009; Castilla et al., 2013). EhcoBUTLER se encuentra adaptado para usarlo en ordenador y en Tablet, especialmente en este último dispositivo por su portabilidad.

Otro elemento de ehcoBUTLER es su sistema lineal de navegación, que permite utilizar el sistema paso a paso (Castilla et al., 2016). El usuario selecciona en el menú principal la aplicación que desea usar y un avatar de aspecto humano le explica, mediante audio y texto, dónde se encuentra y qué puede hacer a continuación. Además, los botones tienen colores según la acción que permiten: el verde es para continuar una tarea, el rojo es para detenerla, y el naranja implica acciones secundarias (Castilla et al., 2020).

Los cuidadores informales, como familiares y amigos, pueden acceder a ehcoBUTLER para interactuar con la persona mayor e informarse sobre qué actividades está realizando en la plataforma. Además, profesionales de la salud se encargan de gestionar los módulos de ehcoBUTLER y a través de este pueden comunicarse con otros profesionales y familiares del adulto mayor. Adicionalmente, organizaciones públicas o privadas pueden colaborar con la financiación de la plataforma o facilitar su acceso.

Por otro lado, a pesar de la variedad de TIC que han sido incorporadas en intervenciones psicosociales, la mayoría de estas se han centrado en el dominio cognitivo. Por lo que también se les suele llamar intervenciones cognitivas basadas en las TIC (Pinto-Bruno et al., 2017). El amplio interés en estas se atribuye a que se dirigen específicamente a prevenir y retrasar el progreso del deterioro cognitivo, promoviendo con ello el beneficio en otros dominios como el físico (He et al., 2019; Mancioppi et al., 2019).

1.2.2 Intervenciones cognitivas basadas en las TIC

Las intervenciones cognitivas pueden agruparse en tres tipos principalmente: estimulación, entrenamiento y rehabilitación cognitiva (Irazoki et al., 2020). La estimulación cognitiva consiste en ejercicios para mantener las funciones cognitivas activas en general. Se realizan de manera individual o grupal, en personas con y sin deterioro cognitivo (Rosell, 2018; Woods et al., 2023). El entrenamiento cognitivo se dirige a mejorar funciones cognitivas específicas mediante ejercicios estructurados y guiados, de forma individual o grupal, en sujetos con y sin deterioro cognitivo (Kallio et al., 2017; Ledreux et al., 2019). En cambio, la rehabilitación cognitiva tiene un enfoque individual, que radica en mejorar habilidades cognitivas ligadas al funcionamiento de la

vida diaria en personas con deterioro cognitivo (Germain et al., 2019; Oltra-Cucarella et al., 2018).

Las intervenciones cognitivas se han presentado tradicionalmente en formato de lápiz y papel. La innovación tecnológica ha llevado a incorporarlas principalmente en TIC como el ordenador, Tablet y móvil por ser dispositivos portátiles, accesibles y rentables (Al Mahmud et al., 2019; García-Casal et al., 2017; Ten Brinke et al., 2017). Si bien las intervenciones cognitivas basadas en las TIC están diseñadas para que su uso sea agradable y divertido, también se han presentado en formato de juegos serios. Es decir, que integran los aspectos lúdicos de los videojuegos, pero tienen el objetivo de mantener o mejorar las funciones cognitivas; diferenciándose así de los juegos que solo se dirigen a entretener (Abd-Alrazaq et al., 2022; Manera et al., 2017).

En cuanto a la efectividad y en comparación con las intervenciones cognitivas de formato tradicional, las realizadas con tecnologías han tenido resultados superiores en mejorar la cognición, depresión y calidad de vida de personas con demencia o DCL (García-Casal et al., 2017; Ge et al., 2018; Hagovská et al., 2017). Estos mejores resultados se atribuyen a la usabilidad y experiencia motivante de la interacción con la TIC (Ge et al., 2018; Hagovská et al., 2017). Sin embargo, se requiere continuar investigando sobre la retención a largo plazo de los efectos del tratamiento reportados (García-Casal et al., 2017).

Entre los diferentes programas que existen de intervención cognitiva para personas mayores con DCL o demencia se encuentran CogniPlus, COGPACK, Brainer, Captain's Log, Cogmed, CogniFit, FesKits, NeuronUp, SOCIABLE y GRADIOR. Estos programas suelen abarcar diferentes dominios cognitivos y también se dirigen a otros trastornos que causan deterioro cognitivo (Irazoki et al., 2020). Uno de estos programas que apuesta por seguir mejorando con nuevas versiones es GRADIOR.

1.2.2.1 GRADIOR: programa computarizado de estimulación, entrenamiento y rehabilitación cognitiva

La Fundación INTRAS lanzó la primera versión de GRADIOR en 1997 (Franco-Martín et al., 2020), convirtiéndose en pionero en España. GRADIOR es un software para la evaluación, estimulación, entrenamiento y rehabilitación de las siguientes funciones cognitivas: orientación, memoria, atención, lenguaje, percepción, cálculo, razonamiento, atención y función ejecutiva. Cada modalidad (ej. función ejecutiva), tiene submodalidades (ej. inhibición visual, inhibición auditiva, etc.) y cada una de estas cuenta con diferentes niveles de dificultad, por lo que el profesional puede crear

tratamientos ajustados a las características clínicas y desempeño de cada usuario (Franco-Martín et al., 2020; Toribio-Guzmán et al., 2018).

GRADIOR se dirige a personas con deterioro cognitivo de diferente etiología (demencias, enfermedad mental, traumatismos craneoencefálicos, entre otros) y también a personas sanas. El programa proporciona instrucciones visuales y auditivas, así como retroalimentación en cada ejercicio sobre si se ha realizado correctamente o no. Además, los profesionales ayudan a los usuarios a familiarizarse con el sistema en las primeras sesiones (Franco-Martín et al., 2020; Toribio-Guzmán et al., 2018).

Desde las primeras versiones de GRADIOR, se han llevado a cabo estudios para evaluar su usabilidad y aceptabilidad en población mayor con o sin deterioro cognitivo, incluso formando parte de otro programa que contenía ejercicios físicos. Los resultados obtenidos fueron positivos, planteándose mejoras en el programa (Franco-Martín & Bueno-Aguado, 2002; Góngora Alonso, Toribio Guzmán, et al., 2020; González-Palau et al., 2013). Aunque la investigación se ha centrado en adultos mayores (Toribio-Guzmán et al., 2018), también se han realizado estudios en personas con esquizofrenia; quienes mostraron una adecuada aceptabilidad hacia GRADIOR, pero a su vez sugirieron mejorarlo (Fumero-Vargas, 2015; Góngora Alonso, Fumero Vargas, et al., 2020).

Los resultados de las investigaciones anteriores impulsaron el desarrollo de la versión 4.5 de GRADIOR, en la que se incorporaron imágenes reales en la mayoría de los ejercicios, en vez de dibujos, para hacerlos más cercanos a la realidad de los usuarios. También se agregaron nuevos ejercicios y un logo renovado. En cuanto a la interfaz del terapeuta, esta se optimizó para que su gestión fuera más intuitiva. Además, GRADIOR puede utilizarse en ordenador con pantalla táctil lo que promueve una interacción directa y fácil, aunque también puede usarse con el ratón (Irazoki et al., 2021; Toribio-Guzmán et al., 2018).

GRADIOR también forma parte de ehcoBUTLER en su módulo cognitivo. Sin embargo, tanto GRADIOR 4.5 (al estar ya desarrollado) como ehcoBUTLER (en desarrollo) se enfrentan al reto de estar adecuadamente adaptados a las personas mayores, dada la brecha digital. Los adultos mayores no crecieron en la era digital, no son nativos digitales como los jóvenes. Por lo que suelen carecer de conocimientos, habilidades, acceso y uso de aplicaciones, conexiones y dispositivos digitales (Van Dijk, 2020). Claramente, los desafíos a los que se enfrentan incrementan si tienen deterioro cognitivo (Castilla et al., 2020).

Además, las tecnologías con diseños inadecuados que no se ajustan a las preferencias ni a las capacidades sensoriales, cognitivas y físicas de los usuarios, los desaniman a utilizarlas o a que las usen inadecuadamente, por lo que no se logran los objetivos de la intervención (Arthanat et al., 2019; Castilla et al., 2020; Cho et al., 2022; Wang et al., 2019). Involucrar a los usuarios en el proceso de desarrollo hace posible que la tecnología sea adoptada; el diseño centrado en el humano es uno de los más usados para lograrlo (Vial et al., 2022).

1.3 Diseño centrado en el humano: usabilidad, experiencia de usuario y aceptabilidad/aceptación

El diseño centrado en el humano se enfoca en desarrollar sistemas interactivos usables, productivos, beneficiosos y accesibles, a través de aplicar conocimientos y técnicas de la usabilidad, entre otros. La usabilidad es el nivel en el que los usuarios pueden utilizar con eficacia, eficiencia y satisfacción un sistema, servicio o producto. La eficacia consiste en la exactitud y completitud con la que los usuarios logran determinados objetivos. La eficiencia son los recursos que emplean (esfuerzo, tiempo, materiales y costos) para obtener los objetivos. En cambio, la satisfacción es el grado en que se cumplen sus expectativas y necesidades; lo cual también forma parte de la experiencia de usuario, frecuentemente abreviada como UX (*User Experience*) (International Organization for Standardization [ISO], 2019).

La UX consiste en las percepciones, creencias, emociones, preferencias y comportamientos de los usuarios antes, durante o después de utilizar un sistema, servicio o producto. Por lo que la UX no solo resulta de la presentación, funcionalidad y asistencia del sistema, producto o servicio, sino también del contexto de uso y de las experiencias previas, habilidades y capacidades del usuario (ISO, 2019). Como puede observarse, la usabilidad y UX son términos amplios y existe un debate científico sobre su solapamiento (Sauer et al., 2020).

La aceptabilidad/aceptación es un término relacionado con la usabilidad y UX (Alexandre et al., 2018). La aceptabilidad consiste en la intención de usar una tecnología (a priori), mientras que la aceptación se refiere a su uso real (a posteriori) (Alexandre et al., 2021). En donde influye la percepción sobre su utilidad, rendimiento, fiabilidad, facilidad y apoyo para usarla, etc. (Ammenwerth, 2019). Evaluar la aceptabilidad y aceptación de una tecnología permite adaptarla e incrementar la probabilidad de que sea utilizada y, por ende, exitosa (Eicher et al., 2017; Hirani et al., 2017). Para evaluar la aceptabilidad/aceptación frecuentemente se utilizan encuestas y cuestionarios (Ammenwerth, 2019; Eicher et al., 2017; Hirani et al., 2017).

En cuanto a la evaluación de la usabilidad, existen diferentes métodos y técnicas como cuestionarios, grupos focales, entrevistas, test heurístico, test de usuario, así como una combinación de estos y otros (Maramba et al., 2019; Toribio-Guzmán et al., 2017). Esta evaluación puede realizarse durante todas las fases de desarrollo para identificar y corregir problemas, garantizando que la interacción con el sistema sea eficiente, eficaz y satisfactoria (Toribio-Guzmán et al., 2017). También existen diversos métodos para evaluar la UX tales como entrevistas, escalas, cuestionarios, observación, medición fisiológica, etc. (Hussain et al., 2018; Lemon et al., 2020). Estas evaluaciones hacen posible clarificar las necesidades de los usuarios y crear interfaces que les resulten motivantes e interesantes (Lemon et al., 2020).

Por tanto, el diseño centrado en el humano permite obtener conocimiento sobre las necesidades y preferencias de los usuarios, transformando ese conocimiento en el diseño óptimo de un sistema, servicio o producto (Vial et al., 2022). En el caso de las adultos mayores, los métodos y técnicas para recopilar los datos se deben elegir tomando en cuenta su declive asociado a la edad y si además tienen deterioro cognitivo (Mannheim et al., 2019).

1.3.1 Evaluación de la usabilidad, UX y aceptabilidad/aceptación en personas mayores con DCL/demencia

En diversos estudios se ha obtenido información de familiares, cuidadores o profesionales para diseñar tecnologías dirigidas a personas mayores, debido a la complejidad de incluir a estas por su deterioro cognitivo y falta de conocimientos informáticos (Dosso et al., 2022; Mannheim et al., 2019; Siriaraya & Ang, 2017). Sin embargo, se ha encontrado que los grupos focales, entrevistas, observaciones, cuestionarios y test de usuario son útiles para incluir a personas mayores con deterioro cognitivo en el desarrollo de tecnologías (Rai et al., 2020).

Los grupos focales son uno de los más utilizados (Holthe et al., 2018). Permiten obtener y comprender diferentes perspectivas y experiencias a detalle, al contar con un facilitador que promueve la participación de todos los miembros del grupo y que la discusión se centre en el tema principal (Setia, 2017). Un estudio que utilizó esta técnica en personas con demencia identificó aspectos clave para el diseño de un entorno virtual: que tuviera fácil acceso y uso, con tareas específicas por cumplir, cuyo contenido fuera realista y apropiado para su edad (Siriaraya & Ang, 2017). En otra investigación con grupos focales de personas con demencia, se obtuvo información sobre sus necesidades emocionales y requisitos para desarrollar una plataforma que supervisara su estado emocional en casa, evocara emociones positivas y ayudara a regular las

negativas (Mulvenna et al., 2017). En otro estudio, mediante grupos focales de adultos mayores con DCL, se identificó que les gustaron los juegos cognitivos con colores llamativos. Además, se consideraron capaces de seguir las instrucciones y manejar la Tablet (Scase et al., 2018).

Los cuestionarios y encuestas son también unas de las más utilizadas para evaluar la usabilidad y aceptación en personas con deterioro cognitivo. Permiten plantear preguntas y categorías de respuesta sencillas, acordes a sus capacidades cognitivas (Cruz et al., 2020). En una investigación se aplicó el Cuestionario de Experiencia del Usuario (*User Experience Questionnaire*, comúnmente abreviado como UEQ) a pacientes con DCL, quienes consideraron un robot asistencial en casa como atractivo, beneficioso y fácil de familiarizarse (Gerłowska et al., 2018). En otro estudio, una encuesta aplicada a personas con demencia sobre un robot, arrojó como resultado que lo consideraron una fuente de compañía e interacción (Dosso et al., 2022).

Sin embargo, se necesitan más investigaciones que incluyan a personas con DCL o demencia en el desarrollo y adaptación de tecnologías que, mediante actividades significativas y placenteras, promuevan su salud. Conocer sus características, necesidades y preferencias permitirá mejorar la usabilidad, experiencia de usuario y aceptabilidad/aceptación de dichas tecnologías (Hitch et al., 2017; Holthe et al., 2018; Meiland et al., 2017; Rai et al., 2020; Wargnier et al., 2018).

También es importante incluir en los estudios a los familiares, cuidadores, profesionales y otras partes interesadas. Esto garantizará que se comprendan en qué coinciden y en qué no coinciden sus perspectivas y las de las personas con deterioro cognitivo, identificando barreras y ajustes por realizar para que todos se beneficien con las intervenciones tecnológicas (Dosso et al., 2022; Menghi et al., 2019; Mulvenna et al., 2017).

Capítulo 2: Justificación

A nivel mundial existe un aumento en el número de personas mayores y se estima que continúe incrementando (ONU, 2022). Su declive y cambios cognitivos, físicos, emocionales y sociales asociados a la edad implican servicios sanitarios. La demanda de estos servicios aumenta si desarrollan deterioro cognitivo o demencia, impactando significativamente en la familia y sociedad (C. Bai & Lei, 2020; Bruna Rabassa et al., 2018; Woodhead & Yochim, 2022). Anteriormente, los tratamientos dirigidos a las personas con deterioro cognitivo se centraban en ser farmacológicos. Sus efectos secundarios y costos económicos impulsaron a implementar los tratamientos no farmacológicos, como alternativas o para aplicarlos conjuntamente, con el fin de ralentizar el deterioro cognitivo y mitigar sus diversos síntomas (Gauthier et al., 2022; Kasper et al., 2020; Steinbeisser et al., 2020). Las intervenciones psicosociales son tratamientos no farmacológicos ampliamente utilizados, cuya efectividad ha sido demostrada (Charras & Dramé, 2019; Chow et al., 2021; Duan et al., 2018; Gauthier et al., 2022; Oyebode & Parveen, 2019).

Se han incorporado las TIC en las intervenciones psicosociales por sus ventajas de aumentar la eficacia y accesibilidad, reducir costes, presentar la intervención de manera más flexible, entretenida y personalizada, etc. (Ahmad et al., 2022; Cho et al., 2022; Cohavi & Levy-Tzedek, 2022; Gauthier et al., 2022; Ge et al., 2018; Robillard et al., 2018). Sin embargo, las intervenciones psicosociales basadas en la TIC para adultos mayores con DCL o demencia se enfrentan al desafío de la brecha digital y a las dificultadas asociadas al deterioro cognitivo (Castilla et al., 2020; Van Dijk, 2020). Si sus diseños no se ajustan a sus capacidades, necesidades ni preferencias, entonces no se utilizarán ni se lograrán los objetivos deseados (Arthanat et al., 2019; Castilla et al., 2020; Cho et al., 2022; Wang et al., 2019).

Partiendo del marco anterior y teniendo el caso de ehcoBUTLER (en desarrollo) y GRADIOR 4.5 (ya desarrollado) surgió la pregunta de investigación sobre si estas intervenciones psicosociales basadas en las TIC están adecuadamente adaptadas a su población objetivo: ehcoBUTLER a adultos mayores con DCL, mientras que GRADIOR a personas mayores con DCL o demencia leve. De hecho, se decidió ampliar la evaluación de ehcoBUTLER desde la perspectiva de individuos con demencia leve. El enfoque en estas poblaciones se debió a la necesidad de disponer de intervenciones que prolonguen el tiempo en fases tempranas, debido a que en las fases avanzadas de la demencia las funciones cognitivas están significativamente deterioradas, hay una pérdida de la autonomía, marcha y movilidad (Gauthier et al., 2022).

Existe evidencia de que el diseño centrado en el humano permite desarrollar tecnologías con diseños óptimos, a través de involucrar a los usuarios en dicho proceso (ISO, 2019; Vial et al., 2022). Sin embargo, la complejidad de incluir a personas mayores con deterioro cognitivo y con falta o pocos conocimientos informáticos, ha generado que la mayoría de estudios incluyan en su lugar a familiares, cuidadores o profesionales (Dosso et al., 2022; Mannheim et al., 2019; Siriaraya & Ang, 2017). Por lo que surgió la necesidad de realizar una revisión sistemática para identificar medidas e instrumentos para evaluar la UX y usabilidad de intervenciones cognitivas basadas en las TIC, así como las características de estas, en estudios que incluyeron a personas con DCL o demencia. La revisión se centró en las intervenciones psicosociales dirigidas al dominio cognitivo (estimulación, entrenamiento y rehabilitación cognitiva) por ser de las más utilizadas (Irazoki et al., 2020; Pinto-Bruno et al., 2017) y, por tanto, que permitieran recabar mayor información.

Para explorar la usabilidad, UX y aceptabilidad de GRADIOR y ehcoBUTLER en personas con DCL o demencia leve, se eligió utilizar principalmente la metodología cualitativa, porque hace posible obtener las percepciones, opiniones, sensaciones y actitudes, comprendiendo las razones subyacentes (Das, 2022). Si bien el enfoque de la investigación se centró en incluir a las personas mayores con DCL o demencia leve, también se consideró importante incluir a cuidadores, profesionales y partes interesadas. Como se comentó en la introducción, comparar sus aportaciones enriquece la identificación de barreras y mejoras por realizar para beneficiar a todos (Dosso et al., 2022; Menghi et al., 2019; Mulvenna et al., 2017).

En resumen, es un hecho que se requieren más estudios en donde los adultos mayores con DCL o demencia tengan un papel activo en el desarrollo y adaptación de tecnologías que promuevan su salud (Hitch et al., 2017; Holthe et al., 2018; Meiland et al., 2017; Rai et al., 2020; Wargnier et al., 2018). Esto indica la oportunidad de la presente investigación para contribuir a la evaluación, desarrollo y mejora no solo de ehcoBUTLER y GRADIOR, sino que los hallazgos se transfieran a otras TIC de intervención psicosocial para que tengan una adecuada usabilidad, UX y aceptabilidad/aceptación en estas poblaciones. Aspectos que favorecen la implementación, adherencia y efectividad del tratamiento (Brade et al., 2017; Irazoki et al., 2021; Lau et al., 2019; Meiland et al., 2017).

Sin embargo, tomando en cuenta que GRADIOR y programas similares no solo se dirigen a personas con DCL o demencia, sino también a otros trastornos que causan deterioro cognitivo (Irazoki et al., 2020), surgió la necesidad de examinar las impresiones

de personas con esquizofrenia acerca de GRADIOR y compararlas con las de los adultos mayores con DCL/demencia. Se eligió a las personas con esquizofrenia, porque también son un grupo grande de usuarios de GRADIOR, con alteraciones cognitivas que los discapacitan (Harvey et al., 2019) y que también comparten la característica de que no suelen utilizar tecnologías modernas (Góngora Alonso, Fumero Vargas, et al., 2020; Lindberg et al., 2019). Además, se han realizado estudios sobre su nivel de satisfacción con GRADIOR y su usabilidad (Fumero-Vargas, 2015; Góngora Alonso, Fumero Vargas, et al., 2020). No obstante, ningún estudio ha comparado las impresiones sobre GRADIOR de ambos grupos. Por lo que se vio la oportunidad de contribuir a identificar si un mismo programa puede ajustarse a las necesidades y preferencias de usuarios con características similares, pero de etiologías diferentes.

Cabe resaltar que la presente investigación, enfocada en la usabilidad y UX, formó parte de un ensayo clínico que evaluó la efectividad de GRADIOR y ehcoBUTLER en personas con demencia leve y DCL (Vanova et al., 2018). Por las razones expuestas en el párrafo anterior, se decidió realizar una ampliación del ensayo clínico justamente para evaluar la UX y la usabilidad de GRADIOR en personas con esquizofrenia.

Por otro lado, en la quinta edición del Manual Diagnóstico y Estadístico de los Trastornos Mentales (DSM-5), el término demencia pasó a ser sustituido por trastorno neurocognitivo mayor, mientras que el DCL por trastorno neurocognitivo menor (Stokin et al., 2015). En la presente tesis se decidió emplear los términos demencia y DCL, por ser frecuentemente utilizados: desde antes del siglo XVIII en el caso de la demencia (Assal, 2019) y desde 1999 el DCL (Petersen et al., 1999).

Capítulo 3: Objetivos e Hipótesis

3.1 Objetivos

3.1.1 Objetivo general

Evaluar y explorar la usabilidad y UX de ehcoBUTLER y GRADIOR como intervenciones psicosociales basadas en las TIC en adultos mayores con DCL, personas con demencia leve y partes interesadas.

3.1.2 Objetivos específicos

1. Identificar estudios de usabilidad y UX de intervenciones psicosociales basadas en las TIC enfocadas en la estimulación, entrenamiento y rehabilitación cognitiva de adultos mayores con DCL/demencia.

1.1. Analizar las medidas e instrumentos para evaluar en adultos mayores con DCL/demencia la usabilidad y UX de intervenciones cognitivas basadas en las TIC.

1.2. Determinar las características y funciones de las intervenciones cognitivas basadas en las TIC dirigidas a personas mayores con DCL/demencia.

2. Evaluar la usabilidad y UX de ehcoBUTLER en adultos mayores con DCL, personas con demencia leve, cuidadores, profesionales y personal de administración/gestión.

2.1. Conocer las similitudes y diferencias entre las percepciones de los participantes sobre la usabilidad y UX de ehcoBUTLER.

2.2. Identificar las potenciales fortalezas de ehcoBUTLER en cuanto a su usabilidad y UX.

2.3. Determinar posibles aspectos por mejorar en la usabilidad y UX de ehcoBUTLER.

3. Evaluar la usabilidad y UX de GRADIOR 4.5 en adultos mayores con DCL, personas con demencia leve, cuidadores, profesionales y personal de administración/gestión.

3.1. Conocer las semejanzas y discrepancias en las percepciones de los participantes sobre la usabilidad y UX de GRADIOR.

3.1.1. Ampliar el conocimiento sobre la usabilidad y UX de GRADIOR desde la perspectiva de otro grupo significativo de usuarios: personas con esquizofrenia.

3.2. Determinar las fortalezas de GRADIOR en cuanto a su usabilidad y UX.

3.3. Identificar aspectos por mejorar en la usabilidad y UX de GRADIOR.

3.2 Hipótesis

Como es sabido, en la investigación cualitativa se puede prescindir de plantear hipótesis, ya que no se hacen suposiciones previas, sino que se parte de indagar la percepción de las personas para describir, explicar y comprender el tema que se está investigando (Bedregal et al., 2017; Romero & Reyes, 2019). No obstante, a continuación, se plantearán hipótesis generales como una manera de elucidar los posibles hallazgos en relación con los objetivos mencionados.

1. Las medidas e instrumentos para evaluar en adultos mayores con DCL/demencia la usabilidad y UX de intervenciones cognitivas basadas en las TIC tendrían características similares.

2. Las intervenciones psicosociales basadas en la TIC enfocadas en la estimulación, entrenamiento y rehabilitación cognitiva presentarían funciones y características semejantes.

3. La valoración de la usabilidad y UX de ehcoBUTLER sería positiva por parte de las personas mayores con DCL, demencia leve, cuidadores, profesionales y personal de administración/gestión.

4. Las percepciones de los adultos mayores con DCL, demencia leve, cuidadores, profesionales y personal de administración/gestión se complementarían identificando fortalezas en la usabilidad y UX de ehcoBUTLER.

5. Las impresiones de las personas mayores con DCL, demencia leve, cuidadores, profesionales y personal de administración/gestión se complementarían determinando aspectos por mejorar en la usabilidad y UX de ehcoBUTLER.

6. La valoración de la usabilidad y UX de GRADIOR 4.5 sería positiva para las personas mayores con DCL, demencia leve, cuidadores, profesionales, personal de administración/gestión e individuos con esquizofrenia.

7. Las percepciones de los adultos mayores con DCL, demencia leve, cuidadores, profesionales, personal de administración/gestión y personas con esquizofrenia se complementarían identificando fortalezas en la usabilidad y UX de GRADIOR 4.5.

8. Las impresiones de las personas mayores con DCL, demencia leve, cuidadores, profesionales, personal de administración/gestión e individuos con esquizofrenia se complementarían determinando aspectos por mejorar en la usabilidad y UX de GRADIOR 4.5.

Capítulo 4: Metodología

En cada artículo de la presente Tesis Doctoral por compendio de publicaciones se utilizó una metodología específica, que se describirá a continuación. Además, en cada artículo se puede consultar en detalle la metodología empleada correspondiente.

4.1 Publicación I

No se encontró ninguna revisión sistemática en PROSPERO (el Registro Prospectivo Internacional de Protocolos de Revisiones Sistemáticas) sobre la usabilidad y UX de tecnologías de intervención cognitiva dirigidas a personas con DCL/demencia, lo que validó el propósito de esta revisión. Por lo que se procedió a una búsqueda bibliográfica en las bases de datos Medline, PubMed, Scopus, ScienceDirect y PsycINFO. Se delimitaron los resultados utilizando los filtros de que los estudios estuvieran publicados entre 2009 – 2019, escritos en inglés o español y las siguientes combinaciones de palabras clave (Tabla 1).

Tabla 1. Combinación de palabras claves

usability AND (tech* OR software OR computer) AND “cognitive stimulation” AND (dementia OR “mild cognitive impairment” OR MCI)
usability AND (tech* OR software OR computer) AND “cognitive training” AND (dementia OR “mild cognitive impairment” OR MCI)
usability AND (tech* OR software OR computer) AND “cognitive rehabilitation” AND (dementia OR “mild cognitive impairment” OR MCI)
(“user experience” OR UX) AND (tech* OR software OR computer) AND “cognitive stimulation” AND (dementia OR “mild cognitive impairment” OR MCI)
(“user experience” OR UX) AND (tech* OR software OR computer) AND “cognitive training” AND (dementia OR “mild cognitive impairment” OR MCI)
(“user experience” OR UX) AND (tech* OR software OR computer) AND “cognitive rehabilitation” AND (dementia OR “mild cognitive impairment” OR MCI)

Los títulos, resúmenes y texto completo de los estudios potenciales fueron revisados por tres investigadoras de manera independiente. Los criterios de inclusión fueron:

- Muestra de personas de 60 años o más con DCL (todos los tipos) o con enfermedad de Alzheimer, demencia frontotemporal o demencia vascular.
- Cualquier tipo de tecnología destinada principal o parcialmente a la estimulación, entrenamiento o rehabilitación cognitiva.

- Tecnologías de estimulación, entrenamiento o rehabilitación cognitiva con mediciones o características de su usabilidad y/o UX.
- Artículos de revistas con estudios descriptivos, explicativos, experimentales, analíticos, piloto y ensayos clínicos.

Para encontrar más estudios potenciales, se realizó una búsqueda manual en Google Scholar y en las listas de referencia de los artículos elegidos. En la figura 1 se resume el procedimiento de búsqueda y selección de estudios.

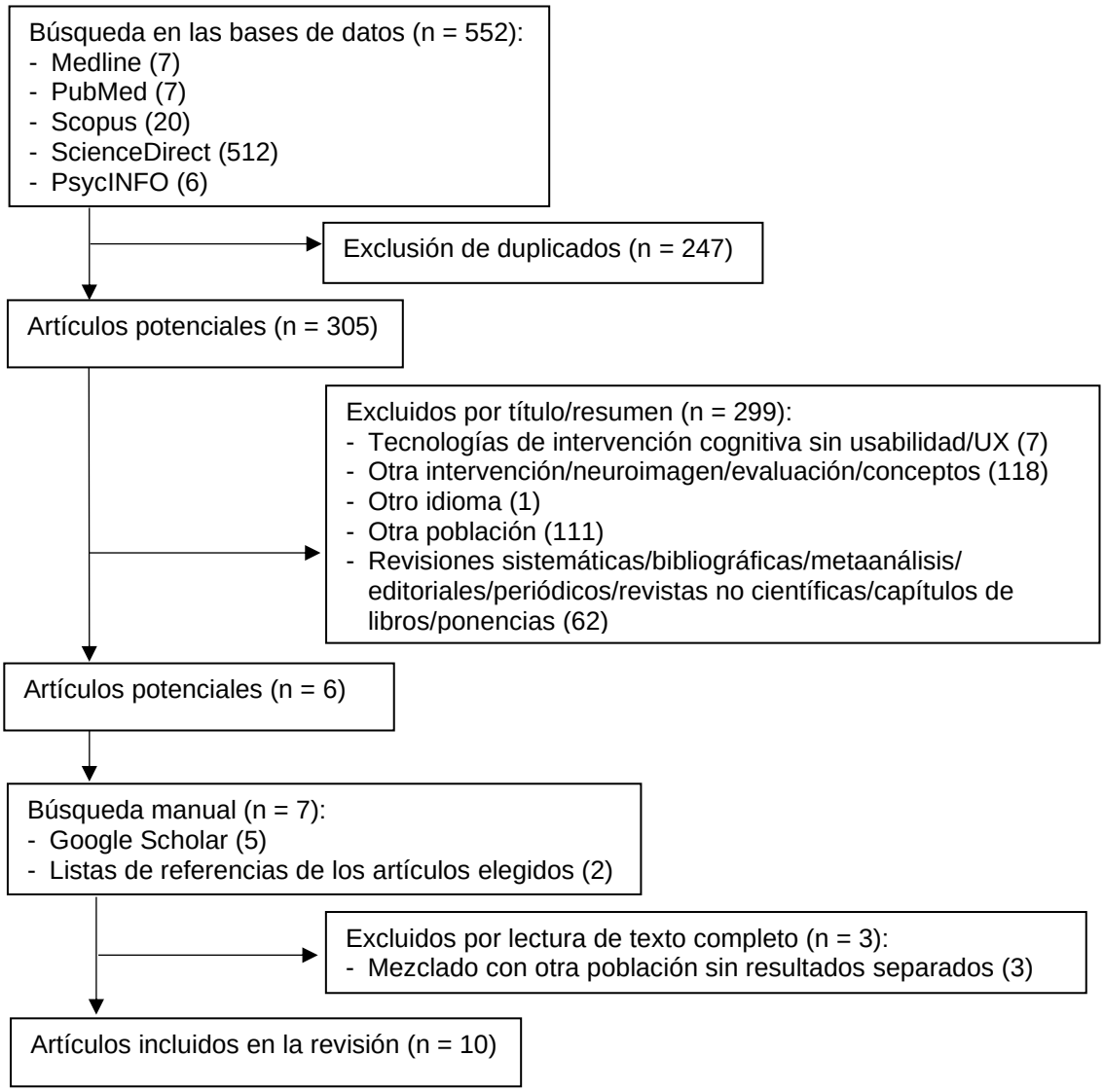

Figura 1. Procedimiento de búsqueda y selección de estudios

La recogida y análisis de datos incluyó las medidas y características de las tecnologías en términos de usabilidad y UX, considerando el número y tipo de estudios, características sociodemográficas de los participantes, tipos de intervenciones

cognitivas, tecnología utilizada y principales resultados. Se realizó una síntesis cualitativa de todos los resultados obtenidos en la revisión.

Los detalles del estudio se registraron en PROSPERO desde la etapa inicial hasta la final. Además, para garantizar la transparencia y claridad de la revisión sistemática, se siguieron los criterios PRISMA (*Preferred Reporting Items for Systematic Reviews and Meta-Analyses*) (Liberati et al., 2009).

4.2 Publicación II

Con el objetivo de conocer si ehcoBUTLER tiene una adecuada aceptabilidad e identificar los requisitos funcionales del sistema, se aplicó una encuesta en línea a potenciales usuarios finales y partes interesadas de diferentes países (España, Italia, Grecia, Países Bajos, Eslovenia, Francia, Serbia e Israel), explorando sus expectativas y preferencias.

4.2.1 Participantes

Los socios del proyecto de cada país reclutaron a potenciales usuarios y partes interesadas. Los criterios de inclusión fueron:

- Usuarios finales: personas de 60 años con DCL y con puntuaciones entre 23 - 27 en el *Mini-Mental State Examination*.
- Cuidadores informales: familiares, amigos o vecinos que prestan cuidado y apoyo a adultos mayores con DCL.
- Cuidadores formales: personas con cualificación o formación profesional para atender a la población mayor (personal de atención sanitaria y social, miembros de centros de actividades o asociaciones benéficas).
- Personal de administración/gestión: personas que gestionan y facilitan sus productos/servicios a la población mayor (empresas de telemedicina, teleasistencia, hospitales y compañías de seguros).

La encuesta fue cumplimentada por 375 personas. De las cuales 62 fueron excluidas, quedando 313 participantes: 35 adultos mayores con DCL, 80 cuidadores informales, 149 cuidadores formales, 49 personal de administración/gestión.

4.2.2 Materiales

Este estudio cualitativo se basó en una encuesta en línea ad hoc para cada grupo de participantes utilizando la plataforma SurveyMonkey, con la que también se recabaron

sus datos sociodemográficos. Todas las versiones de la encuesta contenían un video sobre el objetivo, módulos y diseño de ehcoBUTLER.

4.2.3 Procedimiento

La encuesta se elaboró en inglés y cada socio del proyecto la tradujo a la lengua oficial de su país. Se contactó con los potenciales participantes por correo electrónico, solicitando su participación y proporcionándoles el enlace de la encuesta. Se realizaron entrevistas telefónicas o presenciales cuando no se disponía del correo electrónico o no era el método de contacto más adecuado.

A todos los participantes se les pidió dar su opinión general sobre ehcoBUTLER mediante 6 preguntas (Tabla 2). Además, se solicitó a los usuarios finales que evaluaran cada módulo (cognitivo, emocional, social, ergonómico, estilo de vida, tiempo libre y ocio), utilizando 5 categorías (interesante, útil, necesario, satisface sus necesidades y mejora la atención que recibe) en una escala Likert de 6 puntos (0 = En absoluto, 6 = Absolutamente). Los datos sociodemográficos de todos los participantes también fueron analizados.

Tabla 2. Variables medidas en todos los participantes

Variable	Escala de respuesta
Interés como sistema	0 – 10 (0 = Ninguno, 10 = Alto)
Utilidad percibida	0 – 10 (0 = Ninguna, 10 = Alta)
Intención de futura compra	0 – 4 (0 = Definitivamente no, 4 = Muy probablemente)
Interés en comprar el hardware	a. Preferiría utilizar el mío propio b. Prefiero tener instalados todos los dispositivos (ordenador, pantalla táctil, teclado ergonómico, etc.).
¿Cuánto pagaría por el sistema?	Respuesta abierta
Interés como producto	a. Sí, me parece interesante b. No, no lo necesito c. No, es demasiado complejo d. No, no pagaría por el hardware e. Otros

4.3 Publicación III

Con el objetivo de explorar las percepciones y el nivel de retroalimentación de potenciales usuarios (adultos mayores con DCL y personas con demencia leve) y partes interesadas (cuidadores informales y profesionales de la salud) para mejorar el desarrollo de ehcoBUTLER, se realizaron grupos focales. A través de esta exploración,

el objetivo secundario fue contribuir al desarrollo de plataformas y aplicaciones para Tablets que también se dirijan a promover el bienestar y salud de esta población.

4.3.1 Participantes

En este estudio cualitativo participaron 49 personas: 13 con DCL, 13 con demencia leve, 12 cuidadores informales y 11 profesionales de la salud. Se dividieron en 8 grupos focales: 2 grupos compuestos por adultos mayores con DCL, 2 por personas con demencia leve, 2 por cuidadores y 2 por profesionales.

Los participantes con DCL fueron reclutados de los Talleres de Memoria de la Fundación INTRAS. Sus criterios de inclusión fueron tener 55 años o más, tener un diagnóstico de DCL sin ningún trastorno psiquiátrico asociado, saber leer y escribir, tener experiencia previa con GRADIOR y no padecer problemas visuales ni auditivos.

Las personas con demencia leve fueron reclutadas de los Talleres de Memoria y de la Clínica de Memoria de la Fundación INTRAS. Sus criterios de inclusión fueron tener 55 años o más, tener un diagnóstico de demencia leve sin ningún trastorno psiquiátrico relacionado, saber escribir y leer, no padecer problemas de audición ni visión y tener experiencia previa con GRADIOR.

Los cuidadores fueron reclutados de la Clínica de la Memoria de la Fundación INTRAS. Sus criterios de inclusión fueron ser cuidadores informales que proporcionaban ayuda instrumental y de acompañamiento a adultos mayores, así como tener experiencia previa con dispositivos tecnológicos.

Los profesionales fueron reclutados de diferentes departamentos de la Fundación INTRAS. Sus criterios de inclusión fueron ser un profesional de la salud con experiencia en la atención de personas mayores con deterioro cognitivo y haber trabajado/trabajar con herramientas tecnológicas como parte de su intervención clínica.

4.3.2 Procedimiento

El Hospital Provincial de Zamora dio su aprobación ética para llevar a cabo este estudio. Los participantes aceptaron ser grabados en audio y video, firmaron el consentimiento informado y rellenaron un formulario de datos sociodemográficos. Se utilizó la misma sala accesible para todos los grupos.

El moderador proyectó una vídeo demostración de ehcoBUTLER, explicó su finalidad y funciones, y planteó las preguntas semiestructuradas del guion correspondiente a cada grupo focal. El contenido verbal se transcribió de forma anónima para su posterior análisis.

4.3.3 Análisis de datos

Los datos sociodemográficos se analizaron con SPSS (versión 25), mientras que para el análisis de los datos de los grupos focales se utilizó NVivo 12 Plus. A partir de los guiones y temas discutidos en los grupos focales, se crearon categorías y subcategorías homogéneas para todos los grupos (Figura 2), con el fin de tener el mismo sistema de codificación y comparar el contenido. Luego, se crearon matrices de doble entrada, en las que se cruzó el contenido entre cada participante y cada una de las categorías y subcategorías, para comparar las percepciones positivas y negativas de los grupos.

Posteriormente, se examinó el nivel de retroalimentación de cada participante. Teniendo en cuenta el grado de claridad, exhaustividad y elaboración de sus respuestas, se asignó un valor a la respuesta de cada participante: 1 punto para una baja o falta de retroalimentación, 2 puntos para una retroalimentación moderada y 3 puntos para una retroalimentación alta.

Además, para determinar el nivel de retroalimentación de cada grupo, se establecieron tres rangos de puntuaciones. El mínimo y el máximo de estas puntuaciones varió según el número de miembros de cada grupo (Tabla 3).

Tabla 3. Puntuaciones del nivel de retroalimentación de los participantes

Nivel de retroalimentación	**Puntuaciones**			
	DCL	Demencia leve	Cuidadores informales	Profesionales de la salud
Bajo	13 - 21 puntos	13 - 21 puntos	12 - 19 puntos	11 - 18 puntos
Moderado	22 - 30 puntos	22 - 30 puntos	20 - 28 puntos	19 - 26 puntos
Alto	31 - 39 puntos	31 - 39 puntos	29 - 36 puntos	27 - 33 puntos

El procedimiento descrito hizo posible cruzar el contenido discursivo y el nivel de retroalimentación en cada categoría y subcategoría. Por último, se obtuvo un nivel global de retroalimentación por subcategoría, sumando las puntuaciones de todos los grupos para determinar cuáles eran los temas más comentados. Estas puntuaciones también se distribuyeron en tres rangos de retroalimentación: bajo (49-67 puntos), moderado (68-85 puntos) y alto (86-103 puntos).

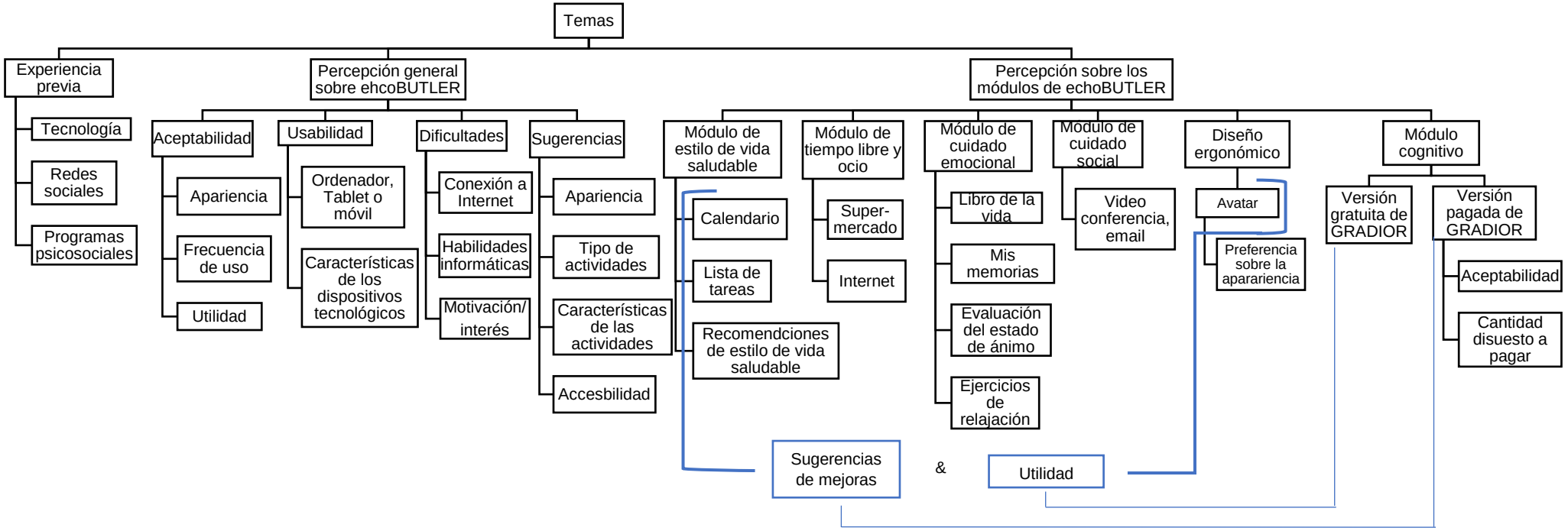

Figura 2. Categorías y subcategorías

4.4 Artículo enviado para su publicación (ver Apéndice)

El objetivo de este estudio transversal fue evaluar y comparar las impresiones de adultos mayores con DCL/demencia leve y personas con esquizofrenia sobre la usabilidad de GRADIOR 4.5 y su UX, para identificar fortalezas y áreas por mejorar, a través de la aplicación del UEQ.

Este estudio, centrado en la usabilidad y UX, formó parte de un ensayo clínico que evaluó la eficacia de GRADIOR para la rehabilitación cognitiva en población con DCL/demencia leve (Vanova et al., 2018). Se llevó a cabo una ampliación del ensayo clínico para evaluar la UX y la usabilidad de GRADIOR en personas con esquizofrenia, porque son un amplio grupo de usuarios cuyas impresiones también son esenciales para mejorar el programa.

4.4.1 Participantes

Se solicitó participar al grupo experimental del ensayo clínico (adultos mayores con DCL/demencia leve) y a un grupo de personas con esquizofrenia (que ya eran usuarios habituales de GRADIOR). Sus criterios de inclusión fueron:

- Personas con DCL: fueron reclutadas de los Talleres de Memoria y Clínica de la Memoria de la Fundación INTRAS, así como del Hospital Universitario Río Hortega. Debían tener 55 años o más, un diagnóstico de DCL, saber leer y escribir, experiencia previa con GRADIOR 4.5 de 4 meses y no padecer problemas visuales ni auditivos.
- Personas con demencia leve: fueron reclutadas de los Talleres de Memoria y Clínica de la Memoria de la Fundación INTRAS y del Hospital Universitario Río Hortega. Debían tener 55 años o más, un diagnóstico de demencia leve, saber escribir y leer, no padecer problemas de audición ni visión y tener experiencia previa con GRADIOR 4.5 de 4 meses.
- Personas con esquizofrenia: fueron reclutadas de la Residencia de la Fundación INTRAS y del Centro de Rehabilitación Psicosocial. Debían tener 18 años o más, un diagnóstico de esquizofrenia, saber leer y escribir, estabilidad mental durante el estudio y al menos 4 meses de experiencia utilizando GRADIOR 4.5. Ellos ya eran usuarios de este programa, porque formaba parte de sus actividades terapéuticas en los centros.

4.4.2 Materiales

Se utilizó el consentimiento informado y formulario de datos sociodemográficos correspondientes al protocolo de 4 meses (Vanova et al., 2018). También se empleó el UEQ por su utilidad para evaluar rápidamente los aspectos de usabilidad y UX, así como la impresión general de los usuarios (Rauschenberger et al., 2013; Schrepp et al., 2017). Se utilizó la versión española de lápiz y papel, que tiene 26 ítems agrupados en 6 escalas (Rauschenberger et al., 2013) (Tabla 4).

Tabla 4. Escalas e ítems del UEQ

Aspecto	Escala	Ítem	Ítem N.º
Impresión general	Atracción	desagradable/agradable	1
		bueno/malo	12
		repelente/atractivo	14
		incómodo/cómodo	16
		atractivo/feo	24
		simpático/antipático	25
Usabilidad	Eficiencia	rápido/lento	9
		ineficiente/eficiente	20
		no pragmático/pragmático	22
		ordenado/desordenado	23
	Transparencia	no entendible/entendible	2
		fácil de aprender/difícil de aprender	4
		complicado/fácil	13
		claro/confuso	21
	Controlabilidad	impredecible/predecible	8
		obstructivo/impulsor de apoyo	11
		seguro/inseguro	17
		cubre expectativas/no cubre expectativas	19
Experiencia de Usuario	Estimulación	valioso/de poco valor	5
		aburrido/emocionante	6
		no interesante/interesante	7
		activante/adormecedor	18
	Novedad	creativo/sin imaginación	3
		original/convencional	10
		convencional/novedoso	15
		conservador/innovador	26

También se usó el conjunto de datos *benchmark* (punto de referencia) de la versión 10 del UEQ, que contiene 21,175 respuestas de 468 estudios que han evaluado diferentes productos mediante el UEQ. Lo que permitió comparar la calidad de GRADIOR con dichos productos, identificando así fortalezas y áreas por mejorar. El *benchmark* contiene 5 categorías para clasificar el producto (Schrepp et al., 2017):

- Excelente: el producto evaluado se encuentra en el rango del 10% de los mejores resultados en el *benchmark*.

- Bueno: el 10% de los resultados en el *benchmark* son mejores que el producto evaluado, mientras que el 75% de los resultados en el *benchmark* son peores.
- Por encima de la media: el 25% de los resultados en el *benchmark* son mejores que el producto evaluado, y el 50% de los resultados en el *benchmark* son peores.
- Por debajo de la media: El 50% de los resultados en el *benchmark* son mejores que el producto evaluado, mientras que el 25% de los resultados en el *benchmark* son peores.
- Malo: el producto evaluado se encuentra en el intervalo del 25% de los peores resultados en el *benchmark*.

4.4.3 Procedimiento

El Hospital Provincial de Zamora dio su aprobación ética para realizar este estudio. Los participantes aceptaron firmar el consentimiento informado, el formulario de datos sociodemográficos y el UEQ. Todos los documentos se rellenaron individualmente en una sala accesible.

Se utilizó el programa estadístico SPSS (versión 25) para analizar los datos sociodemográficos de los participantes. Por otro lado, se utilizaron las herramientas en Excel del UEQ (versión 10) y de la comparación de productos (versión 4) para analizar los datos de dicho cuestionario y comparar las impresiones de ambos grupos de participantes.

Capítulo 5: Compendio de publicaciones

A continuación, se presenta un resumen ampliado en castellano de cada artículo publicado que conforma la Tesis Doctoral. Además, se incluye una copia completa de las publicaciones originales. El formato de cada artículo y sus referencias bibliográficas corresponden a las normas de la revista científica en la que fue publicado.

5.1 Publicación I

Contreras-Somoza, L. M., Irazoki, E., Toribio-Guzmán, J. M., de la Torre-Díez, I., Diaz-Baquero, A. A., Parra-Vidales, E., Perea-Bartolomé, M. V., & Franco-Martín, M. Á. (2021). Usability and user experience (UX) of cognitive intervention technologies for elderly people with mild cognitive impairment (MCI) or dementia. A systematic review. *Frontiers in Psychology*, *12*, 1–15. https://doi.org/10.3389/fpsyg.2021.636116

Título:

Usabilidad y experiencia de usuario (UX) de tecnologías de intervención cognitiva para personas mayores con deterioro cognitivo leve (DCL) o demencia. Una revisión sistemática

Resumen:

Introducción: la incorporación de las tecnologías en las intervenciones cognitivas representa una manera innovadora y atractiva de presentarlas, haciéndolas a su vez más accesibles, flexibles y rentables. Sin embargo, sus ventajas no serán factibles si las tecnologías no están adecuadamente adaptadas a los usuarios. En el caso de las personas mayores con deterioro cognitivo, son pocas las investigaciones que abordan los temas de usabilidad y UX.

Objetivos: encontrar evidencia acerca de las medidas para evaluar la usabilidad y UX de tecnologías de estimulación, entrenamiento y rehabilitación cognitiva dirigidas a adultos mayores con DCL o demencia, así como determinar las características de usabilidad y UX de dichas tecnologías.

Método: se realizó una búsqueda de literatura publicada entre 2009-2019 en las bases de datos Medline, PubMed, Scopus, ScienceDirect y PsycINFO. Tres investigadoras revisaron de forma independiente los estudios potencialmente elegibles, siguiendo determinados criterios de inclusión. Para encontrar más estudios potenciales, se realizó una búsqueda manual en Google Scholar y en las listas de referencia de los artículos

elegidos. Se llevó a cabo una revisión sistemática, presentando una síntesis cualitativa de las medidas de usabilidad y UX con sus resultados, características de los estudios y de las tecnologías de intervención cognitiva.

Resultados: se seleccionaron 10 estudios, de los cuales 5 eran de estimulación cognitiva y 5 de entrenamiento cognitivo. La mayoría (60%) eran programas informáticos con formato de juego serio. La eficiencia y eficacia fueron las medidas más utilizadas para recopilar datos objetivos de usabilidad, mostrando que las personas mayores con deterioro cognitivo necesitan más tiempo (45%) y ayuda (40%), pero son capaces de completar las tareas (60%). En cuanto a los datos de UX o datos subjetivos de usabilidad, los cuestionarios y escalas fueron los métodos más utilizados, indicando que ellos tienen experiencias positivas, a pesar de que en 5 estudios reportaron tener ciertas dificultades con la interfaz.

Conclusiones: la medición de la usabilidad y UX de tecnologías de intervención cognitiva en adultos mayores con DCL o demencia, proporciona una visión integrada que puede contribuir al correcto desarrollo de estas tecnologías en función de las necesidades y características de la población objetivo. Se requieren más investigaciones que incluyan a este grupo poblacional en la evaluación de usabilidad y UX, así como herramientas estandarizadas y un consenso sobre la relación de los términos de usabilidad y UX, para garantizar la futura efectividad de las tecnologías de intervención cognitiva.

Palabras clave: intervención cognitiva, tecnología, usabilidad, experiencia del usuario, demencia, DCL

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SYSTEMATIC REVIEW
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Usability and User Experience of Cognitive Intervention Technologies for Elderly People With MCI or Dementia: A Systematic Review

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Introduction: Incorporating technology in cognitive interventions represents an innovation, making them more accessible, flexible, and cost-effective. This will not be feasible without adequate user-technology fit. Bearing in mind the importance of developing cognitive interventions whose technology is appropriate for elderly people with cognitive impairment, the objective of this systematic review was to find evidence about usability and user experience (UX) measurements and features of stimulation, training, and cognitive rehabilitation technologies for older adults with mild cognitive impairment (MCI) or dementia.

Method: The Medline, PubMed, Scopus, ScienceDirect, and PsycINFO databases were searched for literature published in the last 10 years (2009–2019), and three researchers independently reviewed potentially eligible studies, following specific inclusion criteria. A systematic review of the studies was conducted, presenting a qualitative synthesis of usability and UX measures with their outcomes, study characteristics and features of the cognitive intervention technologies.

Results: Ten studies were selected: five were cognitive stimulation and five were cognitive training. Most of them (60%) were computer-based programs with a serious game format. Efficiency and effectiveness were the most frequent measurements used for collecting objective usability data, showing that elderly people with cognitive impairment require more time (45%) and help (40%) but can complete tasks (60%). Regarding UX or subjective usability data, questionnaires and scales were the most used methods, reporting positive experience despite certain difficulties with the interface in five studies.

Conclusion: Measuring usability and UX in cognitive intervention technologies for older adults with MCI or dementia provides an integrated view that can contribute to their

development according to the needs and characteristics of the target population. More research is required to include this population group in usability and UX studies, as well as standardized tools and consensus on the relationship of these terms to guarantee the future effectiveness of cognitive intervention technologies.

Review registration: This review was registered in the PROSPERO (CRD42020158147) International Register of Systematic Review Protocols.

Keywords: cognitive intervention, technology, usability, user experience, dementia, MCI

INTRODUCTION

It is currently estimated that every 3 s someone develops dementia, and the annual cost of dementia care is estimated at US $ 1 billion, a quantity that will double by 2030 (Alzheimer's Disease International, 2019). Mild cognitive impairment (MCI) is often a transitional stage from normal aging's cognitive decline to dementia, in which the functional abilities of daily life are not preserved (Petersen et al., 2014). As expected, studies have shown that people who undergo normal aging processes display better cognitive performance compared to elderly people with MCI and those with dementia, the latter group having the greatest difficulties (Lavrencic et al., 2019).

Cognition-based interventions are increasingly considered as an important complement and even an alternative to pharmacological treatments for people with dementia (Bahar-Fuchs et al., 2013). In the MCI population, cognitive interventions have been effective in optimizing cognitive functioning, reducing cognitive impairment and delaying the onset of dementia (Faucounau et al., 2010). There are three main approaches to cognition-focused interventions (Bahar-Fuchs et al., 2013): cognitive stimulation (CS), cognitive training (CT), and cognitive rehabilitation (CR).

Cognitive stimulation is usually used in groups for older adults with cognitive impairment, including a variety of activities to keep cognitive functions active in a general and entertaining way (Woods et al., 2012). It can also be used with healthy elderly individuals (HE) to prevent cognitive decline (Rosell, 2018). CT consists of guided standardized exercises to improve performance in certain cognitive functions (Kallio et al., 2017). It can be used in elderly with or without cognitive impairment (Ledreux et al., 2019), wither individually or in groups (Oltra-Cucarella et al., 2018). CR is an individualized approach aimed at improving the functionality in daily living of older adults with cognitive impairment, thus helping to reduce caregiver burden (Oltra-Cucarella et al., 2018; Germain et al., 2019).

Computer-based cognitive interventions have the advantage of being more accessible to the public at large, and are also flexible, self-administered and cost effective (Faucounau et al., 2010; Toribio-Guzmán et al., 2018). In addition, technology allows cognitive exercises to be presented in new and engaging ways (Kueider et al., 2012). For example, video games have moving images, sounds, and feedback that make them more attractive and rewarding than printed materials (Toril et al., 2014). Some authors use the term serious games for tools aimed at specific purposes, such as cognitive games designed to improve cognitive functions rather than for entertainment alone (Robert et al., 2014).

However, good user-technology fit is essential to prevent technology from being ignored or misused (Meiland et al., 2017). Hence, it is important that technologies have a human-centered design, taking users and usability into account in their development (International Organization for Standardization [ISO], 2019a). Usability is the degree to which a product, service or system can be used with effectiveness, efficiency and satisfaction by certain users in a specific context to achieve an objective (International Organization for Standardization [ISO], 2019b).

Different usability testing methods are available and can be used during all phases of a product's development to ensure that its design can meet high-quality standards, identifying problems and correcting them for easy, efficient and effective user-system interaction (Toribio-Guzmán et al., 2017). Furthermore, usability also assesses satisfaction, which, in turn, involves user experience (UX) (International Organization for Standardization [ISO], 2019a). UX consists of the perceptions, emotions, beliefs, preferences and behaviors of the users that happen before, during and after the utilization of a product, service or system (International Organization for Standardization [ISO], 2019b). UX focuses on subjective, temporal, situated and holistic attributes, and on design and user interaction (Bargas-Avila and Hornbæk, 2011; Roto et al., 2011).

Nevertheless, usability issues in cognitive intervention technologies for people with dementia are scarcely mentioned in research (Meiland et al., 2017). Moreover, there are studies that do not provide an integrated understanding of UX in association with technological devices (Megges et al., 2018), and one study reported that few technology systems are specifically designed to approach the cognitive limitations that affect older adults with cognitive impairment (Wargnier et al., 2018). In a population sector that is already subject to the frustration and lack of confidence that is associated with the limitations of their condition, the impact of unsuitable technological designs can add to such negative feelings (Smeenk et al., 2018).

Technologies aimed at people with cognitive impairment have to take into account their needs, preferences, abilities and limitations, since lack of awareness of their particularities not only affects them, but also their families and society at large, involving a costly burden for the community (Czaja et al., 2019). Given the importance of developing cognitive

interventions whose technology is acceptable, usable and relevant to the elderly population with cognitive impairment, the objective of this systematic review was to obtain evidence about usability and UX measures and features of stimulation, training, and cognitive rehabilitation technologies for older adults with MCI or dementia.

MATERIALS AND METHODS

Materials

This systematic review focused on usability and UX studies that address stimulation, training, and cognitive rehabilitation technologies for older adults with MCI or dementia, seeking evidence regarding such cognitive intervention technologies' usability and UX measures and characteristics.

The PRISMA (Preferred Reporting Items for Systematic reviews and Meta-Analyses) guidelines were followed to ensure the review's transparency and clarity (Liberati et al., 2009). Accordingly, the analysis and presentation of quality evidence-based information allows it to be adequately conveyed to those interested in mental health support technological programs, whose fast and growing development means that not all of them include the characteristics that would be desirable or achieve suitable goals (Baumel, 2016; Baumel et al., 2017).

This review was registered in the PROSPERO (CRD42020158147)[1] International Register of Systematic Review Protocols, whose purpose is also to increase transparency in systematic reviews, avoiding duplication and minimizing bias (Schiavo, 2019).

Procedure

The PROSPERO website was searched for previous systematic reviews on the topic and none were found, which validated the purpose of this review. The Medline, PubMed, Scopus, ScienceDirect, and PsycINFO databases were searched in August and September 2019 using certain combinations of keywords to delimit the search (**Table 1**).

ScienceDirect did not support the truncation symbol, so the term technology was used instead of tech*. In all the databases, results were limited to the last 10 years (2009 – 2019) and to being written in English or Spanish. The search results were exported to the EndNote citation manager. A total of 552 studies were obtained, of which 305 remained after the removal of duplicates. The titles and/or abstracts of these studies were read, and the following criteria were used to find potentially eligible articles:

Inclusion criteria:

- People aged 60 and over with MCI (all subtypes) or with one of the following types of dementia: Alzheimer, frontotemporal dementia, vascular dementia
- Any type of technology mainly or partly aimed at stimulation, training or cognitive rehabilitation
- Stimulation, training, or cognitive rehabilitation technologies where measurements or characteristics of usability and/or user experience are provided
- Journal articles with descriptive, explanatory, experimental or analytical studies as well as clinical trials and pilot studies

Exclusion criteria:

- Older adults with other types of dementia or clinical conditions (Lewy Body, Pick's disease, Creutzfeldt-Jakob disease, alcohol-related dementia, AIDS dementia complex, Huntington's disease, Parkinson's disease, Down syndrome, brain injury) or healthy older adults
- Programs where the use of technology was not intended for therapeutic purposes of stimulation, training or cognitive rehabilitation
- Stimulation, training or cognitive rehabilitation technologies with no description regarding usability or user experience
- Systematic/literature reviews, meta-analyses, editorials, newspapers, magazines, book chapters, and conference papers

This narrowed the selection down to six articles. In order to find more potentially eligible studies, a manual Google Scholar search was conducted based on the terms 'usability technology cognitive stimulation training rehabilitation dementia MCI.' In addition, the reference lists of all the selected studies were screened to ensure that no possible articles were left out. These two steps broadened the sample to 13 articles, whose full-text versions were examined to verify whether they were appropriate for inclusion. Three researchers conducted this process independently, subsequently comparing their results to achieve a consensus on which studies to include or exclude. Finally, a total of 10 articles were included. This search and selection process is summarized in **Figure 1**.

Of the 10 included studies, that by Kyriazakos et al. (2017) addressed the target population and another sample that did not meet the inclusion criteria, but it was not excluded because the results obtained for the target population were presented separately.

Data Extraction

The measures and features to be extracted and analyzed were chosen according to the main characteristics of usability; namely, effectiveness, efficiency and satisfaction (considering the latter

TABLE 1 | Keywords combination.

Usability AND (tech* OR software OR computer) AND "cognitive stimulation" AND (dementia OR "mild cognitive impairment" OR MCI)
Usability AND (tech* OR software OR computer) AND "cognitive training" AND (dementia OR "mild cognitive impairment" OR MCI)
Usability AND (tech* OR software OR computer) AND "cognitive rehabilitation" AND (dementia OR "mild cognitive impairment" OR MCI)
("user experience" OR UX) AND (tech* OR software OR computer) AND "cognitive stimulation" AND (dementia OR "mild cognitive impairment" OR MCI)
("user experience" OR UX) AND (tech* OR software OR computer) AND "cognitive training" AND (dementia OR "mild cognitive impairment" OR MCI)
("user experience" OR UX) AND (tech* OR software OR computer) AND "cognitive rehabilitation" AND (dementia OR "mild cognitive impairment" OR MCI)

[1] https://www.crd.york.ac.uk/prospero/display_record.php?ID=CRD42020158147

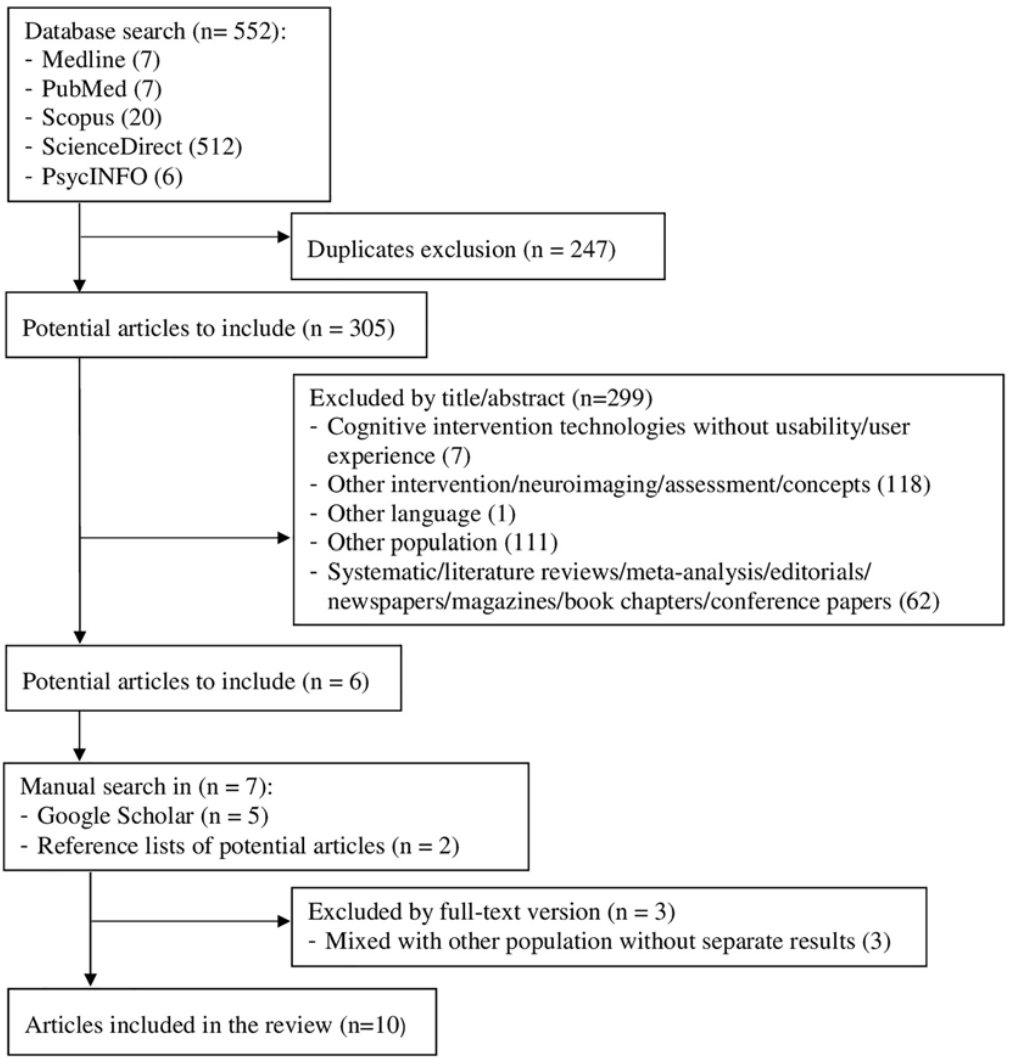

FIGURE 1 | Search procedure and studies selection.

as part of UX), as defined in International Organization for Standardization [ISO] (2019b):

- Effectiveness: accuracy and completeness with which users achieve specific goals
- Efficiency: resources used in relation to the results achieved, such as time, effort, materials and costs
- User experience: perceptions, emotions, beliefs, preferences, comfort, accomplishments, responses and behaviors that happen before, during and after use, as well as the extent to which the user's needs and expectations are met (satisfaction)

Considering the ongoing scientific debate about the overlap between usability and UX, this study approaches UX as an extension of usability, since UX focuses on assessing subjective aspects such as satisfaction (Sauer et al., 2020).

It should be noted that no articles were excluded from this data collection. The analysis was conducted based on the number and type of studies, participants' socio-demographic characteristics, types of cognitive interventions and technology used, measures and features of usability and UX and their main results.

Data Analysis

Due to the different usability and UX measures, as well as the variety of methodologies used in the studies, a qualitative synthesis of the results was performed following the Cochrane guidelines for data synthesis and analysis (Ryan, 2013). Firstly, study characteristics such as design and participants are presented. Then, features such as type, format, software, and hardware of cognitive intervention technologies are reported. Finally, a description is given about the usability and UX measures found in the studies and their outcomes.

RESULTS

Characteristics of the Studies

The search yielded 552 studies, narrowed down to six potential articles after the removal of duplicates and the screening of titles and abstracts according to the inclusion and exclusion criteria. Also based on these criteria, a manual search led to the addition of seven more potential studies. The full-text version of these 13 articles was read, and, finally, 10 articles were included for analysis (**Figure 1**).

The selected papers were eight pilot studies (González-Abraldes et al., 2010; Boulay et al., 2011; González-Palau et al., 2013; Manera et al., 2015; Djabelkhir et al., 2017; Garcia-Sanjuan et al., 2017; Kyriazakos et al., 2017; Tziraki et al., 2017) and two clinical trials (Haesner et al., 2015; Ben-Sadoun et al., 2016). Most of them had been conducted in Europe and the number of subjects that made up their samples ranged from 7 to 180, most of them women aged 60–90 with MCI or dementia (some with mild dementia and others with Alzheimer's disease), as well as HE (**Tables 2**, **3**).

The length of the interventions varied between a single session and 3 months. Sessions were given 1–3 times per week, and each of them lasted between 10 and 90 min. At the beginning, eight of the studies included a trial period for older adults to adapt to the tool (González-Abraldes et al., 2010; Boulay et al., 2011; Haesner et al., 2015; Manera et al., 2015; Ben-Sadoun et al., 2016; Djabelkhir et al., 2017; Garcia-Sanjuan et al., 2017; Kyriazakos et al., 2017) that ranged between 1 session and 2 weeks (**Table 3**).

There were dropouts reported in six of the studies (Boulay et al., 2011; González-Palau et al., 2013; Manera et al., 2015; Djabelkhir et al., 2017; Garcia-Sanjuan et al., 2017; Tziraki et al., 2017), with rates ranging from 4.8 to 31.6%. The most frequent reasons for withdrawal were medical problems (50%), followed by reluctance to continue after the first contact with the technological tool (19.5%), family problems as well as refused to try (11.1% respectively) and, lastly, because they considered the exercise easy or uninteresting (8.3%) (**Table 3**).

Features of Cognitive Intervention Technologies

Regarding the type of cognitive intervention, five were CS technologies: X-Torp (Ben-Sadoun et al., 2016), MINWii (Boulay et al., 2011), Computer Cognitive Stimulation (CCS) (Djabelkhir et al., 2017), Telecognitio (González-Abraldes et al., 2010) and Serious Game (Tziraki et al., 2017); and another five were aimed at CT: Tangibot (Garcia-Sanjuan et al., 2017), Long Lasting Memories (LLM) (González-Palau et al., 2013), eWALL (Kyriazakos et al., 2017), Kitchen and Cooking (Manera et al., 2015), and Web-based CT platform (Haesner et al., 2015). This last study and two others (González-Abraldes et al., 2010; Djabelkhir et al., 2017) were different from the rest because they used technology that already existed to gather information or develop their own. On the other hand, none of the studies included technology aimed at CR (**Table 3**).

In four of the studies the cognitive intervention technologies found consisted of cognitive exercises (González-Abraldes et al., 2010; González-Palau et al., 2013; Haesner et al., 2015; Djabelkhir et al., 2017) and six studies were based on serious games (Boulay et al., 2011; Manera et al., 2015; Ben-Sadoun et al., 2016; Garcia-Sanjuan et al., 2017; Kyriazakos et al., 2017; Tziraki et al., 2017). It should be noted that the games or video games whose purpose was linked to cognitive intervention rather than entertainment were serious games (Robert et al., 2014). On the other hand, several were programs with other functions such as physical training, social interaction, music therapy and assisted environments (**Table 3**).

The most commonly used hardware for cognitive interventions was the personal computer (60%), followed by the Tablet (40%), touch screens or screens (30%, respectively), gamepad/joystick, sensor or smartphone (20%, respectively). The least used were robots, mouse and headphones (10%, respectively). The described characteristics of the software and hardware were those strictly used and mentioned in the cognitive area of the studies found (**Table 4**).

Measures of Usability and UX in Cognitive Intervention Technologies

To facilitate understanding and comparison of the measures found, they were divided into usability and UX, considering UX as an extension of usability that focuses on subjective data. The measures are shown in **Table 5**.

Usability was measured using five main tools: number of completed tasks, number of errors or failed actions, time to complete tasks, number of unnecessary actions, and number of interventions made by the moderator. The first two corresponded to effectiveness, while the last three belonged to efficiency. On the other hand, six tools for UX measurement were found: questionnaires and scales, verbalizations and behaviors, attendance rates, interviews, time spent doing the activity and number of tasks completed. Only one study (González-Abraldes et al., 2010) used a single tool, while the other nine studies (Boulay et al., 2011; González-Palau et al., 2013; Haesner et al., 2015; Manera et al., 2015; Ben-Sadoun et al., 2016; Djabelkhir et al., 2017; Garcia-Sanjuan et al., 2017; Kyriazakos et al., 2017; Tziraki et al., 2017) used a combination of them.

Specifically, in terms of effectiveness, the most commonly used measure was the number of tasks completed by participants, found in four studies (Manera et al., 2015; Ben-Sadoun et al., 2016; Garcia-Sanjuan et al., 2017; Tziraki et al., 2017), followed by the number of errors, in two studies (Boulay et al., 2011; Garcia-Sanjuan et al., 2017). Regarding efficiency, the most frequent measure was the time it took to complete tasks, which appeared in four studies (Boulay et al., 2011; Ben-Sadoun et al., 2016; Garcia-Sanjuan et al., 2017; Tziraki et al., 2017), followed by moderator interventions, in 3 studies (Boulay et al., 2011; González-Palau et al., 2013; Garcia-Sanjuan et al., 2017) and the number of unnecessary actions in only 1 (Garcia-Sanjuan et al., 2017).

The measures mentioned above correspond to objective usability data collection. However, because usability also involves measuring the UX parameter of satisfaction, which involves collecting subjective data (Sauer et al., 2020), the following

TABLE 2 | Participant's sociodemographic characteristics.

Technology	Experimental group			Control group			Country
	Participants	Age (S.D.)	Sex	Participants	Age (S.D)	Sex	
X-Torp (Ben-Sadoun et al., 2016)	4 AD, 6 MCI	82.3 (±6.4)	4 W, 6 M	8 HE	71.4 (±10.1)	5 W, 3 M	France
MINWii (Boulay et al., 2011)	7 AD	88.5 (N/A)	4 W, 3 M	N/A	N/A	N/A	France
CCS and CCE (Djabelkhir et al., 2017)	10 MCI (CCS)	75.2 (±6.4)	7 W, 3 M	10 MCI (CCE)	78.2 (±7.0)	6 W, 4 M	France
Tangibot (Garcia-Sanjuan et al., 2017)	12 MCI, 12 SCI	81.33 (±8.48)	*32 W, 8 M	16 HE	81.33 (±8.48)	*32 W,8 M	Spain
LLM (González-Palau et al., 2013)	52 MCI, 33 MD	81.97 (±9.16) 83.44 (± 5.67)	64 W, 21 M	95 HE	81.87 (±6.84)	70 W, 25 M	Spain
Web-based CT platform (Haesner et al., 2015)	6 MCI	60–70 years (N/A)	3 W, 3 M	6 HE	>80 years	3 W, 3 M	Germany
Telecognitio: two apps (González-Abraldes et al., 2010)	8 MCI	75 (±6.7)	N/A	N/A	N/A	N/A	Spain
eWALL (Kyriazakos et al., 2017)	48: MCI ARI, COPD	Older adults (N/A)	N/A	N/A	N/A	N/A	Austria, Italy, Denmark, Netherlands
Kitchen and Cooking (Manera et al., 2015)	9 MCI, 12 AD	75.8 (±9.1) 80.3 (±6.3)	7 W, 2 M8 W, 4 M	N/A	N/A	N/A	France
Serious Game (Tziraki et al., 2017)	24 Dementia	65 – 90 years (N/A)	15 W, 9 M	14 HE	65 – 90 years	11 W, 3 M	Israel

AD, Alzheimer disease; ***apps****, applications;* ***ARI****, Age-Related Functional Impairments;* ***CCE****, computerized cognitive engagement;* ***CCS****, computer cognitive stimulation;* ***COPD****, chronic obstructive pulmonary disease;* ***CT****, cognitive training;* ***HE****, healthy elderly;* ***LLM****, long lasting memories;* ***M****, man;* ***MCI****, mild cognitive impairment;* ***MD****, mild dementia;* ***N/A****, not apply;* ***S.D.****, standard deviation;* ***SCI****, severe cognitive impairment;* ***W****, woman.*
*******, sex distribution on the entire sample.*

UX measures were considered in this review: participants' verbalizations and behaviors, which appeared in three studies (Boulay et al., 2011; Garcia-Sanjuan et al., 2017; Tziraki et al., 2017), and interviews, also found in three studies (Haesner et al., 2015; Djabelkhir et al., 2017; Garcia-Sanjuan et al., 2017). These were followed by time participants spent on doing the tasks when there was no time limit, which was addressed in two studies (Manera et al., 2015; Ben-Sadoun et al., 2016); attendance rates, considered in one (Djabelkhir et al., 2017); and number of tasks that participants performed when free do as many as they wanted (regardless of whether they were poorly or well executed), also found in only one (Manera et al., 2015).

Questionnaires and scales were the most widely used tools for UX, appearing in eight studies (González-Abraldes et al., 2010; Boulay et al., 2011; González-Palau et al., 2013; Haesner et al., 2015; Manera et al., 2015; Ben-Sadoun et al., 2016; Djabelkhir et al., 2017; Kyriazakos et al., 2017). The standardized tools found were: Technology Acceptance Model (TAM), Positive Affect Negative Affect Scale (PANAS), User Experience Questionnaire (UEQ), Piper Fatigue Scale (PFS) and Technology Commitment Questionnaire. The non-standardized tools that were used tended to be Likert-type scales of satisfaction, motivation, affectivity, sustainability, interest, ease of use and learning.

The most used in UX were satisfaction scales, found in three studies (Boulay et al., 2011; González-Palau et al., 2013; Manera et al., 2015), followed by TAM (Ben-Sadoun et al., 2016; Kyriazakos et al., 2017), PANAS (Manera et al., 2015; Ben-Sadoun et al., 2016), and Motivation Scale (Manera et al., 2015; Djabelkhir et al., 2017) in two studies, respectively. Finally, UEQ (Kyriazakos et al., 2017), PFS (Manera et al., 2015), Technology Commitment Questionnaire (Haesner et al., 2015), Affective Scale (González-Palau et al., 2013), Sustainability Scale (González-Palau et al., 2013), Ease of Use and Learn Scale (González-Palau et al., 2013), Interest Scale (Manera et al., 2015), and an *ad hoc* questionnaire (González-Abraldes et al., 2010) were registered in one study, respectively.

Of the 10 studies, 6 measured both usability (effectiveness and efficiency) and UX (Boulay et al., 2011; González-Palau et al., 2013; Manera et al., 2015; Ben-Sadoun et al., 2016; Garcia-Sanjuan et al., 2017; Tziraki et al., 2017), while four focused on UX (González-Abraldes et al., 2010; Haesner et al., 2015;

TABLE 3 | Methodological and descriptive characteristics of the studies.

			Intervention				
Technology	**Design**	**Type**	**Format**	**Familiarization**	**Total duration**	**Dropouts**	**Other features**
X-Torp (Ben-Sadoun et al., 2016)	Clinical trial	CS	Serious game	2 wks	1 mo (20-80 min/sess, 3 sess/wk)	N/A	Physical training
MINWii (Boulay et al., 2011)	Pilot study	CS	Serious game	1 sess	3 mos (10-20 min/sess, 1 sess/wk)	MP (n = 1); RTC after 2nd sess (*n* = 1)	Music therapy
CCS and CCE (Djabelkhir et al., 2017)	Pilot study	CCS	Exercises	1 sess	3 mos (90 min/sess, 1 sess/wk)	MP (*n* = 1, CCS)	CCS: social interaction CCE: training to use a tablet-PC, social interaction
Tangibot (Garcia-Sanjuan et al., 2017)	Pilot study	CT	Serious game	Before each task	1 sess (3 tasks/4 times each one)	RTT (n = 4); RTC after 1st contact (n = 2)	N/A
LLM (González-Palau et al., 2013)	Pilot study	CT	Exercises	N/A	3 mos (40 min/sess, 3 sess/wk)	MP (*n* = 7); FP (*n* = 4); RTC (*n* = 3)	Physical training
Web-based CT platform (Haesner et al., 2015)	Clinical trial	CT	Exercises	1 sess	1 sess	N/A	Social media
Telecognitio: two apps (González-Abraldes et al., 2010)	Pilot study	CS	Exercises	Before the intervention	4 sess (15 min/each app)	N/A	N/A
eWALL (Kyriazakos et al., 2017)	Pilot study	CT	Serious games	1 sess	6 wks	N/A	AAL; ELEs; AmI
Kitchen and Cooking (Manera et al., 2015)	Pilot study	CT	Serious games	1 sess	1 mo (subjects played it as much as they wanted)	RTC after first wk (*n* = 1)	N/A
Serious Game (Tziraki et al., 2017)	Pilot study	CS	Serious games	N/A	10 wks (20–30 min/sess, 1–2 sess/wk)	MP (*n* = 9); GEU (*n* = 3)	N/A

AAL, active assisted living; ***AmI****, ambient intelligence;* ***apps****, applications;* ***CCE****, computerized cognitive engagement;* ***CCS****, computerized cognitive stimulation;* ***CS****, cognitive stimulation;* ***CT****, cognitive training;* ***CT****, cognitive training;* ***ELEs****, enhanced living environments;* ***FP****, family problems;* ***GEU****, game easy and uninteresting;* ***LLM****, long lasting memories;* ***min****, minutes;* ***mo****, month;* ***mos****, months;* ***MP****, medical problems;* ***N/A****, not apply;* ***RTC****, refused to continue;* ***RTT****, refused to try;* ***sess****, session;* ***wk****, week;* ***wks****, weeks.*

Djabelkhir et al., 2017; Kyriazakos et al., 2017), as can be seen in **Figure 2**.

Outcomes of Usability and UX Measures in Cognitive Intervention Technologies

The measurements found in the studies collected both objective and subjective data, so it is important and interesting to observe the differences or similarities in the results obtained from usability and UX measures. These results are summarized in **Table 5**.

Cognitive Stimulation Technologies

Djabelkhir et al. (2017) presented a CCS program that consisted of cognitive exercises and social interaction, as well as a Computerized Cognitive Engagement (CCE) system that involved training to use a tablet-PC and social interaction. Only UX measures were taken, obtaining similar positive results in both groups of older adults with MCI: everyone attended every session and high levels of motivation were reported before and after the interventions. The main motivations were to resist the onset of Alzheimer's disease and to cope with loneliness. In addition, participants generally found the group sessions engaging and stimulating and expressed a desire to continue on a regular basis.

In the study by González-Abraldes et al. (2010), CS was also performed through cognitive exercises. They introduced two computerized apps for older adults with MCI. The differences were that app A had visual and audio statements, pictures, limited response time and a touch screen; while app B had audio statements, real pictures, no fixed response time, different levels of difficulty and a mouse. Only UX was measured. Both groups reported difficulties in using the exit icon and in remembering the questions to answer them, although those who used app A found more difficulty in both aspects (50 and 100%, respectively). In addition, the app A group reported difficulties associated with the pause icon and stated that there was "very little" time to answer (62.5% respectively). Finally, participants defined the use of the devices as complex: 62.5% of the participants in app A considered

TABLE 4 | Hardware and software of the studies' cognitive interventions.

Technology	Hardware									Software			
	PC	Tablet	Smart phone	Robot	Mouse	Screen	Touch screen	Sensor	Gamepad, Joystick, other	Head phones	Program	App	Web platform
X-Torp (Ben-Sadoun et al., 2016)	**Yes**	No	No	No	No	**Yes**	No	**Yes**	No	No	**Yes**	No	No
MINWii (Boulay et al., 2011)	**Yes**	No	No	No	No	**Yes**	No	No	**Yes**	No	**Yes**	No	No
CCS (Djabelkhir et al., 2017)	No	**Yes**	No	No	No	**Yes**	No	No	No	No	No	No	**Yes**
Tangibot (Garcia-Sanjuan et al., 2017)	No	No	**Yes**	**Yes**	No	No	No	**Yes**	**Yes**	No	**Yes**	No	No
LLM (González-Palau et al., 2013)	**Yes**	No	No	No	No	No	**Yes**	No	No	**Yes**	**Yes**	No	No
Web-based CT platform (Haesner et al., 2015)	**Yes**	**Yes**	**Yes**	No	No	No	No	No	No	No	No	No	**Yes**
Telecognitio: app A and B (González-Abraldes et al., 2010)	**Yes** ***	No	No	No	**Yes** **	No	**Yes** *	No	No	No	No	**Yes** ***	No
eWALL (Kyriazakos et al., 2017)	**Yes**	No	No	No	No	No	**Yes**	No	No	No	No	**Yes**	No
Kitchen and Cooking (Manera et al., 2015)	No	**Yes**	No	No	No	No	No	No	No	No	**Yes**	No	No
Serious Game (Tziraki et al., 2017)	No	**Yes**	No	No	No	No	No	No	No	No	**Yes**	No	No

CCS, computerized cognitive stimulation; CT, cognitive training; LLM, long lasting memories; PC, personal computer.
, App A; **, App B; *, Both apps.*

that they had to press the touch screen for too long or that it was inaccurate, while 62.5% of the subjects in app B found it difficult to use the mouse.

Tziraki et al. (2017) engaged in CS via serious games for older adults with dementia and HE. Usability results were positive and, although it took people with dementia longer to complete the tasks, they were able to complete 61% of them and their performance improved with listening cues. Positive results were also obtained in UX for people with dementia, who reported that the games were fun and engaging, listening cues contributing to the latter. In addition, they interacted and spoke to the tablet showing an increase in their self-efficacy, remembering easy and difficult components and developing learning techniques. However, HE found the tool too easy and hardly engaging.

According to the results of X-Torp (Ben-Sadoun et al., 2016), a serious game format with cognitive and physical training, people with Alzheimer's disease and MCI completed fewer tasks and spent more time on them as compared to HE. UX results were consistent with those of usability, as adults with cognitive impairment reported more difficulties (although the results were not significant) and feelings of lack of competence (which increased for everyone). In general, the groups accepted the tool in terms of interest and positive emotions with the difference that people with Alzheimer's disease showed more interest, while HE presented more positive emotions. Furthermore, there was no difference in the time spent by these groups on X-Torp.

As for MINWii (Boulay et al., 2011), which provided CS through a video game and music therapy, all the subjects with Alzheimer's disease held the joystick correctly, 57.1% of them made fewer mistakes and 85.7% took less time to complete the tasks. Few physical and verbal moderator interventions were required. This positive degree of usability was consistent with UX, because participants were generally very satisfied and expressed their desire to continue using it.

TABLE 5 | Usability and UX measures and results of studies in cognitive intervention.

Technology	Usability		UX	
	Measures	**Results**	**Measures**	**Results**
X-Torp (Ben-Sadoun et al., 2016)	Completed tasks	HE > AD, MCI	TAM: Ease of use	-Difficulty: AD, MCI > HE (nss) -Competence: HE > AD, MCI (it increased for all)
	Time to complete tasks	HE < AD, MCI	TAM: Usefulness	Interest: AD, MCI > HE
			PANAS	Positive emotions: HE > AD and MCI
			Time spent doing it*	No differences between groups
MINWii (Boulay et al., 2011)	Errors	4 participants decreased tasks errors	Satisfaction Questionnaire	High satisfaction of all participants
	Time to complete tasks	6 participants decreased the time Everyone held the joystick correctly	Verbalizations and behaviors	Participants expressed a desire to continue
	Interventions by moderator	Verbal interventions decreased Few physical interventions were made		
CCS and CCE (Djabelkhir et al., 2017)	N/A	N/A	Attendance rates	Everyone attended all sessions
			Motivation scale	High levels before and after the intervention by all
			Interviews	Both groups: -Main motivations: resist AD onset and loneliness -Group sessions considered engaging and stimulating -Expressed a desired to continue on a regular basis
Tangibot (Garcia-Sanjuan et al., 2017)	Completed tasks	HE > MCI (nss) MCI > SCI	Verbalizations and behaviors	62.5% of subjects showed enjoyment: HE > MCI, SCI
	Time to complete tasks	HE < MCI SCI ≈ MCI	Questions about whether they liked it - interview	80% of participants liked it: HE > MCI, SCI
	Errors	SCI > MCI, HE HE > MCI (nss)		
	Unnecessary actions	HE < MCI		
	Interventions by moderator	57.5% of participants needed help: SCI > MCI, HE		
LLM (González-Palau et al., 2013)	Interventions by moderator	Needed explanations: PWD, MCI > HE	Satisfaction scale	No differences between groups: -73.0% it met their expectations -66.9% felt confident using technologies -83.7% found it beneficial to health
			Affective scale	No differences between groups: 79.0% had fun
			Sustainability scale	No differences between groups: -78.1% thought it would be worth paying -84% expressed a desire to continue -96.1% would recommend it
			Ease of use and learn scale	-60.1% of participants found it easy to learn -40% of PWD found it harder to use without help

(Continued)

TABLE 5 | Continued

Technology	Usability		UX	
	Measures	**Results**	**Measures**	**Results**
Web-based CT platform (Haesner et al., 2015)	N/A	N/A	Interviews	MCI subjects would prefer audio-video communication, but not with strangers HE would prefer messages or emails MCI > HE: preference to sessions outside of a classroom environment, have adapted levels of difficulty, receive personal feedback Both groups would like to: Use it on a regular basis for cognitive health Repeat exercises as often as they wished Have a variety of playful exercises Have a preliminary and subsequent progress tests Have not potential distractions: loud noises, bright colors, lots of animations Have cognitive self-educational supplement Have background information about other users Personal data to be handled confidentially Be run by a trusty church, government, medical services
			Technology Commitment Questionnaire	HE > MCI: 44.8/60 and 35.5/60 respectively
Telecognitio: app A and B (González-Abraldes et al., 2010)	N/A	N/A	*Ad hoc* questionnaire	Exit icon difficulty: A > B, 50% and 37.5% respectively Difficulty retaining questions: A > B, 100% and 37% respectively Hardware difficulty: A ≈ B, 62.5% accuracy and pulse time errors on touch screen and 62.5% handling the mouse, respectively App A: 62.5% pause icon difficulty 62.5% considered "very little" the time to respond
eWALL (Kyriazakos et al., 2017)	N/A	N/A	UEQ	MCI participants preferred cognitive exercise, activity and sleep apps
			TAM	
Kitchen and Cooking (Manera et al., 2015)	Completed tasks	70% successfully completed	Satisfaction scale	High satisfaction: AD > MCI
			Interest scale**	It interested them
			Motivation scale**	Intrinsic motivation > external motivation
			PANAS	Positive emotions > negative emotions
			PFS	Not very fatigued
			Time spent doing it*	3h 48 min at home
			Tasks done*	85% done at home
Serious Game (Tziraki et al., 2017)	Completed tasks	61% completed correctly by PWD. Auditory cueing improved their performance	Verbalizations and behaviors	HE: Found it too easy and not highly engaging PWD: Expressed fun and engaging. Auditory cueing improved their engagement Increased their self-efficacy Interacted and spoke to the tablet Remembered certain easy and difficult components Developed learning techniques
	Time to completed tasks	HE < PWD		

***AD**, Alzheimer disease; **app**, application; **CCE**, computerized cognitive engagement; **CCS**, computerized cognitive stimulation; **CT**, cognitive training; **h**, hour; **HE**, healthy elderly; **LLM**, long lasting memories; **MCI**, mild cognitive impairment; **min**, minutes; **N/A**, not apply; **nss**, not statistically significant; **PANAS**, positive affect negative affect scale; **PFS**, piper fatigue scale; **PWD**, people with dementia; **SCI**, severe cognitive impairment; **TAM**, technology acceptance model; **UEQ**, user experience questionnaire; **UX**, user experience.*

**, participants were free to do the tasks as much as they wanted.*

***, adapted from Gourlan et al. (2013).*

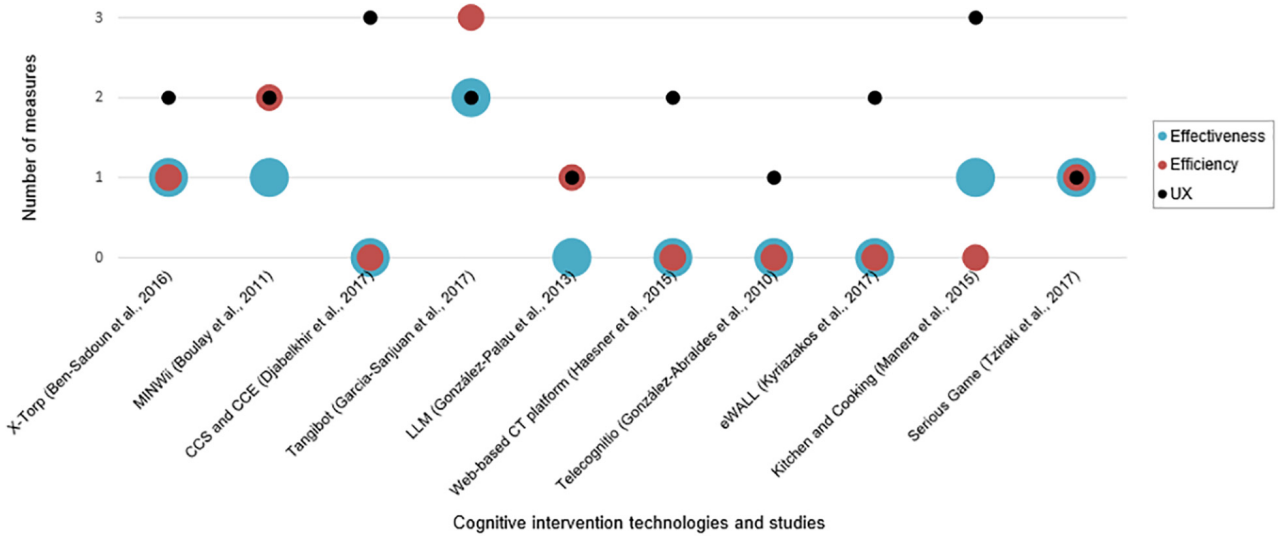

FIGURE 2 | Number of effectiveness, efficiency, and UX measures used in the studies.

Cognitive Training Technologies

In LLM (González-Palau et al., 2013), CT was performed via cognitive exercises to be completed by older adults with cognitive impairment (MCI and dementia) and HE. It also included a physical training function. In terms of usability, subjects with cognitive impairment were found to need more moderator explanations than HE. The perception of some people with dementia coincided with this fact in their UX, as 40% of them found it harder to use without help. However, 60.1% of participants found it easy to learn in general. In addition, the fact that 79.0% of the participants had fun and felt satisfied proved high acceptability of this tool: 73.0% reported that it met their expectations, 66.9% felt confident using technologies, and 83.7% found it beneficial for their health. There were also positive results in sustainability, as 78.1% thought it would be worth paying for it, 84% expressed a desire to continue using it and 96.1% would recommend LLM.

Haesner et al. (2015) used existing CT platforms and social media with older adults with MCI and HE to gather information about their preferences to develop their own web-based CT platform with cognitive exercises. Only UX measurements were taken. Both groups agreed that they would like to use it regularly for cognitive health, repeat the exercises as often as they wished, have a variety of playful exercises, have a preliminary and subsequent progress tests, have no potential distractions (such as loud noises, bright colors or too many animations), have a cognitive self-educational supplement, have background information about other users, have personal data handled confidentially and have the platform run by a trusted institution (church, government, or medical services). On the other hand, the differences between the groups were that HE preferred messages or emails, while MCI subjects preferred audio-video communication, although not with strangers. Likewise, the MCI group expressed a preference for sessions outside a classroom environment and adapted levels of difficulty and would like to receive personal feedback. However, HE showed more engagement with technology than older adults with MCI (44.8/60 and 35.5/60, respectively).

The CT serious game program called Kitchen and Cooking (Manera et al., 2015), was used with older people with MCI and Alzheimer's disease obtaining positive usability results, since 70% of the tasks were successfully completed. UX results were also positive, because the participants were generally interested, did not get very tired, played freely for an average of 3 h 48 min and performed 85% of the scenarios at home. In addition, they were motivated (intrinsic motivation being higher than extrinsic), felt more positive emotions than negative ones and were highly satisfied (people with Alzheimer disease showed more satisfaction than those with MCI).

The eWALL platform (Kyriazakos et al., 2017) provides CT in video game format and also includes home assisted environment functions. Only UX was measured, the results showing that MCI participants preferred cognitive exercise, activity and sleep apps. Finally, in another study (Garcia-Sanjuan et al., 2017), older adults with MCI, severe cognitive impairment and HE received CT in game format through the Tangibot robot. Usability measures showed that subjects with severe cognitive impairment had more difficulties, completed fewer tasks, made more mistakes and needed more help from the moderator. However, the time they spent on completing the tasks was similar to that spent by people with MCI, and 57.5% of the participants needed help. On the other hand, HE performed fewer unnecessary actions, took less time to complete the tasks, and completed more tasks than older adults with MCI. Regarding the latter, the difference was not significant, and neither was the fact that they made more mistakes than individuals with MCI. Overall UX results were positive: 62.5% expressed enjoyment and 80% liked it, although HE showed it more than individuals with cognitive impairment.

DISCUSSION

This systematic review presents current measures and characteristics of usability and UX in the field of CS, CT and CR technologies for older adults with MCI or dementia. This is relevant because of the importance of developing cognitive intervention systems in a digital age where technology is required to cater for the needs and particularities of this population group. A total of 10 studies were selected: five aimed at CS and five at CT. Most of them used a serious game format (n = 6), while the others consisted of cognitive exercises. The prevalence of the serious game format is consistent with other studies that support it as an increasingly popular alternative for the treatment of cognitive impairment because of its contribution to user motivation (Johnson et al., 2016; Manera et al., 2017). In addition, most were fundamentally computer-based programs (n = 6), which is also consistent with other studies where this hardware is found to facilitate older adults' interaction with technology (Góngora Alonso et al., 2019).

Given the ongoing debate on the relationship between usability and UX as broad terms that can overlap, this review took the position of considering UX (which focuses on the subjective area) as an extension of usability (which also evaluates objective items) (Tractinsky, 2018; Sauer et al., 2020). This allowed a consistent categorization in the different studies found where each had its own position. Both usability and UX were measured in 6 of the studies, while the other four focused on UX.

Effectiveness and efficiency appeared in the studies among the measurement of objective aspects of usability. Effectiveness consisted of counting the number of tasks that were completed by the participants (n = 4) and the number of mistakes (n = 2). According to Georgsson and Staggers (2016), these are the most commonly used effectiveness measures to provide information on how easy or difficult it was for subjects to solve them and of the obstacles that hindered their progress. However, apart from knowing whether the individual managed to complete the task, the resources he/she used are also important (International Organization for Standardization [ISO], 2019b), which is where efficiency comes into play. In the studies found, efficiency involved the time spent by participants on completing the tasks (n = 4), the number of unnecessary actions (n = 1) and moderator assistance (n = 3). These measures are consistent with other investigations (Landman et al., 2014; Bevan and Carter, 2016) where time spent on task completion is commonly used (Georgsson and Staggers, 2016).

Regarding UX, which allows the measurement of subjective aspects of usability, almost all the studies found used questionnaires and scales (n = 8). According to Albert and Tullis (2013), these self-reporting data collection tools provide the most relevant information about users' perceptions: if they report positive feelings or reactions about a technology, then they are likely to use it or reuse it. Some of the scales and questionnaires in the review were already standardized (e.g., TAM, PANAS, UEQ). Carvajal et al. (2011) emphasizes the use of standardized tools as a means of ensuring measuring quality, since they are valid, reliable, precise and feasible. The standardized and non-standardized questionnaires/scales found were not only about satisfaction, but encompassed other dimensions such as acceptability, which according to Borsci et al. (2020) is related, as well as other elements that are considered to be part of UX such as motivation, affectivity, perceptions and sustainability (Kramer, 2012; Lallemand et al., 2015).

The other tools found to measure UX consisted of observing participants' behavior while they interacted with the cognitive intervention technologies and conducting interviews. According to Hartson (2019), both are necessary, because they are a way of gathering information about what subjects express in their verbal and non-verbal behavior, as well as what they report. In addition, other measures of UX found were time spent and number of tasks that participants performed freely at home as often as they wanted, alongside attendance rates when tasks were performed at a center. These indicators of how often a program is used are linked to UX and are indicative of whether or not the technology system will be successfully implemented (Hong et al., 2014; Partala and Saari, 2015).

On the other hand, the study by Haesner et al. (2015) was different from the others in this review, because these authors only presented evidence of already existing technology and CT program exercises to gather information and develop their own software in the future. Although it could be argued that preferences and attitudes not linked to a current experience are not considered UX (Albert and Tullis, 2013), such criticism does not apply in this case, since UX can involve indirect interaction, which can trigger a certain behavior, and because of the effect of observing and thinking about the system, product or service (Albert and Tullis, 2013; Hartson, 2019).

Furthermore, because effectiveness and efficiency focus on objective aspects of usability while UX focuses on subjective aspects such as satisfaction, it is important to be aware of the differences and similarities in the studies' measurement results. According to Pluye et al. (2009), although quantitative and qualitative data may seem divergent, they actually have great potential to improve assessment and understanding of the topic in question.

In the studies of CS and CT technologies found (González-Palau et al., 2013; Ben-Sadoun et al., 2016; Garcia-Sanjuan et al., 2017; Tziraki et al., 2017), usability measures were consistent in that the performance of older adults with dementia or MCI was poorer (they completed fewer tasks, took longer to complete them or needed more help) as compared to that of healthy elderly people, which was also observed in other studies on their general functioning (de Frias et al., 2009). If both population groups are compared, usability results may appear negative for individuals with cognitive impairment; however, if attention is paid to the latter's performance, it can be observed that, despite their difficulties, they were able to complete a considerable number of tasks, reduce their errors and time spent on task completion, and also lengthen their period of interaction with the program. These results can also be seen in the studies found that only included individuals with cognitive impairment in their measurements (Boulay et al., 2011; Manera et al., 2015), and are in line with Holthe et al. (2018), who stress that technology programs with

adequate usability allow people with lower cognitive capacity to achieve goals because they are user-friendly.

It is also essential to know how older adults with MCI or dementia regard their experience with the relevant technological intervention, given that it will help to improve its usability and success (Foster, 2014; Holthe et al., 2018). Regarding the measurements of UX reported in the review, in some studies people with cognitive impairment perceived difficulties in using the technological tool without help or in using certain icons and devices (González-Abraldes et al., 2010; González-Palau et al., 2013; Ben-Sadoun et al., 2016). These subjective data results are related to the objective performance data described above. However, these difficulties did not prevent them from having a positive experience, and, according to most of the studies they reported feelings of satisfaction, fun, engagement, interest, motivation, acceptability, a desire to continue using it as often as they wished, and even an increase over time in their feeling of self-efficacy (González-Abraldes et al., 2010; Boulay et al., 2011; González-Palau et al., 2013; Haesner et al., 2015; Manera et al., 2015; Ben-Sadoun et al., 2016; Djabelkhir et al., 2017; Garcia-Sanjuan et al., 2017; Kyriazakos et al., 2017; Tziraki et al., 2017).

These positive results are further supported by the low number of dropouts reported in the studies, most of which were due to medical problems associated with old age and aspects that were beyond the subjects' control. Torous et al. (2020) argue that UX and dropouts are strongly related, and that the degree of dropouts depends on how the technology was introduced. In this regard, most of the studies in the review included a period for older adults to become familiar with the cognitive intervention tool. On the other hand, half of the technological tools contained other functions besides CT, which could have influenced the results of the usability and UX measurements obtained. In fact, Contreras-Somoza et al. (2020) indicate that complementing cognitive intervention systems with social or emotional functions could improve adherence.

Finally, it is important to consider this review's limitations. First, most of the studies were conducted in Europe and most of the participants were women. As is known, sex and social background influence a person's characteristics (McCarrey et al., 2016). Second, no studies were found on usability or UX of CR technology, perhaps because CR focuses on improving functionality in activities of daily living, i.e., it is not restricted to cognitive tasks (Oltra-Cucarella et al., 2018). Third, some studies had few participants with dementia or MCI, although they equally provide relevant data in a field where few investigations were found. However, studies on participatory design or user-centered design could provide more data, even if they do not focus specifically on usability and UX evaluation. Computer sciences and engineering publications could also provide data in this area, although these sciences do not usually approach it from a clinical perspective. Fourth, not all studies provided detailed information about their software and hardware, as did other studies (Irazoki et al., 2020); nevertheless, for the purposes of this review they gave an overview of the technology used. Fifth, another limitation is not having assessed the risk of bias and the quality of the studies; however, only articles published in scientific journals were used. Finally, comparing instruments that measure usability and UX was challenging, because there is no consensus on these broad terms (Sauer et al., 2020) and there are also few studies involving older people with dementia or MCI, which may be due to a certain skepticism about the level of feedback they can provide and doubts about the appropriateness of testing prototypes on them, since possible mistakes can make them feel confused and disappointed with new technologies (Boman et al., 2014; Holthe et al., 2018).

CONCLUSION

This systematic review identified 10 studies that measured usability and UX in cognitive intervention technologies for older people with dementia or MCI. The studies showed lack of scientific consensus on the relationship between usability and UX, most of them using measures indiscriminately. This review's approach to UX (which focuses on subjective data) as an extension of usability (which also evaluates objective data) made it possible to consistently categorize the tools used to measure these parameters.

The objective measurement of usability, efficiency and effectiveness data led to the conclusion that older adults with cognitive impairment can complete a considerable number of tasks, even though they require more time and help in technological cognitive interventions. Likewise, questionnaires and scales were the most widely used tools to measure the subjective data of satisfaction and its related dimensions, the results showing that they regarded it as a positive experience, despite certain difficulties involving elements of the interface or the devices.

Measuring usability and UX in cognitive intervention technologies for older adults with MCI or dementia provides an integrated view that can contribute toward their proper development, since it is not only important to know if the technology is easy to use to achieve the therapeutic goals, but also whether the user perceives it as pleasant. To take these measurements it is essential to involve the target population: older people with cognitive impairment, who can give valuable feedback, despite their difficulties.

For future work, more research is needed to include this population group in usability and UX studies, as well as standardized tools and consensus on the relationship of these terms, which are crucial to guarantee the future effectiveness and success of technological interventions in the field of CS, CT, and CR. In this sense, it would also be interesting to compare the usability and UX results with effectiveness results. Finally, it is also necessary that studies give more information about the software and hardware features in order to have a more enriching view of usability and UX measures.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

AUTHOR CONTRIBUTIONS

L-CS and MF-M conceived the presented systematic review. LC-S, EI, and AD-B performed the data collection and were supervised by JT-G. LC-S drafted the manuscript with feedback of JT-G and IT-D. MP-B and EP-V provided the further critical feedback. MF-M, JT-G, and LC-S revised the last version of the manuscript. All the authors contributed to the manuscript and approved the submitted version.

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5.2 Publicación II

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Título:

Estudio sobre la aceptabilidad de una plataforma TIC para personas mayores con deterioro cognitivo leve

Resumen:

Introducción: el envejecimiento de la población impacta en los servicios de atención social, finanzas públicas y mercado laboral. En el envejecimiento ocurre un declive físico y cognitivo, tendiendo a su vez al aislamiento social que supone una amenaza para su vida independiente. El DCL suele ser una etapa de transición entre el envejecimiento y la demencia, comprometiendo esta última su capacidad para realizar actividades cotidianas. Por lo que es fundamental promover un envejecimiento saludable. EhcoBUTLER es una TIC en desarrollo financiada por la Unión Europea (H2020; ID: 643566), destinada especialmente a personas mayores con DCL para mejorar su salud, independencia y calidad de vida, sobre todo a nivel social.

Objetivos: evaluar la aceptabilidad de ehcoBUTLER mediante una encuesta realizada a usuarios potenciales (personas con DCL) y actores implicados en su cuidado (cuidadores informales, cuidadores formales y personal de administración/gestión), explorando sus expectativas y preferencias; anticipando al mismo tiempo los requisitos funcionales del sistema.

Método: 313 personas fueron incluidas (11% usuarios finales, 25% cuidadores informales, 48% cuidadores formales y 16% personal de administración/gestión), provenientes de España, Italia, Grecia, Países Bajos, Eslovenia, Francia, Serbia e Israel. La encuesta ad hoc se realizó en línea, excepto en los casos donde la entrevista telefónica o presencial era el método de contacto más apropiado.

Resultados: los participantes valoraron positivamente las distintas funcionalidades de ehcoBUTLER. El 86,1% lo percibió como un sistema interesante y útil. También lo valoraron como un producto comercialmente atractivo (75,1%). Los usuarios finales expresaron una mayor preferencia por el módulo social y estarían dispuestos a pagar

un precio mensual bajo por ehcoBUTLER. Los profesionales estarían dispuestos a pagar eligiendo modularmente sus funcionalidades, pero también esperarían que fuera financiado por el Sistema Nacional de Salud, centros o empresas.

Conclusiones: los participantes consideraron ehcoBUTLER interesante, útil y ergonómico. Sin embargo, para implementarlo eficazmente es necesario superar la brecha digital y abordar el problema de la insuficiente inversión en productos dirigidos a personas mayores con deterioro cognitivo. Además, complementar los sistemas de entrenamiento cognitivo con funcionalidades sociales, emocionales o de entretenimiento podría mejorar la adherencia a su uso.

Palabras claves: aceptabilidad, TIC, estimulación psicosocial, entrenamiento cognitivo, adultos mayores, DCL

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PATIENT FACING SYSTEMS

Study on the Acceptability of an ICT Platform for Older Adults with Mild Cognitive Impairment

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Abstract

EhcoBUTLER is an Information and Communication Technology (ICT) solution funded by the European Union (H2020; ID: 643566) and intended especially for elderly people with mild cognitive impairment (MCI) to improve their health, independence and quality of life, particularly at the social level. The purpose of this study is to assess the acceptability of ehcoBUTLER based on a survey delivered to potential users and actors involved in their care, exploring their expectations and preferences, while anticipating the system's functional requirements. The survey was delivered online to 313 participants (11% end users, 25% informal caregivers, 48% formal caregivers and 16% administration/management staff) from eight countries. Participants rated the different functionalities of ehcoBUTLER positively, 86.1% perceiving it as an interesting and useful system. Likewise, they assessed it as a commercially attractive product (75.1%). End users expressed a stronger preference for the social module. Nevertheless, they would be ready to pay a low monthly price for ehcoBUTLER. Professionals would be willing to pay choosing its functionalities modularly, but they would also expect it to be funded by the National Health System, centres or businesses. The conclusion is that all participants found ehcoBUTLER interesting, useful and ergonomic. However, to effectively implement it, it is necessary to bridge the digital gap and address the issue of insufficient investment in products aimed at older adults with cognitive impairment. To supplement cognitive training systems with social, emotional or entertainment functionalities could improve adherence to their use.

Keywords Acceptability · ICT · Psychosocial stimulation · Cognitive training · Older adults · MCI

This article is part of the Topical Collection on *Patient Facing Systems*

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Introduction

The world population is ageing [1] and it impacts on social welfare, government finances and labour markets [2]. A common characteristic of ageing is the onset of physical or cognitive problems [3]. Forms of mild cognitive impairment (MCI) are common [4]: epidemiological studies on MCI in different continents show a prevalence between 5.0% - 36.7% [5]. MCI is often found to be a transitional stage between normal aging and dementia [6], and can result in memory loss or distraction issues [7]. The next step from cognitive impairment is dementia, which is characterized by increased memory loss, decreased attention span and loss of skills for performing daily activities [8].

Older people are also vulnerable to social isolation [9, 10], which poses a threat to independent living [11] and increases their mortality [12]. Lack of social interaction can be a consequence of the onset of cognitive and physical impairment, retirement, death of loved ones, living on their own or in institutions [13]. It is essential, therefore, to promote healthy

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Table 1 Services and applications of the ehcoBUTLER system

Service	Goal	Applications within the service
Emotional tools [28]	Early prevention and detection of anxiety and/or depression symptoms	Screening for Anxiety/Depression My Memories Cheerful and Relaxing Nature Book of Life
Social tools [29]	Foster social relationships and increase social capital	Videoconference E-mail Friend Search News Social Profile Share on Book of Life
Leisure tools [29]	Facilitate access to new Internet applications	EhcoBUTLER Compatible Apps Market Internet Access Bookmarks
Cognitive training tools [31, 32]	Leisure tools for prevention Professional tools for intervention	Leisure GRADIOR Therapy GRADIOR
Lifestyle [33–35]	Promote healthy lifestyles	Nutrition Fall Detection Activity Calendar
Ergonomics [36, 37]	Facilitate autonomy and technological learning	Avatar –Written/Audio Support Ergonomic Design Multilanguage Features

ageing and optimize social participation [14]. This justifies the developing tools aimed at fostering social interaction as well as cognitive stimulation and training to improve the elderly population's quality of life [15, 16].

Information and Communication Technologies (ICT) are currently known to be useful to reduce social isolation in the elderly by allowing them keep in touch with the outside world, gain social support, participate in activities and boost their self-confidence [17, 18]. Furthermore, older adults who use computers have been observed to be at a lower risk of receiving a diagnosis of dementia up to 8.5 years later [19].

EhcoBUTLER is an ICT platform in development, aimed at facing the challenge of active and healthy aging, especially in elderly with MCI at social level, with different services and modules in which each user can choose the tools that they wish to use. However, its potential benefits can be negatively affected by social issues, interest, motivation, cognitive/physical capacity or the place where they live [16], so it is necessary to examine variables that allow predicting the acceptability that its functionalities will have in the direct and indirect users. The Technology Acceptance Model provides the theoretical background for a methodology to assess users' acceptance [20]. The variables perceived ease-of-use and perceived usefulness are important in the shaping of attitudes, behavioural intention and final decision to use the technology concerned [21, 22]. The elderly's acceptance

Table 2 Modules for each stakeholder

Stakeholders	Modules
End users	Ergonomic design Free time and leisure module Cognitive module Lifestyle model Emotional care model Social care module
Formal caregivers	Main module for patient management and telecare Lifestyle management module Physical training management module Module for the management of emotional monitoring Module for the management of social networking tools Module for the management of cognitive training
Informal caregivers	Support for the family care module Social module for families
Administration and management staff	Management of the centre Patient management module Free time and leisure management module Module for the management of cognitive training tools Multimedia management module

Table 3 Variables measured for all users

Variable	Response scale
Interest as a system	0–10 (0 = None, 10 = High)
Perceived usefulness	0–10 (0 = None, 10 = High)
Future purchase intention	0–4 (0 = Definitely not, 4 = Very probably)
Interest in purchasing hardware	a. I would rather use my own b. I would rather have all the devices installed (computer, touchscreen, ergonomic keyboard, etc.)
How much would you pay for the system?	Open question
Interest as a product	a. Yes, I think it's interesting b. No, I don't need it c. No, it's too complex d. No, I wouldn't pay for the hardware e. Other

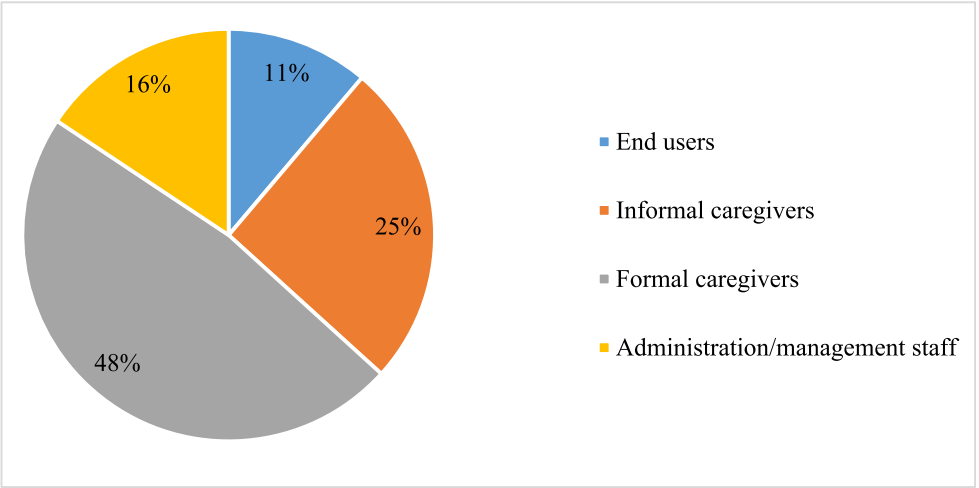

Fig. 1 Stakeholders sample

of technology is also influenced by reliability, cost and technological expertise [23]. Therefore, it is crucial for technologies, like ehcoBUTLER, to be developed according to user's needs, abilities and interests. Likewise, helping older people to bridge the digital divide will bring greater integration and will benefit all society [24].

The purpose of this study is to assess the acceptability of ehcoBUTLER by means of a survey delivered to potential users and actors involved in their care, as essential part of its development in the European project.

Method

This qualitative study was based on an ad hoc online survey, because it allows gathering and analyzing information of the characteristics and attributes of a larger representative sample [25] which, in line with the human-centred design, will enable the identification of system's functional requirements and develop an useful and acceptable technological tool according to the needs and conditions of users and interested actors [26].

Participants

The survey was completed by 375 individuals. To recruit them, each project partner selected representative users who were going to be subjected to the tool (business model). Therefore, the sample conformed was naturalistic of each partner, in which 5 partners were from Spain, 2 from Italy and 1 from Greece, Netherlands, Slovenia, France, Serbia and Israel respectively. The participants were categorized into end users, informal caregivers, formal caregivers and administration/management staff.

Inclusion criteria

- End users: individuals over the age of 60 with MCI who had obtained scores between 23 and 27 on the Mini-Mental State Examination (MMSE) [27].

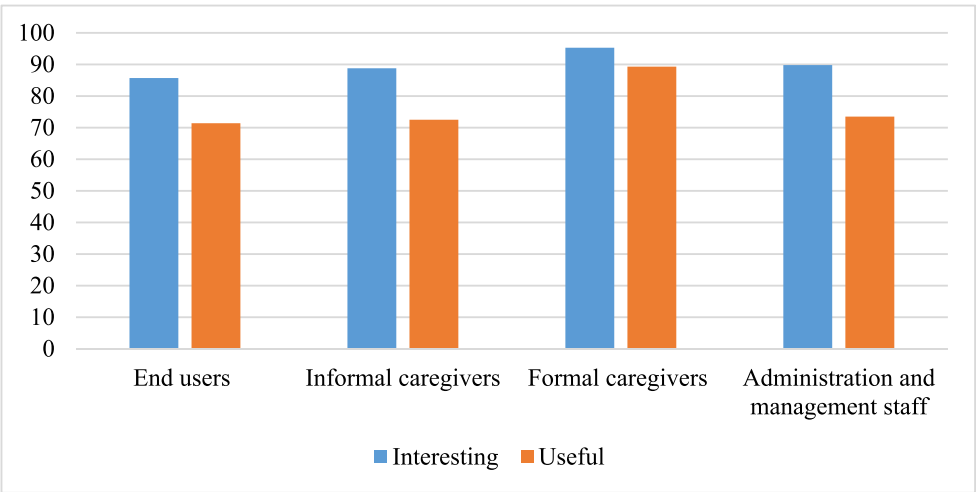

Fig. 2 Stakeholders' interest and perceived usefulness for ehcoBUTLER

Table 4 Stakeholders' ehcoBUTLER purchase probabilities

	Purchase probability	End users	Informal caregivers	Formal caregivers	Administration/management staff
Negative score	Not at all likely	1 (2.9%)	2 (2.5%)	2 (1.3%)	1 (2.0%)
	Unlikely	5 (14.3%)	15 (18.8%)	16 (10.7%)	2 (4.1%)
	I don't know	11 (31.4%)	15 (18.8%)	44 (29.5%)	16 (32.7%)
	Total	17 (48.6%)	32 (40.0%)	62 (41.6%)	19 (38.8%)
Positive score	Probable	14 (40.0%)	32 (40.0%)	64 (43.0%)	18 (36.7%)
	Very likely	4 (11.4%)	16 (20.0%)	23 (15.4%)	12 (24.5%)
	Total	18 (51.4%)	48 (60.0%)	87 (58.4%)	30 (61.2%)

- Informal caregivers: family, friends or neighbours providing care and support to elderly with MCI.
- Formal caregivers: individuals with professional qualifications or training to meet the needs of the elderly population (social workers, healthcare providers, people in the area of social welfare, outpatient care, members of activity centres or charities).
- Administration/management staff: people whose role consists of administering and facilitating their products/services to the elderly population (telehealth/telecare companies, hospitals and insurance companies).

Materials

Online survey

An ad hoc online survey was produced for each stakeholder with the purpose of exploring their general views on ehcoBUTLER. End users were administered a version that also assessed their opinion of each module. Sociodemographic data were collected from all participants. The survey was developed using SurveyMonkey cloud-based software (https://es.surveymonkey.com/r/QYW6ST6).

Video demonstration

The versions of the survey included an initial video displaying all the functionalities and customized modules of ehcoBUTLER. Table 1 shows the services and applications offered by it. Most of these have been validated in previous studies and refactored to fit this project:

Procedure

Survey preparation and dissemination

An ad hoc online survey was developed for this study, including variables that indicated interest in the tool [36], perceived usefulness and economic parameters for the analysis of marketing opportunities. Finally, there were questions to gather qualitative information about ehcoBUTLER.

The survey was developed in English and each partner translated it into the official language of its country (Spanish, Dutch, French, Italian, Greek, Hebrew, Serbian and Slovenian). Subsequently, SurveyMonkey was used to distribute the survey in each country. Each partner prepared a list of potential users according to their own business model. Stakeholders were contacted via an e-mail requesting their participation in the survey through a personalized link. When such means was not available or was not the most suitable method of contact, psychologists/team partners conducted telephone or face-to-face interviews asking for their participation and assessment. Respondents were selected through convenience sampling.

Description of the Survey

The introduction to the survey consisted of a video demonstration of ehcoBUTLER and its modules, explaining the

Table 5 Stakeholders' preferences for using their own devices or for ehcoBUTLER to provide them

Stakeholders	Use their own devices	Use ehcoBUTLER devices	No answer
End users	15 (42.9%)	16 (45.7%)	4 (11.4%)
Informal caregivers	44 (55.0%)	29 (36.3%)	7 (8.8%)
Formal caregivers	66 (44.3%)	79 (53.0%)	4 (2.7%)
Administration /management staff	14 (28.6%)	30 (61.2%)	5 (10.2%)
Total	139 (44.4%)	154 (49.2%)	20 (6.4%)

Table 6 Intention to purchase the ehcoBUTLER system

	n (%)	Amount willing to pay	Do not know (%)
End users	30 (85.7%)	9.50€/month	5 (14.3%)
Informal caregivers	73 (91.3%)	20€/ month	7 (8.8%)
Formal caregivers	98 (65.8%)	35€/ month	51 (34.2%)
Administration/management staff	37 (75.5%)	50€/month	12 (24.5%)

Note: **n** = Sample

purpose, main features and details of the design. This was followed by the collection of sociodemographic data. Subsequently, the versions of the survey were delivered according to user type and all included a brief description of ehcoBUTLER's modules, which was different for each of the stakeholders (Table 2).

All stakeholders were required to give their general opinion of the platform in the survey, which included 5 questions (Table 3).

End users were additionally required to assess each module using 5 categories (interesting, useful, necessary, satisfies your needs and improves the care you receive) on a 6-point Likert scale (0 = Not at all; 6 = Absolutely) (Appendix, Table 14). This is how whether there were any modules requiring adaptations according to end users' needs and expectations was explored.

Results

Participants

Of the 375 individuals who completed the survey, 62 were excluded from the analysis: 56 for incomplete data and 6 end users for not meeting the MMSE score inclusion criterion. Analyses were conducted on the basis of the answers obtained from 313 participants, most of them were formal caregivers as shown in Fig. 1.

Most of the participants were Spanish women with university qualifications. The average age for caregivers and administration/management staff was 44.6 (±12.3), while that of end users was 76.3 (±8.3). Most of the latter and of the formal caregivers coincided in having income levels between 10,000 and 20,000 €. Only part of the informal caregivers was within such income range, while another coincided with the standard income of administration/management staff (between 20,000 and 40,000 €) (Appendix, Table 15).

General survey

To improve understanding of the results, scores were divided into positive and negative. The results of the general survey show high means of positive scores in all ehcoBUTLER modules: 91.7% of the participants considered it to be an interesting system and 80.5% assessed it as useful (Fig. 2).

Most of the participants (58.5%) showed an interest in buying ehcoBUTLER, especially formal caregivers, followed by informal caregivers, administration/management staff and end users (Table 4).

Most formal carers and administration/management staff would rather ehcoBUTLER provided them with the hardware required to use the platform. Half of the end users also preferred this option, but informal caregivers would rather use their own devices (Table 5).

76% of the stakeholders ($n = 238$) would be willing to pay monthly for having ehcoBUTLER. Administration/management staff was willing to pay the highest amount for it, while end users would pay the least (Table 6).

Among the participants who were uncertain of how much they would be prepared to pay ($n = 75$, 24%), formal caregivers had the greatest difficulty in deciding, invoking reasons such as that the price would depend on the number of modules and usefulness, or that they expected the programme to be financed by the National Health System (NHS), centres or companies.

As for ehcoBUTLER's commercial potential, most of stakeholders believed that it was an interesting product. Formal caregivers showed the highest interest, followed by informal caregivers, administration/management staff and end users (Table 7).

Table 7 Stakeholders' perception of ehcoBUTLER as an interesting product

Stakeholders	Yes, it's interesting	No, I don't need it	No, it's complicated	No, you must pay	Other	No answer
End users	27 (77.1%)	0	1 (2.9%)	1 (2.9%)	2 (5.7%)	4 (11.4%)
Informal caregivers	60 (75.0%)	4 (5.0%)	4 (5.0%)	4 (5.0%)	1 (1.3%)	7 (8.8%)
Formal caregivers	112 (75.2%)	16 (10.7%)	2 (1.3%)	11 (7.4%)	3 (2.0%)	5 (3.4%)
Administration/management staff	36 (73.5%)	1 (2.0%)	1 (2.0%)	2 (4.1%)	3 (6.1%)	6 (12.2%)
Total	235 (75.1%)	21 (6.7%)	8 (2.6%)	18 (5.8%)	9 (2.9%)	22 (7.0%)

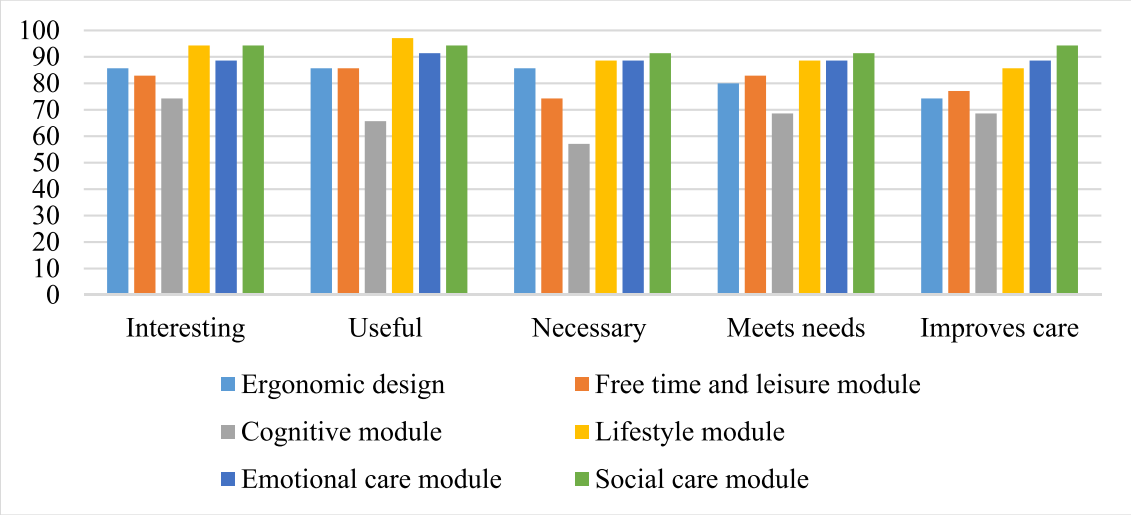

Fig. 3 End users' assessment for each module

End User Survey

End users were surveyed on each ehcoBUTLER's module, assessing on a 6-point Likert scale the following categories for each module: interest, usefulness, need for such service, extent to which it meets their needs and improvement in the care they are receiving (Appendix, Table 14). To make understanding of the results easier, scores were divided into negative (0–3) and positive (4–6).

All modules achieved positive scores. The social care module scored the highest, with 93.1% of the users assessing it positively, while the cognitive module was assessed positively by 66.9% of the users (Fig. 3).

As regards categories, all modules generally received very positive scores, with interesting (86.6%) and useful (86.6%) scoring the highest, while necessary achieved 80.9%. (Fig. 3).

As regards ehcoBUTLER's ergonomic design, intended for easy and autonomous usage, most end users agreed that it was interesting, useful and necessary (85.7% in all cases). The second place was taken by their considering that it could meet their needs and, in the third place was that it would improve the care they were receiving (Table 8).

The free time and leisure module, designed to foster participation in different activities, was mostly assessed as useful by end users (85.7%). In second place, they agreed that it was interesting and might meet their needs, in third place came that it could improve their care, and last of all, their belief that it was necessary (Table 9).

End users made a positive assessment of the cognitive module, aimed at facilitating exercises designed and supervised by professionals to train cognition. The category interesting was the most positively valued (74.3%), followed by the claim that it could meet their needs and that it could improve the care they were receiving. Next came useful and, last, necessary (Table 10).

The lifestyle module, aimed at supporting the performance of everyday activities, was assessed by end users as useful (97.1%). Second came the category of interesting, and third those of necessary and capable of meeting their needs. Improvement of their care came last (Table 11).

Table 8 End users' opinion on the ergonomic design of ehcoBUTLER

Ergonomic design			Interesting	Useful	Necessary	Meets needs	Improves care
Negative score	0	Not at all	0	0	1 (2.9%)	0	1 (2.9%)
	1	Hardly	0	1 (2.9%)	0	1 (2.9%)	1 (2.9%)
	2	Not much	1 (2.9%)	0	3 (8.6%)	2 (5.7%)	4 (11.4%)
	3	Somewhat	4 (11.4%)	4 (11.4%)	1 (2.9%)	4 (11.4%)	3 (8.6%)
	Total		5 (14.3%)	5 (14.3%)	5 (14.3%)	7 (20.0%)	9 (25.7%)
Positive score	4	Sufficient	10 (28.6%)	13 (37.1%)	11 (31.4%)	13 (37.1%)	9 (25.7%)
	5	A lot	10 (28.6%)	8 (22.9%)	13 (37.1%)	9 (25.7%)	8 (22.9%)
	6	Absolutely	10 (28.6%)	9 (25.7%)	6 (17.1%)	6 (17.1%)	9 (25.7%)
	Total		30 (85.7%)	30 (85.7%)	30 (85.7%)	28 (80.0%)	26 (74.3%)

Table 9 End users' opinion on ehcoBUTLER's free time and leisure module

Free time and leisure module			Interesting	Useful	Necessary	Meets needs	Improves care
Negative score	0	Not at all	0	0	1 (2.9%)	0	1 (2.9%)
	1	Hardly	1 (2.9%)	1 (2.9%)	0	0	0
	2	Not much	2 (5.7%)	1 (2.9%)	3 (8.6%)	1 (2.9%)	1 (2.9%)
	3	Somewhat	3 (8.6%)	3 (8.6%)	5 (14.3%)	5 (14.3%)	6 (17.1%)
	Total		6 (17.1%)	5 (14.3%)	9 (25.7%)	6 (17.1%)	8 (22.9%)
Positive score	4	Sufficient	10 (28.6%)	10 (28.6%)	7 (20.0%)	11 (31.4%)	9 (25.7%)
	5	A lot	13 (37.1%)	13 (37.1%)	14 (40.0%)	11 (31.4%)	11 (31.4%)
	6	Absolutely	6 (17.1%)	7 (20.0%)	5 (14.3%)	7 (20.0%)	7 (20.0%)
	Total		29 (82.9%)	30 (85.7%)	26 (74.3%)	29 (82.9%)	27 (77.1%)

The emotional care module, which includes activities aimed at improving mood and fostering positive feelings, was positively assessed by end users. Most of them (91.4%) thought it was useful and coincided in the rest of scores qualifying it as interesting, necessary, capable of meeting their needs and capable of improving the care they were receiving (Table 12).

The social care module includes tools suitable for elderly people that will allow them to communicate with others via the Internet. Most end users considered it interesting, useful and capable of improving their care (94.3% respectively). They also assessed it as necessary and capable of meeting their needs (Table 13).

Discussion

An ad hoc survey was prepared for the purpose of this study and delivered online to learn the degree of acceptability of ehcoBUTLER by elderly people with MCI and by all those involved in their care. EhcoBUTLER is an ICT platform that is currently under development and whose aim is to promote health, independence and quality of life, though mainly at the social level, in elderly people with MCI. The survey was conducted in different countries and respondents were potential direct users (end users with MCI) and indirect users (formal/informal caregivers and administration/management staff), with the purpose of involving them in the development of what is required from ehcoBUTLER.

The findings show that ehcoBUTLER was well accepted as an interesting and useful platform by all the participants. In the general survey, formal caregivers allocated the highest positive scores in such categories: 95.3% assessed it as interesting and 89.3% as useful. This information is relevant, since good acceptance by professionals is essential for any technology's implementation in the healthcare area [37]. In the end users' survey version, the categories of interesting and useful also obtained high positive scores (86.6% respectively). This study is in line with other studies in that the development of new technologies such as ehcoBUTLER may appeal to the elderly population. There is evidence that elderly people tend express high interest in technologies for cognitive stimulation [38] and training [39]. Moreover, users with cognitive impairment perceive cognitive and social support technologies as the most useful tools, also expressing greater willingness to use them [40].

Table 10 End users' opinion on ehcoBUTLER's cognitive module

Cognitive module			Interesting	Useful	Necessary	Meets needs	Improves care
Negative score	0	Not at all	2 (5.7%)	1 (2.9%)	2 (5.7%)	1 (2.9%)	1 (2.9%)
	1	Hardly	2 (5.7%)	2 (5.7%)	2 (5.7%)	2 (5.7%)	3 (8.6%)
	2	Not much	3 (8.6%)	4 (11.4%)	6 (17.1%)	6 (17.1%)	6 (17.1%)
	3	Somewhat	2 (5.7%)	5 (14.3%)	5 (14.3%)	2 (5.7%)	1 (2.9%)
	Total		9 (25.7%)	12 (34.3%)	15 (42.9%)	11 (31.4%)	11 (31.4%)
Positive score	4	Sufficient	12 (34.3%)	9 (25.7%)	10 (28.6%)	11 (31.4%)	11 (31.4%)
	5	A lot	9 (25.7%)	7 (20.0%)	7 (20.0%)	11 (31.4%)	9 (25.7%)
	6	Absolutely	5 (14.3%)	7 (20.0%)	3 (8.6%)	2 (5.7%)	4 (11.4%)
	Total		26 (74.3%)	23 (65.7%)	20 (57.1%)	24 (68.6%)	24 (68.6%)

Table 11 End users' opinion on ehcoBUTLER's lifestyle module

Lifestyle module			Interesting	Useful	Necessary	Meets needs	Improves care
Negative score	0	Not at all	0	0	0	0	1 (2.9%)
	1	Hardly	0	0	0	0	0
	2	Not much	0	0	0	0	0
	3	Somewhat	2 (5.7%)	1 (2.9%)	4 (11.4%)	4 (11.4%)	4 (11.4%)
	Total		2 (5.7%)	1 (2.9%)	4 (11.4%)	4 (11.4%)	5 (14.3%)
Positive score	4	Sufficient	7 (20.0%)	10 (28.6%)	5 (14.3%)	11 (31.4%)	9 (25.7%)
	5	A lot	17 (48.6%)	15 (42.9%)	20 (57.1%)	13 (37.1%)	12 (34.3%)
	6	Absolutely	9 (25.7%)	9 (25.7%)	6 (17.1%)	7 (20.0%)	9 (25.7%)
	Total		33 (94.3%)	34 (97.1%)	31 (88.6%)	31 (88.6%)	30 (85.7%)

On the other hand, while the category of necessary was given a positive score by end users, the rest of categories obtained higher positive scores. The reason for this is that older adults might prefer face-to-face interventions because of the difficulties they find in technologies [41]. Elderly people's lack of experience with technologies reveal the existence of a digital divide, so that education and training in their usage should be a path to bridging it, which is one of ehcoBUTLER's objectives. Likewise, it is important for the design of this technology to focus on the users' perceived needs [40]. In this regard, ehcoBUTLER inherits all its ergonomic design from BUTLER, which in prior studies achieved very positive usability results among seniors [41–42], guiding users by linear navigation and an avatar.

This is endorsed by further studies that maintain that better performance can be expected from older adults (whether healthy or with MCI) if they are provided with a user-friendly introduction [43]. Although the elderly may at first be reluctant to participate for fear of doing it wrong, they can end up enjoying technological tools that motivate them to train their cognitive skills, share their positive experience with family [44] and keep up with the times in an ICT-driven society [45]. The scores achieved by these users on ehcoBUTLER are also encouraging and suggest that its use will be well accepted by its target users.

It is also significant that formal caregivers found the greatest difficulties in deciding the amount they were willing to pay for ehcoBUTLER, stating that they would expect it to be funded by the NHS, centres or companies. This is consistent with the fact that administration/management staff was willing to pay more for the platform, while end users were less willing to pay. These attitude could be explained by the impoverishment that comes with old age due to the reduction/interruption of labour activities [46]. In this regard, the United Nations [47] called for the collaboration of governments, organizations and the private sector suggesting that technology might contribute to an independent life, reduce loneliness

Table 12 End users' opinion on the emotional care module

Emotional care module			Interesting	Useful	Necessary	Meets needs	Improves care
Negative score	0	Not at all	1 (2.9%)	0	0	0	2 (5.7%)
	1	Hardly	0	0	1 (2.9%)	0	0
	2	Not much	0	2 (5.7%)	2 (5.7%)	0	0
	3	Somewhat	3 (8.6%)	1 (2.9%)	1 (2.9%)	4 (11.4%)	2 (5.7%)
	Total		4 (11.4%)	3 (8.6%)	4 (11.4%)	4 (11.4%)	4 (11.4%)
Positive score	4	Sufficient	9 (25.7%)	7 (20.0%)	11 (31.4%)	15 (42.9%)	10 (28.6%)
	5	A lot	13 (37.1%)	16 (45.7%)	12 (34.3%)	13 (37.1%)	18 (51.4%)
	6	Absolutely	9 (25.7%)	9 (25.7%)	8 (22.9%)	3 (8.6%)	3 (8.6%)
	Total		31 (88.6%)	32 (91.4%)	31 (88.6%)	31 (88.6%)	31 (88.6%)

Table 13 End users' opinion on ehcoBUTLER's social care module

Social care module			Interesting	Useful	Necessary	Meets needs	Improves care
Negative score	0	Not at all	0	0	1 (2.9%)	1 (2.9%)	1 (2.9%)
	1	Hardly	0	0	0	0	0
	2	Not much	2 (5.7%)	2 (5.7%)	2 (5.7%)	0	0
	3	Somewhat	0	0	0	2 (5.7%)	1 (2.9%)
	Total		2 (5.7%)	2 (5.7%)	3 (8.6%)	3 (8.6%)	2 (5.7%)
Positive score	4	Sufficient	3 (8.6%)	7 (20.0%)	4 (11.4%)	6 (17.1%)	8 (22.9%)
	5	A lot	14 (40.0%)	8 (22.9%)	10 (28.6%)	15 (42.9%)	10 (28.6%)
	6	Absolutely	16 (45.7%)	18 (51.4%)	18 (51.4%)	11 (31.4%)	15 (42.9%)
	Total		33 (94.3%)	33 (94.3%)	32 (91.4%)	32 (91.4%)	33 (94.3%)

and bridge the age gap. Thus, it is necessary to overcome the digital divide and also that of investment in ageing.

Regarding the study of each module, social care scored the highest (93.1%), while the cognitive module obtained a positive score of 66.9%. These results are proof of the usefulness of social participation and relationships [48], which is the main objective of ehcoBUTLER: counter social isolation in people with MCI; and is how potential users also seem to see it. Nevertheless, a clinical trial on GRADIOR (stimulation, training and cognitive rehabilitation programme, which ehcoBUTLER is associated with) has been scheduled to compare the value of psychostimulation through social participation against direct cognitive stimulation and against the association of both.

Conversely, the above result could have been influenced by the fact that most of the sample were women, who have stronger inclinations towards social integration than men [49]. Likewise, women have been found to be more resilient to age-related cognitive impairment [50].

Finally, it is important to consider this study's limitations. First, samples of each stakeholder were unequal in each country, so it was no possible to compare the results per countries. However, samples were free from selection biases and representative of the population for whom the platform was intended, as well as naturalistic of every project partner according to their business models. The high percentage of positive opinions on ehcoBUTLER substantiate that sample increases would have no impact on the rating obtained.

Another limitation is that there have been missing values for certain variables, especially in the questions related to ehcoBUTLER's commercial potential. Nevertheless, even these questions were answered by more than half of the respondents.

Conclusions

The purpose of this study was to assess the acceptability of ehcoBUTLER. The conclusion drawn is that it is an ergonomic, interesting and useful tool for all the participating users. The social module was considered to be the most useful by older adults, a result that could suggest that clinical tools could improve their acceptability by offering further social functionalities and improving elderly's access to information and social communication skills.

Another important aspect yielded by the study is evidence of an investment gap in products designed for older people with MCI. Care and services for this population requires investment in healthcare tools that may improve autonomy in the use of technologies, so it should be designed according to the capacities of this users and aimed at improving their quality of life at different levels.

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Compliance with Ethical Standards

Conflict of Interest None.

Appendix

Table 14 Categories for each module assessed by end users

	Not at all 0	Hardly 1	Not much 2	Somewhat 3	Sufficient 4	A lot 5	Absolutely 6
Interesting							
Useful							
Necessary							
Meets target population's needs							
Improves care of elderly people in this aspect							

Table 15 Stakeholders' sociodemographic characteristics

Stakeholders	Country	n (Sex)	Age (S.D.)	Education	Income
End users	15 Spain 4 Netherlands 2 Italy 2 France 4 Israel 5 Serbia 3 Slovenia	35(21 W, 14 M)	76.3 ± 8.3	3 P/S 14 PU/VT 18 UD	3 < 10,000€ 11 10,000 – 20,000€ 9 20,000 – 30,000€ 7 30,000 – 40,000€ 5 > 40,000€
Informal caregivers	24 Spain 5 Greece 7 Netherlands 5 Italy 11 France 3 Israel 9 Serbia 16 Slovenia	80 (45 W, 35 M)	46.8 ± 13.1	1 P/S 18 PU/VT 61 UD	12 < 10,000€ 20 10,000 – 20,000€ 19 20,000 – 30,000€ 10 30,000 – 40,000€ 19 > 40,000€
Formal caregivers	77 Spain 29 Greece 4 Netherlands 26 Italy 2 France 5 Israel 5 Serbia 1 Slovenia	149 (89 W, 60 M)	43.3 ± 12.1	1 P/S 7 PU/VT 141 UD	14 < 10,000 46 10,000 – 20,000€ 29 20,000 – 30,000€ 23 30,000 – 40,000€ 37 > 40,000€
Administration/management staff	22 Spain 5 Greece 5 Netherlands 9 Italy 7 France 1 Serbia	49 (29 W, 20 M)	44.7 ± 11.0	1 P/S 0 PU/VT 48 UD	2 < 10,000€ 10 10,000 – 20,000€ 13 20,000 – 30,000€ 13 30,000 – 40,000€ 12 > 40,000€

Note: **n** = Sample; **W** = Women; **M** = Men; **P/S** = Primary/Secondary; **PU/VT** = Pre-university Education/Vocational training; **UD** = University degree; **S.D.** = Standard deviation

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5.3 Publicación III

Contreras-Somoza, L. M., Toribio-Guzmán, J. M., Sánchez-Gómez, M. C., Irazoki, E., Martín-Cilleros, M. V., Verdugo-Castro, S., Parra-Vidales, E., Perea-Bartolomé, M. V., & Franco-Martín, M. Á. (2022). Perceptions of Older People with Cognitive Impairment , Caregivers , and Professionals about ehcoBUTLER (Tablet Health Care Platform): A Qualitative Focus Group Study. *International Journal of Environmental Research and Public Health*, *19*, 1–23. https://doi.org/10.3390/ijerph19116761

Título:

Percepciones de personas mayores con deterioro cognitivo, cuidadores y profesionales sobre ehcoBUTLER (Plataforma para el cuidado de la salud en Tablet): Un estudio cualitativo de grupos focales

Resumen:

Introducción: ehcoBUTLER es una plataforma en desarrollo dirigida principalmente a personas mayores con DCL para promover su bienestar y salud. Sin embargo, para utilizar tecnologías las personas mayores se enfrentan a barreras relacionadas con el declive de sus funciones, falta de conocimientos informáticos y diseños inadecuados; incrementando sus dificultades si tienen deterioro cognitivo. Se necesitan conocer sus perspectivas y las de las partes interesadas para derribar barreras y desarrollar tecnologías que beneficien a todos.

Objetivos: explorar las percepciones y nivel de retroalimentación de usuarios potenciales (personas mayores con DCL o demencia leve) y partes interesadas (cuidadores informales y profesionales de la salud) sobre ehcoBUTLER para mejorar su desarrollo. A través de esta exploración, el objetivo secundario fue contribuir al desarrollo de otros software y aplicaciones que promuevan la salud integral de adultos mayores con deterioro cognitivo.

Método: 49 personas participaron (13 con DCL, 13 con demencia leve, 12 cuidadores informales y 11 profesionales de la salud). Se realizaron 8 grupos focales: 2 grupos de adultos mayores con DCL, 2 de personas con demencia leve, 2 de cuidadores y 2 de profesionales. Se analizó el contenido discursivo y nivel de retroalimentación sobre las siguientes categorías: experiencia previa con tecnología, redes sociales o programas psicosociales, percepción general de ehcoBUTLER y percepción sobre los módulos de echoBUTLER; cada una de las cuales contenía subcategorías.

Resultados: a los participantes les gustó el aspecto de ehcoBUTLER, les gustaría utilizarlo y se interesaron sobre todo por sus herramientas emocionales, de estilo de vida saludable, cognitivas y ergonómicas. No obstante, consideraron necesario contar con: formación previa, aplicaciones más intuitivas y personalizables, de bajo precio o gratuitas, opción de acceder a los contenidos mediante un USB o que no se necesite conexión a Internet, así como añadir otras actividades y funciones.

Conclusiones: ehcoBUTLER está bien orientado para satisfacer las necesidades y preferencias de los usuarios potenciales. Sin embargo, es necesario mejorar su usabilidad, accesibilidad y sostenibilidad. Las perspectivas de los participantes proporcionaron una visión completa para mejorar ehcoBUTLER, de modo que en el futuro pueda beneficiar a las personas mayores para que sean agentes activos de su salud, apoyar a los cuidadores en su papel y que tengan un descanso, y a los profesionales para que dispongan de una plataforma multi intervención. Los presentes hallazgos pueden contribuir al desarrollo de otros software y aplicaciones para Tablet que promuevan el bienestar integral de esta población.

Palabras claves: DCL, demencia, cuidado de la salud, estimulación psicosocial, plataforma para ejecutar en Tablet, aplicaciones, grupos focales, envejecimiento activo

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Perceptions of Older People with Cognitive Impairment, Caregivers, and Professionals about ehcoBUTLER (Tablet Health Care Platform): A Qualitative Focus Group Study

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Abstract: EhcoBUTLER is a tablet platform mainly aimed at the elderly with mild cognitive impairment (MCI) to promote their well-being and health. The main objective of this study was to explore the perceptions and feedback level of the ehcoBUTLER potential users and stakeholders to improve its development. Through this exploration, the secondary objective was to contribute to the development of software/apps that promote their integral health. Focus groups were conducted (13 elderly with MCI, 13 with dementia, 12 caregivers, 11 professionals). The content and feedback level were analyzed. Participants liked the appearance of ehcoBUTLER, would like to use it, and were mainly interested in the emotional, healthy lifestyle, cognitive, and ergonomic tools. It is necessary to have prior training, more intuitive/customizable apps, low-price/free, offline/USB content, and add other activities/features. EhcoBUTLER is well-oriented to meet the needs and preferences of potential users. However, improvements in its usability, accessibility, and sustainability are needed. The participants' perspectives provided a comprehensive view to improve ehcoBUTLER, so that in the future, it can benefit the elderly to be active agents in their health; support caregivers in their role and to have a respite; and professionals to have a multi-intervention platform. The present findings can contribute to the development of tablet software/apps that promote the integral well-being of this population.

Keywords: MCI; dementia; health care; psychosocial stimulation; tablet platform; apps; focus groups; active aging

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1. Introduction

1.1. Background

Older adults often suffer from social isolation, loneliness [1], and cognitive and physical decline [2], which impacts their emotional state [3]. These difficulties may be worsened if cognitive decline progresses to mild cognitive impairment (MCI) and then to dementia [4]. The increase in the life expectancy of the older population represents a challenge to improve their quality of life, while reducing the costs of providing them with care and

health services [5]. In this way, technological innovation can be a help and support to promote their well-being and solve this challenge [5].

New technologies have generated a revolution in health and social care [6]. Technologies have facilitated data entry, processing, and storage [7] and have also enabled the automation of activities and processes, leading to greater efficiency and cost reductions [8]. In addition, they have improved flexibility and access to services for people who are homebound, or who have limited transportation [9]. Furthermore, technologies have improved the quality of health care by enabling greater communication between the professionals and patients and dynamic services that increase the patients' involvement in their health [8].

However, the use of new technologies by the elderly also involves challenges, especially if they have cognitive impairment [10]. They face barriers related to the decline in their functions and lack of computer skills because they were born before the technological revolution [11,12]. In addition, they often face problems related to inadequate design, in which their characteristics and needs are not taken into account, so they feel discouraged in using them [10,13].

Therefore, technologies that are appropriately adapted to an elderly population with cognitive impairment and that promote their well-being stand out. For example, CIRCA (Computer Interactive Reminiscence and Conversation Aid) is an application (app) for people with dementia (PWD) to interact with photos, video, and music on a touch screen, thus promoting their communication with their caregivers [14] and also improving their quality of life [15]. Another example of technology supporting the care of individuals with MCI or dementia is a virtual reality program with real and familiar environments, which has been shown to improve their mental well-being [16].

Regarding the cognitive area, there are various cognitive intervention software for elderly people with MCI or PWD; such a variety allows for the professionals and end users to select the one that best suits their objectives and cognitive needs [17]. In addition, there are games for individuals with MCI or dementia to train cognitive functions such as Kitchen and Cooking, which was considered as interesting and motivating [18]. Furthermore, games can be used for leisure, fun, and recreational purposes [19].

On the other hand, the ReaCT (Rehabilitation in Alzheimer's disease through Cognitive Support Technology) app supports the self-management of PWD through a calendar as the main tool. Functions can be adjusted to suit the needs and preferences of each person, and caregivers also have access to it [20]. Another example is the Digital Memory Notebook (DMN), which is a tablet app to support the independence for individuals with MCI. Most participants perceived that the DMN improved their satisfaction with life and daily activities [21].

It has been shown that older adults with MCI and people with early dementia are interested in using technologies that promote their cognitive functions, lifestyle, and overall health [22]. Therefore, a technology that has the tools to address the various aspects above-mentioned could represent several benefits to this population in a single system.

1.2. EhcoBUTLER

EhcoBUTLER is an Information and Communication Technology that has different modules: healthy lifestyle, leisure and free time, emotional, social, and cognitive care. EhcoBUTLER is funded by the European Union (H2020; ID: 643566) and is under development. Its aims to promote the health, well-being, and independence of older people, especially those with MCI at the social level [23]. EhcoBUTLER also has an ergonomic design inherited from BUTLER, which has demonstrated an adequate level of usability in the older population [12]. As part of its ergonomic design, and to promote its portability, the system was especially adapted for use on a tablet. In addition, touch screen tablets are a relatively inexpensive for people with cognitive impairment to engage in meaningful activities [24].

Another important element of ehcoBUTLER is its linear navigation system, which allows users to use the system step-by-step [25]. Users select the apps they wish to use from

the main menu, and a human-looking avatar explains in audio and text what they can do next. In addition, the buttons have different colors according to their actions: green is for continuing a task; red is for deleting data or undoing a step; and orange implies secondary actions [10].

Family members and informal caregivers of the elderly can access ehcoBUTLER to interact with them and find out what they are doing. In addition, the professionals manage and customize the different modules of the platform and can also use it to communicate with other professionals and relatives of the elderly person.

1.3. Human Centered-Design

Most systems aimed at the elderly population consist of a single app to reduce their mental load; this does not mean that a system with several apps is impossible, but that it requires additional efforts in its design and evaluation [12]. Indeed, elderly people believe that despite the potential benefits of technology, if adequate measures are not taken to help them to use it, the digital divide will expand [26]. It is not only necessary to develop tools that are easy to use, but also to provide a pleasant user experience [27], and a human-centered design would allow for the development of products and services with such features [28].

One of the most widely used tools in human-centered design are focus groups [29], because they allow for a better understanding of the needs and particularities of the users, according to their opinions and attitudes [30,31]. Some studies have conducted focus groups of PWD to develop technologies. For example, key aspects in the design of a virtual environment were identified through the opinions and thoughts gathered from focus groups such as easy access, realistic and age-appropriate content, and tasks with specific objectives [32]. In other research, focus groups of PWD provided insights into the challenges they faced in terms of emotional stability and their requirements to develop a sensor platform to monitor their emotional state at home [33].

More studies are needed that include older people and investigate how they feel about new technologies, their reasons for using them, their frequency, and form of use [34]. In addition, in the development of technological products and services, the perspectives of the elderly and stakeholders are essential to break down barriers and benefit everyone [35]. The participation of PWD is also a challenge [33], because their communication skills are typically one of the most affected [36]. Their difficulties increase as their disease progresses, so it is important to focus on mild dementia to generate interventions from an early stage [37] as well as from the MCI because of their risk of conversion to dementia [38].

1.4. Objective of This Study

The main objective of this study was to explore the perceptions and feedback level of the ehcoBUTLER potential primary users (older adults with MCI and people with mild dementia) and stakeholders (informal caregivers and health professionals) to improve the development of this platform according to their needs, preferences, and suggestions. Through this exploration, the secondary objective was to contribute to the development of tablet platforms and apps aimed at promoting the integral well-being and health of this population.

2. Method

2.1. Design

This is a qualitative study with a phenomenological approach, in which focus groups were conducted. This approach and technique are useful for gathering and understanding a wide range of perceptions, ideas, and opinions by providing an interactive environment where members share and compare their views, encouraging even reserved individuals to participate [39].

2.2. Participants

A total of 49 people participated in the study. Eight focus groups were conducted: two for older adults with MCI, two for PWD, two for caregivers, and two for professionals. Each group consisted of five to eight members to promote their participation [40]. Table 1 details their sociodemographic characteristics.

Table 1. The participants' sociodemographic characteristics.

Participants	Sex	Age	Civil Status	Education Level
P1(MCI)G1	Man	69	Married	Primary school
P2(MCI)G1	Woman	77	Widowed	Secondary school
P3(MCI)G1	Woman	76	Married	Secondary school
P4(MCI)G1	Man	59	Single	Secondary school
P5(MCI)G1	Woman	83	Widowed	Read and write
P1(MCI)G2	Woman	70	Widowed	Primary school
P2(MIC)G2	Woman	87	Widowed	Primary school
P3(MCI)G2	Woman	78	Married	Primary school
P4(MCI)G2	Woman	65	Widowed	Primary school
P5(MCI)G2	Woman	80	Widowed	Read and write
P6(MCI)G2	Woman	82	Divorced	Primary school
P7(MCI)G2	Woman	82	Widowed	Primary school
P8(MCI)G2	Woman	71	Separated	Secondary school
P1(D)G1	Woman	80	Widowed	Read and write
P2(D)G1	Woman	69	Widowed	Primary school
P3(D)G1	Woman	78	Widowed	Read and write
P4(D)G1	Woman	71	Separated	Primary school
P5(D)G1	Man	86	Married	Read and write
P1(D)G2	Man	87	Married	Primary school
P2(D)G2	Man	73	Single	Primary school
P3(D)G2	Woman	77	Widowed	Primary school
P4(D)G2	Woman	50	Separated	University degree
P5(D)G2	Woman	72	Married	Secondary school
P6(D)G2	Woman	77	Widowed	Read and write
P7(D)G2	Woman	81	Married	Primary school
P8(D)G2	Man	93	Widowed	Primary school
P1(C)G1	Woman	51	Single	University degree
P2(C)G1	Woman	36	Married	Associate degree
P3(C)G1	Man	42	Married	Associate degree
P4(C)G1	Woman	37	Married	University degree
P5(C)G1	Woman	49	Divorced	Associate degree
P1(C)G2	Man	73	Married	University degree
P2(C)G2	Woman	78	Widowed	Read and write
P3(C)G2	Man	59	Married	Secondary school
P4(C)G2	Woman	72	Married	Secondary school
P5(C)G2	Woman	50	Married	Associate degree
P6(C)G2	Man	58	Married	Secondary school
P7(C)G2	Woman	45	Single	Associate degree
P1(PR)G1	Woman	27	-	-
P2(PR)G1	Woman	38	-	-
P3(PR)G1	Woman	38	-	-
P4(PR)G1	Woman	29	-	-
P5(PR)G1	Woman	33	-	-
P6(PR)G1	Man	50	-	-
P1(PR)G2	Woman	25	-	-
P2(PR)G2	Woman	35	-	-
P3(PR)G2	Man	39	-	-
P4(PR)G2	Man	26	-	-
P5(PR)G2	Woman	24	-	-

C = caregiver; D = dementia; G = group; MCI = mild cognitive impairment; P = participant; PR = professional.

Potential participants with MCI, dementia, and their caregivers were contacted by telephone, while the professionals were invited by email. They were asked whether they wanted to participate after explaining the aim of the study, the confidentiality of the data, and the estimated duration of the focus groups. In addition, in case any need arose, the caregivers of PWD gave their consent for their relatives to participate.

2.2.1. MCI Groups

They lived in the community and were recruited from the Memory Workshops of INTRAS Foundation (Zamora, Spain). The inclusion criteria were: 55 years or older, have a diagnosis of MCI (meeting the criteria of Petersen [41]) without any associated psychiatric disorder, be able to read and write, and not have vision/hearing difficulties. In addition, the participants had previous experience with a computer-based cognitive stimulation, training, and rehabilitation program called GRADIOR [42,43] from attending those workshops. Thirteen elderly adults with MCI participated. Most of them were widowed (53.85%) women (84.62%) with a primary education (53.85%) and had an average age of 75.31 (SD = 8.05).

2.2.2. Dementia Groups

Participants were recruited from the Memory Workshops and the Memory Clinic of the INTRAS Foundation (Zamora, Spain). They lived in the community and their inclusion criteria were to be 55 years or older, be able to write and read, have no hearing/vision problems, and have a diagnosis of mild dementia without any related psychiatric disorder. Their diagnosis was based on meeting the Diagnostic and Statistical Manual for Mental Disorders (DSM-5) criteria for major neurocognitive disorder, the current term for which was previously called dementia [44].

Participants also had previous experience with GRADIOR from attending workshops or the clinic. A middle-aged adult with early onset of dementia was included as an exception. Thirteen people participated with a mean age of 76.46 (SD = 10.53). Most were widowed (46.15%) women (69.23%) and had a primary education (53.85%).

2.2.3. Caregiver Groups

The inclusion criteria for this group were to be informal caregivers who provided instrumental and accompaniment aids to older adults, and to have previous experience with technological devices. Their recruitment also came from the Memory Clinic of INTRAS Foundation (Zamora, Spain). Twelve caregivers participated, most of whom were married (66.67%) women (66.67%), had an associate degree (41.67%), and an average age of age 54.17 (SD = 14.11).

2.2.4. Professional Groups

This group had the inclusion criteria of: being a health professional (psychologists, neuropsychologists, therapists, etc.) with experience attending older adults with cognitive impairment and had worked or presently worked with technological tools as part of their clinical intervention. Their recruitment came from different departments of the INTRAS Foundation. Eleven professionals participated with a mean age of 33.09 (SD = 7.91) and most were women (72.73%).

2.3. Procedure

The Provincial Hospital of Zamora gave its ethical approval to carry out this study (Protocol Code: 387-E.C.). The focus groups were conducted at the INTRAS Foundation's Memory Clinic (Zamora, Spain) and there were two members of the research team during them: one was the moderator, while the other took manual notes.

The moderator began by explaining the objective of the study, the audio and video recording of the meeting, the data confidentiality, and asked the participants whether they agreed to participate. All of them signed the informed consent form and filled out a

sociodemographic data form. The same accessible room was used for all groups. To avoid interruptions and distractions, a signboard indicated that the meeting was being recorded.

The moderator then showed a video demonstration of ehcoBUTLER, explained its purpose and functions, and asked the semi-structured questions from the scripts. There were three scripts: one for older adults with cognitive impairment, one for caregivers, and another one for professionals.

The script of the elderly and that of their caregivers inquired about their use and preference of technologies and social networks, their general perception of ehcoBUTLER and its main tools, aspects to improve it, how often they would use it, and whether they would be willing to pay for it. The professionals' script differed in asking them about psychosocial stimulation programs, rather than about technologies and social networks.

The moderator redirected the topic when necessary and encouraged all participants to provide their opinion. The focus groups lasted approximately one hour each and, at the end, participants were given a small present to thank them for their collaboration. The verbal content of the discussions was transcribed anonymously for further analysis. All of the material was carefully stored in a security filing cabinet, where only the team's researchers had access.

2.4. Data Analysis

First, the sociodemographic data of the participants were analyzed; the SPSS statistical program (version 25) was used to obtain their percentages, means, and standard deviations. Second, the NVivo 12 Plus program was used for the analysis of the focus group data because it makes coding and node management more efficient. Based on the scripts and themes discussed in the focus groups, homogeneous categories and subcategories were created for all groups, in order to have the same coding system and compare the content of the groups in relation to the categories and subcategories. The general categories were: (1) Previous experience with technology, social networks, or psychosocial programs; (2) General perception of ehcoBUTLER; and (3) Perceptions of ehcoBUTLER modules (Figure 1). In addition, due to the extent of the subcategories of the ehcoBUTLER modules, these are detailed in Figure 2.

Third, double entry matrices were created, where the content was crossed between each participant and each of the categories and subcategories to compare the positive or negative perceptions of the groups.

Fourth, the level of feedback was examined. Considering the degree of clarity, completeness, and elaboration of their answers, a value was assigned for each participant's response: 1 point for lack/low feedback, 2 points for medium feedback, and 3 points for high feedback. Then, to determine the feedback level of each group, three ranges of scores were established. The minimum and maximum of these scores varied according to the number of members in each group (Table 2). For example, as there were 13 participants in the MCI group, the minimum score had to be 13 and the maximum score 39, so this range was divided into three proportional parts corresponding to the three levels of feedback.

Table 2. The participants' feedback level scores.

Level of Feedback	Scores			
	MCI	Dementia	Caregivers	Professionals
Low	13–21 points	13–21 points	12–19 points	11–18 points
Medium	22–30 points	22–30 points	20–28 points	19–26 points
High	31–39 points	31–39 points	29–36 points	27–33 points

MCI = mild cognitive impairment.

The procedure described above allowed us to cross the discursive content and the level of feedback in each category and subcategory. Finally, an overall level of feedback per subcategory was obtained by summing the scores with all groups together to determine

which were the most commented on topics. These scores were also distributed in the three feedback ranges: low (49–67 points), medium (68–85 points), and high (86–103 points).

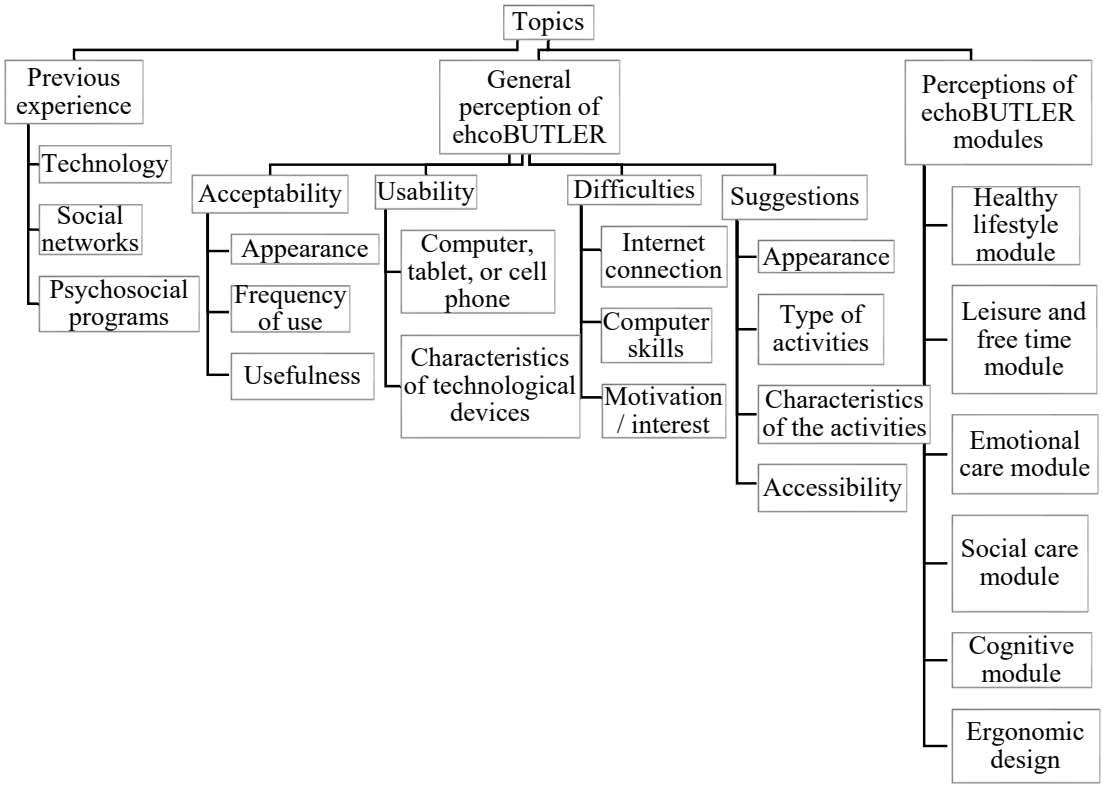

Figure 1. The main categories and subcategories.

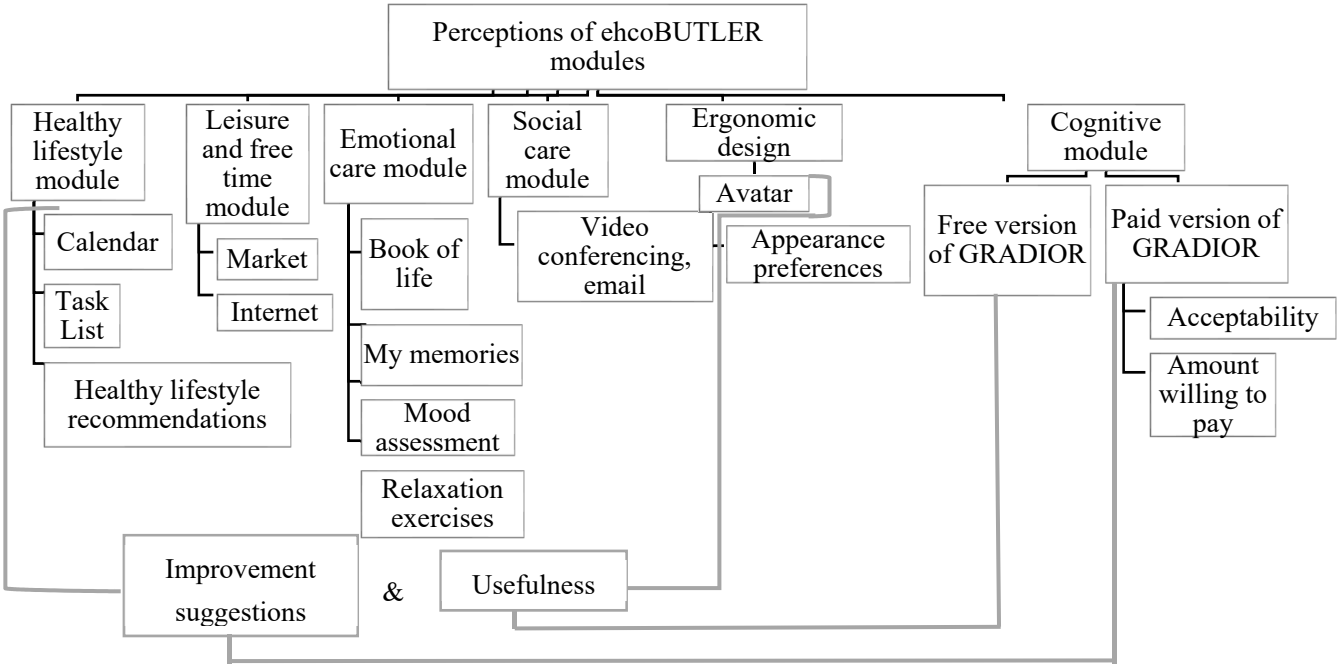

Figure 2. The subcategories of the ehcoBUTLER modules.

3. Results

Table 3 summarizes the participants' positive and negative perceptions and some of their most representative quotes. In addition, Table 4 shows the level of feedback from each group and the most discussed to the least discussed topics.

Table 3. An overview of the participants' perceptions.

Category	Positive Perceptions	Negative Perceptions	Participants' Quotes
Previous experience with technology, social networks, or psychosocial programs	To communicate, take pictures, use the Internet, and work Easy to use on tablet Functions for the elderly person and the caregiver	Difficulty, fear, or dislike of using it Not widely personalized	P1(D)G1: *" . . . I don't dare"* P7(C)G2: *" . . . for . . . calls, WhatsApp, taking a picture . . . checking things on the Internet . . . for work . . . ".* P4(PR)G1: *" . . . Uno Más or Uno Plus . . . includes a part of care for relatives, medical assistance in taking medication, cognitive rehabilitation and calendar . . . in tablet format and it was very simple . . . but you couldn't individualize it so much . . . ".*
General ehcoBUTLER acceptability	Simple appearance Appropriate colors and font Daily or frequent use (60–90 min) Emotional, leisure and cognitive benefits	Only use it in a center Lack of computer skills Difficulty due to cognitive impairment Not personalized	P4(MCI)G1: *"I need to be entertained and relaxed with something".* P5(C)G2: *"I think they would use it here. If they don't come here, at home they won't use it".* P1(PR)G2: *"I liked it, because it has light colors, which do not generate aversion . . . very simple, that the screen is not full of things . . . ".*
General ehcoBUTLER usability	Portable Large touch screen Economic	Difficulty using keyboard or mouse	P4(D)G1: *"Tablets are very convenient, because you can take them wherever you want . . . unless you carry one of those tiny portable computers . . . if you carry it on your mobile, it is easier . . . ".* P7(D)G2: *"My opinion is . . . the one that costs less".* P3(C)G1: *"Yes, tactile, the bigger the better".*
General ehcoBUTLER difficulties	-	Internet is not essential for seniors Lack of computer skills Memory problems Disinterested or unmotivated if it is imposed	P4(PR)G1: *"Pay Internet for an application . . . only for that . . . if they already have it at home is because they live in a son's house or because . . . the council gives access . . . free . . . ".* P3(PR)G2: *" . . . they should know what a chat room is, they should be fluent in using the keyboard, in using the mouse . . . ".* P1(PR)G2: *" . . . If they see it as something imposed . . . they don't want to".*

Table 3. *Cont.*

Category	Positive Perceptions	Negative Perceptions	Participants' Quotes
General ehcoBUTLER suggestions	Personalize it Large icons Small amount of text Physical exercises More cognitive exercises Virtual itineraries Voice command calling Repeat exercises Offline/USB content Pre-training for users	-	P2(MCI)G1: *"Yes, a program that makes your head work".* P3(MCI)G1: *" . . . exercises with pedals, walking on a treadmill . . . ".* P7(C)G2: *" . . . that you can customize it . . . change the tones, the wallpaper . . . that it is adaptable for the person . . . that he/she likes it as much as possible and uses it as much as possible".* P4(PR)G1: *"That there would be offline content . . . that they would be provided with a USB with the purchase of the application . . . ".*
Healthy lifestyle module	Nutritional advice Reminders Appointments noted in one place	Non-independent use Paper notes are easier Similar functions between Calendar and Task List Forgetfulness or disinterest in doing it	P8(MCI)G2: *"It gives ideas of what is good for you and what is bad for you".* P2(C)G1: *" . . . my mother doesn't care if you tell her what to eat, what to walk, what to do . . . she doesn't do it . . . ".* P5(PR)G1: *" . . . easier for them to take notes on paper . . . ".*
Leisure and free time module	Entertainment with cognitive benefits Online procedures Visit websites of interest	Non-independent use Risky Internet use	P3(D)G1: *"Good . . . because it is something you see, and you learn . . . something always remains in your memory . . . ".* P4(C)G2: *" . . . my relative uses it and I am afraid of it because hotels appear. The Internet is very risky, at least for my relative".* P6(PR)G1: *" . . . select an application . . . that would have to be done by an external person, a caregiver, someone who recommends something . . . ".*
Emotional care module	Reinforcement of identity Relaxation Motivation Emotional state monitoring	Non-independent use Non-genuine answers Virtual environments, not real ones	P2(D)G2: *"I would like to, because then those who come after us will see what we have done . . . ".* P7(C)G2: *"Very appropriate . . . something that gives them peace of mind, and that takes them out of a thought that is wearing them out . . . ".* P4(PR)G2: *" . . . I think it is much better for them to go to the park for a walk, than to go indoors to see a digital tree when they can go down to the river and see real trees . . . ".*

Table 3. *Cont.*

Category	Positive Perceptions	Negative Perceptions	Participants' Quotes
Social care module	Social contact, especially with people who live far away	Non-independent use Email difficult to use	P1(MCI)G2: *"Well, I would like it, because there will be someone you have abroad, children, grandchildren . . . ".* P4(D)G1: *"Good, because if you are also seeing the other caller, then look how nice it is".* P3(PR)G1: *"I can't imagine them answering the email . . . I mean, I don't see that. I think a videoconference is better".*
Cognitive module	Exercise cognitive functions, especially memory Personalized Low price	Low economic income	P3(D)G2: *"Yes, anything for the head".* P1(C)G1: *"It's fine . . . as long as it is appropriate to the level of each person, personalized".* P7(MCI)G2: *"Hey, if it's not a large amount, because we are pensioners . . . ".*
Ergonomic design	Explain and remember the instructions	Artificial appearance and voice	P4(D)G2: *"Indicates what to do; good, good, it orients".* P4(PR)G1: *" . . . it would be important for the avatar to be as real as possible and less robot-like . . . for the voice to have the same oscillations as a human person, to have a human aspect . . . ".*

C = caregiver; D = dementia; G = group; MCI = mild cognitive impairment; P = participant; PR = professional.

Table 4. The level of feedback by the subcategories, groups, and totals.

Category	Subcategory	Participants' Feedback Level				Overall Level of Feedback
		MCI	D	C	PR	
Previous experience	Technology	MF (24)	LF (19)	HF (29)	LF (11)	MF (83)
	Social networks	MF (26)	LF (19)	MF (23)	LF (11)	MF (79)
	Psychosocial programs	LF (13)	LF (13)	LF (12)	LF (14)	LF (52)
General ehcoBUTLER acceptability	Appearance	MF (23)	LF (18)	LF (12)	LF (17)	MF (70)
	Frequency of use	LF (19)	LF (16)	MF (22)	LF (11)	MF (68)
	Usefulness	LF (21)	LF (20)	MF (23)	MF (19)	MF (83)
General ehcoBUTLER usability	Use of computer, tablet, or cell phone	LF (18)	MF (26)	MF (22)	LF (17)	MF (83)
	Characteristics of technological devices	MF (23)	LF (13)	LF (18)	LF (13)	LF (67)
General ehcoBUTLER difficulties	Internet connection	LF (13)	LF (13)	LF (12)	LF (15)	LF (53)
	Computer skills	LF (13)	LF (13)	LF (12)	MF (19)	LF (57)
	Motivation	LF (13)	LF (13)	LF (12)	LF (14)	LF (52)
General ehcoBUTLER suggestions	Appearance	LF (13)	LF (13)	LF (16)	LF (15)	LF (57)
	Type of activities	LF (18)	MF (23)	LF (19)	LF (11)	MD (71)
	Characteristics of the activities	LF (16)	LF (13)	LF (17)	LF (11)	LF (57)
	Accessibility	LF (13)	LF (13)	LF (12)	LF (17)	LF (55)

Table 4. *Cont.*

Category	Subcategory		Participants' Feedback Level				Overall Level of Feedback
			MCI	D	C	PR	
Healthy lifestyle module	Calendar	Usefulness	MF (27)	LF (21)	MF (26)	MF (22)	HF (96)
		Improvement suggestions	LF (13)	LF (13)	LF (16)	MF (19)	LF (61)
	Task List	Usefulness	LF (15)	MF (25)	LF (15)	MF (24)	MF (79)
		Improvement suggestions	LF (13)	LF (13)	LF (12)	LF (18)	LF (56)
	Healthy lifestyle recommendations	Usefulness	MF (27)	MF (25)	MF (24)	MF (26)	HF (102)
		Improvement suggestions	LF (13)	LF (13)	LF (12)	MF (22)	LF (60)
Leisure and free time module	Market	Usefulness	MF (26)	MF (24)	LF (12)	MF (22)	MF (84)
		Improvement suggestions	LF (13)	LF (13)	LF (12)	MF (20)	LF (58)
	Internet	Usefulness	LF (19)	MF (23)	LF (17)	LF (18)	MF (77)
		Improvement suggestions	LF (13)	LF (13)	LF (12)	LF (14)	LF (52)
Emotional care module	Book of life	Usefulness	LF (21)	MD (28)	LF (18)	MF (21)	HF (88)
		Improvement suggestions	LF (13)	LF (13)	LF (13)	LF (17)	LF (56)
	My memories	Usefulness	MF (22)	LF (19)	MF (22)	LF (16)	MF (79)
		Improvement suggestions	LF (13)	LF (13)	LF (12)	LF (16)	LF (54)
	Mood assessment	Usefulness	MF (29)	MF (22)	MF (27)	MF (25)	HF (103)
		Improvement suggestions	LF (13)	LF (13)	LF (13)	MF (21)	LF (60)
	Relaxation exercises	Usefulness	MF (25)	MF (25)	MF (23)	MF (26)	HF (99)
		Improvement suggestions	LF (15)	LF (13)	LF (14)	MF (21)	LF (63)
Social care module	Video conferencing and email	Usefulness	LF (21)	MF (23)	LF (19)	MF (20)	MF (83)
		Improvement suggestions	LF (13)	LF (13)	LF (14)	LF (16)	LF (56)
Cognitive module	Free version of GRADIOR	Usefulness	LF (16)	MF (23)	LF (15)	LF (11)	LF (65)
	Paid version of GRADIOR	Acceptability	MF (23)	LF (18)	LF (19)	MF (26)	HF (86)
		Amount willing to pay	LF (18)	LF (13)	LF (16)	LF (18)	LF (65)
		Improvement suggestions	LF (13)	LF (13)	LF (12)	LF (17)	LF (55)
Ergonomic design	Avatar	Usefulness	MF (22)	MF (22)	HF (29)	HF (27)	HF (100)
		Appearance preferences	LF (21)	LF (17)	LF (17)	LF (11)	LF (66)
		Improvement suggestions	LF (13)	LF (14)	LF (18)	MF (23)	MF (68)

C = caregiver; D = dementia; HF = high feedback; LF = low feedback; MCI = mild cognitive impairment; MF = medium feedback; PR = professional.

3.1. Previous Experience with Technology, Social Networks, or Psychosocial Programs

The participants presented low to medium feedback on this topic. However, the caregivers provided clear and complete answers (high level of feedback = 29 points) in the technology subcategory, indicating the various devices they had and the uses they gave them, as described below.

The caregivers had been using cell phones, computers, and/or tablets for personal and/or work purposes (e.g., calls, messages, photographs, Internet) for several years. On the other hand, older adults with MCI and PWD tended to use landlines and/or cell phones to maintain social contact or in the case of emergencies. They also used computers when they attended the Memory Workshops or Memory Clinic. They did not use other technological devices because they did not like them, found them difficult to use, or did not dare.

The elderly with MCI and PWD did not use any social networks, while the caregivers tended to use Facebook, Instagram, or Twitter. Regarding the psychosocial programs, few professionals reported having experience with these types of programs, finding them easy to use on a tablet and with functions for the elderly person and the caregiver, but with the disadvantage of not being highly personalized.

3.2. General Perception of ehcoBUTLER

3.2.1. Acceptability (Appearance, Frequency of Use, and Usefulness)

The participants showed medium feedback in this category, showing ideas that were not as developed or that were limited to responding affirmatively or negatively to another participant's idea. Regarding their perceptions, older adults with MCI, PWD, and the professionals liked the appearance of ehcoBUTLER because of its light colors, the background was not overloaded with elements, and the font type and size. Participants with MCI and PWD stated that they would like to use the platform from every day to a few times a week or in their free time, for an hour or an hour and a half.

However, the caregivers indicated that their family members would only use it when they attended the center, and not at home, due to their lack of computer skills, cognitive impairment, and that the platform was not very personalized. Professionals also perceived these difficulties. Nevertheless, the caregivers perceived it to be useful in improving the mood of their relatives, even if they did not perform the activities correctly. Older adults with MCI and PWD found it useful to improve their memory, learn new things, relax, or as entertainment.

3.2.2. Usability (Use of Computer, Tablet or Cell Phone, and Characteristics of Technological Devices)

Participants presented a low to medium level of feedback on this topic as they responded without explaining the reason for their choice, or their answers could have been further elaborated. Nevertheless, it was possible to identify in their perceptions that people with MCI would prefer to use ehcoBUTLER through a computer. The caregivers preferred for their relatives to use it on a computer or tablet due to the size of their screens. Some professionals supported the tablet for this population because of the intermediate screen size while other professionals supported the cell phone because older adults usually already have one. The PWD also preferred the cell phone for its portability or because it was the cheapest option. However, the participants agreed that the device should have a large touch screen for ease of use compared to a mouse or keyboard.

3.2.3. Difficulties (Internet Connection, Computer Skills and Motivation)

The participants provided low feedback in this category. However, the professionals presented a medium level of feedback (19 points) in the computer skills subcategory, providing some examples of possible difficulties in its use by the population with cognitive impairment, as is shown below.

The professionals considered it necessary to have computer skills to use the software (chat, password creation, login, enlarge the screen) and hardware (mouse, keyboard), and that it could be difficult for older people; even more so when considering their cognitive impairment, because they could forget important data such as their password. Furthermore, the professionals considered it difficult for elderly people to have the Internet at home, because it is not indispensable for them, and would not be cost-effective for them to pay it just to use ehcoBUTLER. They also pointed out that older adults might be disinterested or discouraged if they perceive its use as an imposition on their family members.

3.2.4. Suggestions (Appearance, Type of Activities, Characteristics of the Activities and Accessibility)

This category had low feedback from the participants, except in the subcategory of the type of activities where the PWD presented medium feedback (23 points), indicating that it was not necessary to add more activities to ehcoBUTLER. However, the other participants recommended making certain improvements, as described below.

To improve ehcoBUTLER's appearance, some caregivers suggested the option of customizing it, and some professionals recommended large icons and a small amount of text. Regarding the type of activities, some elderly with MCI wished to add physical exercises and more cognitive exercises. Some caregivers recommended voice command calls and virtual routes for their family members to practice moving from one place to another in their city, even if they could not do it physically.

Regarding the characteristics of the activities, older adults with MCI wanted to repeat the exercises in which they failed. The caregivers suggested customizing the exercises according to each person's interests. To improve accessibility, some professionals recommended offline or USB content as well as pre-training for the users.

3.3. Perceptions of the ehcoBUTLER Modules

3.3.1. Healthy Lifestyle Module

In this category, the participants presented a high level of feedback in the subcategory of usefulness of the healthy lifestyle recommendations (102 points) and the Calendar (92 points), while they gave medium feedback (79 points) on the Task List. Overall, the participants gave low feedback on suggestions for improving these tools. Their perceptions are shown below.

Calendar

EhcoBUTLER will have a Calendar for entering important dates such as birthdays or doctor's appointments. Older adults with MCI, PWD, and the professionals perceived it as useful for helping users to remember important dates, given their memory problems. However, some professionals and most caregivers felt that people with cognitive impairment would not be able to use it independently, so they would not enjoy its benefits.

Several professionals suggested incorporating the prioritization of appointments through eye-catching reminders with sounds and that they should be made a day before the appointment for the elderly and their relatives, even if they were not using the platform. On the other hand, some caregivers recommended that a professional help their relatives to manage this tool.

Task List

In ehcoBUTLER's Task List, users would be able to record their daily life activities and receive reminders about them. Most of the PWD and some elderly with MCI found it useful for its reminders as they had memory problems. However, one participant with MCI preferred to continue taking notes on paper, and some professionals also supported this, because it would be easier for older adults to take them to where they needed them such as to the supermarket.

Nevertheless, some professionals considered the Task List as being useful because it would allow for elderly people to get into the habit of typing and having everything on the same device. However, some caregivers felt that the cognitive impairment of their relatives would prevent them from using it independently.

Several professionals suggested that the Task List should be improved by differentiating it from the Calendar or by merging them into one called "reminders". They also recommended that the platform should send an appointment reminder to the elderly person and the family member at the same time, even if they were outside the platform.

Healthy Lifestyle Recommendations

EhcoBUTLER will provide recommendations of healthy habits by proposing activities inside or outside the platform, according to the user's needs. Most of the older adults with MCI, PWD, and the professionals found the personalized nutritional advice especially helpful. However, most caregivers felt that their relatives would forget the advice or would not apply it in real life. Regarding improvements, several professionals suggested direct access to the advice, motivational notifications of new content, and to keep the previous recommendations available.

3.3.2. Leisure and Free Time Module

The participants provided medium feedback on the usefulness of the Market (84 points) and the Internet (77 points). On the other hand, they had a low level of feedback when suggesting improvements for these tools. Their perceptions are presented below.

Market

Through the Market, users are able to incorporate new apps to the system such as games, books, etc. Most older adults with MCI and PWD perceived this as useful for entertainment, learning, and working on their memory, mainly through games or books. However, some participants with MCI preferred activities outside the home such as courses or playing cards.

Most professionals considered that this could be useful if the caregiver selected the activities according to the interests of the older person, in order to facilitate their identification and use. In terms of suggestions for improvement, several professionals suggested providing direct access to the activities previously determined by the caregivers.

Internet

The platform will have an easy and direct access to navigate across different websites. The participants with MCI and PWD wanted to use it to visit websites of interest or to do online paperwork, if it was easy to use and they were taught how to use it. Several professionals also found it useful if access to certain pages was customized to make it easier for the older person to use. Few caregivers felt that this tool could be useful if it had different webpages already set; otherwise, it could be a risky use, for example, pages that involve payments such as hotels.

In terms of suggestions for improvement, few professionals indicated that, in addition to customizing access to certain webpages, the users should have the option of accessing related sites.

3.3.3. Emotional Care Module

The participants provided a high level of feedback on the usefulness of the Book of life, Mood assessment, and Relaxation exercises (88, 103, 99 points respectively), while it was medium on My memories (79 points). There was low feedback in the suggestions for their improvement. These perceptions are shown below.

Book of Life

In ehcoBUTLER, users are able to write their autobiography (complementing it with images, audio, video), and share it with their family and friends. Older adults with MCI and PWD felt that this tool would allow them to share with their descendants what they were doing. Some professionals also found it useful for the therapeutic benefits of reminiscence. However, few professionals and caregivers perceived that it could be a burden for the caregiver to digitize the photographs and accompany the family member during the reminiscing process.

Regarding improvements, some professionals recommended that each person should express their autobiographical memories according to their preferences (writing, speaking, or singing). In addition, one caregiver suggested that the platform narrate them for the elderly.

My Memories

Users will also be able to save photos, music, or videos as memories and will have the option to share them. The participants with MCI, PWD, professionals, and some caregivers considered it useful for evoking meaningful and motivating memories of some moment in the life of the elderly person. However, few caregivers perceived it negatively, because they would not have enough time to help their relatives to elaborate these memories. Regarding possible improvements, few professionals recommended the use of real photographs, and not images downloaded from the Internet.

Mood Assessment

EhcoBUTLER monitors the users' mood by asking them how they feel when they sign in and sign out. This will allow for the early detection of depressive or anxious symptoms that will alert the professionals. Most of the participants with MCI and PWD perceived it to be useful because it would be a way to take care of them, especially when they were in a low mood when remembering certain events. Several professionals and caregivers also perceived it positively for keeping track of mood, where the professionals added the benefit of being alerted to the situation and adopting content according to it. However, some caregivers and professionals indicated the difficulty that some older people with cognitive impairment might give an automatic response, which did not truly reflect how they felt.

In terms of improvements, several professionals suggested that users should only be asked once a day or every 12 h how they felt to avoid repetitive questions if they accessed the platform several times a day. One caregiver recommended that the question and response options be asked orally, not just in writing.

Relaxation Exercises

These exercises consist of videos about nature with mindfulness techniques. Most of the elderly with MCI, PWD, and half of the caregivers found them useful to help older adults to stop focusing on possible worries or negative thoughts. However, some people with cognitive impairment, a caregiver, and several professionals preferred that the older adults relax by taking walks in nature, which in turn would contribute to their physical health.

A few participants with MCI suggested incorporating documentaries to relax. Several professionals and a few caregivers recommended that the relaxation exercises be accompanied by scenarios with real images.

3.3.4. Social Care Module

The participants presented a medium level of feedback on the usefulness of videoconferencing and email (83 points), while they presented a low one when suggesting improvements for these tools (56 points). Their perceptions are shown below.

Video Conferencing and Email

Individuals with MCI and PWD as well as the professionals and caregivers felt that videoconferencing would be useful for older adults to make contact and see people who were far away, if it was easy to use. On the other hand, the professionals and caregivers perceived emails negatively, because the population with cognitive impairment would not be able to use it. However, some professionals and a caregiver agreed in recommending that these tools would be improved if the contacts had an icon with their image and direct access. In addition, they suggested that users could send their email message via a voice memo.

3.3.5. Cognitive Module

EhcoBUTLER has two versions of the GRADIOR program: one free and one paid version. Participants gave a high level of feedback (86 points) on the acceptability of the paid version; while they had low feedback on the amount they were willing to pay and on suggestions for improvements. On the usefulness of the free version, they also had low feedback. Their perceptions are described below.

Free Version of GRADIOR

This version has cognitive stimulation and training exercises to keep cognitive functions active in general. Older adults with MCI, PWD, and the caregivers considered it useful for working on different cognitive functions, especially memory.

Paid Version of GRADIOR

This version contains specialized cognitive training and rehabilitation exercises for impaired cognitive functions, so it may be subject to payment. Some older adults with MCI and PWD had a negative perception about paying for it because they were pensioners, and their financial income was low. However, other participants with MCI were only willing to pay if the amount was small. Several professionals also thought that users might pay if it was a small fee and if they came to a center to encourage adherence by having the support of a therapist. Some caregivers were willing to pay on a month-to-month and wanted the flexibility to decide whether they wanted to continue paying or not, depending on their family member's level of improvement.

Regarding the amount to be paid, few participants indicated an exact fee: EUR 20 per month estimated by people with MCI; while between EUR 3 to EUR 15 per month, or EUR 300 per year, as estimated by the professionals. As for possible improvements, few professionals suggested that this version should be made available as an add-on within a care package in a nursing home or center to make it more accessible at a flat rate per year.

3.3.6. Ergonomic Design

The participants had a high level of feedback on the usefulness of the avatar (100 points). On the other hand, they had a medium level on the suggestions for improvement and a low level on its appearance. Their perspectives are shown below.

Avatar

This virtual character will assist the users in audio and text at every step of the platform. The participants with MCI, PWD, professionals, and caregivers agreed that the avatar would be useful in facilitating the use of ehcoBUTLER by explaining and reminding the users of the instructions.

Regarding the characteristics of the avatar as a young man, the PWD indicated that they liked it as it was. Older adults with MCI and caregivers were indifferent to the sex of the avatar; what they considered important was its helping role. However, some professionals and a few caregivers recommended that the avatar have the voice and image of a real person. Other professionals suggested being able to choose whether the avatar would explain the instructions orally, written, or both.

4. Discussion

This was a qualitative study that set up focus groups of older adults with MCI, PWD, professionals, and caregivers to improve the development of ehcoBUTLER, a tablet platform aimed at promoting the health and quality of life in the elderly population. Formally, it should not be considered as just a study of a specific platform, but the evaluation of the main features for the development of tablet-based software for people with MCI or dementia. EhcoBUTLER has different apps to support the independent life and well-being of people with cognitive impairment. There are several systems that are limited to a single app to avoid the mental load on the elderly; however, a system with various apps is also possible, although it requires additional effort to adapt it [12]. The findings of this study can help in the future development of tablet software and apps to promote the integral health of this population.

In general, the participants showed acceptability toward the appearance and usefulness of ehcoBUTLER to promote different areas and were interested in using its apps frequently. The perceived usefulness and interest of the participants of this study aligns with other research in which ehcoBUTLER was considered useful and interesting by potential users and stakeholders [23]. Other investigations have also found that older adults with MCI and PWD are interested in using technologies that promote their health [22], and that aesthetics are important in significantly impacting the perceived suitability of the technology [45].

However, the professionals and caregivers felt that cognitive impairment, lack of computer skills, and lack of motivation of the elderly could make it difficult for them to take advantage of ehcoBUTLER. These results are in line with other studies, which have identified barriers to technological opportunities for the elderly such as their declining functions, lack of technological skills, and may be discouraged from using technology for fear of finding it difficult to use or understand [10,11,13]. In this study, the professionals also pointed out that older adults often do not have access to the Internet. This is supported by a report in which 20–40% of older people in Spain have used the Internet at some time [46]. Therefore, the suggestion of the professionals to provide ehcoBUTLER content offline or via USB is essential to improve its accessibility. In fact, other research supports the alternative, where the elderly can download the apps' content to access them without an Internet connection [22]. This should be considered in the development of platforms for older people at home.

In this study, the professionals also recommended that potential users receive training to learn how to use ehcoBUTLER. This is important, because participants with cognitive impairment used landlines and cell phones to make calls or in case of emergency and were afraid of using other technologies. Other studies have also identified that receiving training and learning about the benefits of technologies can make the difference in showing interest in them [47] and in striving to master their use, even if they are not perceived as easy at first [48]. Consequently, it is necessary to keep in mind the technological gap in older people and provide them with training to make these technologies familiar to them. This would not only improve the accessibility of the platforms, but also their acceptability and usability.

To further promote ehcoBUTLER usability, the participants preferred to use it on an inexpensive, portable device with a large touch screen. These results on the characteristics of the technological device are supported by other investigations because touch screens facilitate the interaction of older adults with technological devices [49] and their portability facilitates the application of the intervention [17]. The low cost of the device is also an important consideration, since the incomes of the elderly decrease as they get older [46]. In this regard, touch screen tablets are a relatively low-cost option for the elderly [24]. However, governments should consider providing free apps to promote independent living as a relevant measure to avoid earlier institutionalization. Indeed, another study found that professionals expected the technological intervention to be financed by the National Health System, companies, or centers [23].

In the present study, the participants also recommended customizing the platform according to the interests of the elderly as well as adding other activities and features. Another study also highlighted the importance of personalizing the technological tool and taking into account the considerations of the elderly, because it can facilitate a meaningful and positive engagement of the older population with it [50]. Now, we will discuss the apps in ehcoBUTLER where the participants had a high level of feedback and, therefore, a higher level of interest. This will help in the development and improvement of future platforms to contain the apps that most interest this population.

The participants showed a high level of feedback on the usefulness of these tools: Mood Assessment, Healthy Lifestyle Recommendations, Avatar, Relaxation Exercises, Calendar, and Book of Life. The elderly with MCI, PWD, the caregivers, and professionals had a positive perception of their usefulness. At the same time, the caregivers and professionals highlighted that older adults with cognitive impairment would need help to use them and take advantage of their benefits. These difficulties coincide with those they noted in the general perception of ehcoBUTLER, so their suggestions for improving each app as well as customization and training could encourage more independent use. Indeed, research has shown that, in order to break down barriers and benefit everyone, the perceptions of the end users and stakeholders must be considered in the development of technological products and services [35].

In the present study, most of the tools with a high level of feedback belonged to the Emotional Care Module (Mood Assessment, Relaxation Exercises, and Book of Life). Other research has indicated that people with cognitive impairment are more at risk of suffering from depression or anxiety [3,51], so it makes sense that in this study, the participants showed great interest in caring for the emotional and relaxation state of the older adults. In addition, other studies using a reminiscence app [15] and virtual reality [16] found that they improved the well-being and quality of life of the elderly with cognitive impairment.

Related to the quality of life, the participants of the present study also showed great interest in apps that promoted a healthy lifestyle (Healthy Lifestyle Recommendations and Calendar). There is evidence that cognitive decline influences older adults to feel less able to make decisions about their daily activities [52]. Therefore, it makes sense that in the present study, the participants showed great interest in apps that supported their daily lives, especially in the calendar function and nutritional advice. Other research has supported the recommendations that the elderly maintain a nutritional balance and the use of a calendar to be more oriented in their activities, among others, are useful for them to maintain, as much as possible, one of the most precious capacities: autonomy to take care of themselves and govern their actions [53]. In addition, there is a calendar app [20] and a notebook app [21] that have been reported to contribute to this population's satisfaction with their lives.

The participants in this study also had special interest in the avatar, because of its potential usefulness in explaining and remembering what to do on the platform. These results coincide with other research that highlights the avatar's role as a guide, promoting a positive experience and facilitating its implementation [54]. The fact that ehcoBUTLER will have ergonomic tools that will make its use easier and more enjoyable such as the avatar is a key element for its introduction, especially when the target population is older people with cognitive impairment. This should also be considered in the development of platforms aimed at these target users.

In relation to the cognitive area, the participants showed a high interest discussing the paid version of GRADIOR. The older adults did not want to pay for it or only wanted to pay a small amount because they were pensioners. The caregivers were willing to pay according to the improvement in their family members. These results are consistent with an earlier ehcoBUTLER study [23] in which the end users wished to pay the least amount, while the caregivers wanted to pay depending on its usefulness or preferred it to be financed by other institutions. Once again, the results indicate that the economic issue should be seriously considered in the platforms for this population.

On the other hand, it is important to note that ehcoBUTLER focused mainly on promoting the social area, but in the present study, the social module did not have a high level of feedback. Nevertheless, the option of sharing the Book of Life (which was highly valued in the Emotional Module) is also part of the Social Module because it involves interaction with other people [23]. The participants' high interest indicates their preference for this social activity (sharing the Book of Life) rather than videoconferencing or email. This is consistent with other studies in which reminiscence was the most widely used social intervention compared to videoconferencing and others [55]. In addition, email has been found to represent a cognitive load for older subjects due to the various steps they must remember to do tasks such as saving and managing attachments [56]. These aspects should be considered to improve the selection and development of social apps aimed at this population.

In this study, the leisure and free time module apps also did not have a high feedback level. However, in the general perception of ehcoBUTLER, the participants showed interest in its use for entertainment. This discrepancy can be explained by their perceptions that the elderly would need help from their caregivers to configure these tools and preferred them to do activities outside the home. In fact, some participants also supported activities outside the home rather than the Relaxation Exercises in the Emotional Care Module. Activities outside the home are clearly beneficial for the well-being of the elderly, but if they cannot go out due to some limitation, there are activities that they can do at home [57]. In these cases, tablet platforms such as ehcoBUTLER offer them with a good alternative or complement for a more active and healthy life. In this sense, the caregivers play a facilitating role in the use of technology by older adults with cognitive impairment [48]. However, it is important to simplify this task and provide them a respite [50]. This could be achieved with appropriately adapted technologies for the elderly population with MCI or dementia.

The present study conducted focus groups to gather the points of view of older people with cognitive impairment, caregivers, and professionals to further develop and better adapt the different ehcoBUTLER features. This is line with other studies. It has been shown that end-user and stakeholder perceptions are essential for the ultimate development of the technology to benefit everyone [35]. In addition, focus groups have been proven to be useful to gather and understand their opinions, needs, particularities, and attitudes [30,31]. In fact, in other investigations, the focus groups of PWD yielded key aspects for the design, conceptualization, and refinement of the technologies aimed at this population [32,33]. This technique should be considered in the development of psychosocial stimulation software for the elderly with cognitive impairment.

Finally, it is important to understand the limitations of this study. First, valuable data may have been lost because nonverbal responses were not analyzed. Second, there were no follow-up interviews and some aspects of the focus group dialogue could not be further developed [40], for example, when the participants showed a low or medium level of feedback. Third, the participants already had previous experience with GRADIOR, so their results may be different from those without such experience. However, several studies support the results presented, and knowing a little bit about the uses of technologies was good for their understanding of the objectives of the study. Indeed, having that experience allowed them to have a point of comparison to make suggestions for improvements in ehcoBUTLER or other tablet apps.

Fourth, the participants' responses could have been influenced by being at the INTRAS Foundation, where they had a relationship with GRADIOR (as users, caregivers of users, or employees of the foundation). However, the platform presented to them in the focus groups was ehcoBUTLER, and its cognitive module was inquired without specifying that it would be GRADIOR.

Fifth, PWD were included in this study to evaluate ehcoBUTLER, which is especially aimed at older adults with MCI. However, the coincidence of the participants' perceptions on the positive aspects and features to be improved indicates their acceptability with the required adaptations to be made.

For future work, more studies are needed that focus on the opinions, ideas, and attitudes of older people with cognitive impairment, along with those of the stakeholders, regarding platforms with different apps for health care, wellness, and psychosocial stimulation. In addition, using joint methodologies such as focus groups with interviews, questionnaires, and/or surveys can allow for more knowledge to be acquired for the appropriate development of this kind of tool in a digital era. Future research focused on the above aspects could contribute to providing older adults with MCI/dementia with innovative and adapted platforms that promote their quality of life, in which they could receive care and health services with greater access, efficiency, dynamism, and reduce the costs of such services.

5. Conclusions

The main purpose of this study was to explore the perceptions and level of feedback of the potential primary users (older adults with MCI and PWD) and actors involved in their care (professionals and caregivers) regarding a tablet platform (ehcoBUTLER) to improve its development according to their points of view. In conclusion, the development of ehcoBUTLER is properly oriented, because the participants showed acceptability toward the platform. Its appearance and the tools of the emotional module, healthy lifestyle, cognitive care, and ergonomic design were key aspects in such acceptability. However, usability, sustainability, and accessibility improvements are needed. These improvements could be properly achieved by making ehcoBUTLER apps more intuitive and personalized and offering pre-training to learn how to use them (due to older people's unfamiliarity with technology) as well as promoting that the platform could be used on large touch screen devices, that had offline/USB content, and was part of a low-cost or free care package. These improvements, being based on the perceptions of the potential users and stakeholders, could encourage users to have a positive experience with ehcoBUTLER and favor its future implementation.

The suggestions for improving ehcoBUTLER were mainly provided by the professionals and caregivers, while the elderly focused on how they felt about the platform. Their different perspectives allows for a more complete vision to advance its development and to better meet their needs and preferences. This could promote that in the future, it could benefit older adults with MCI or mild dementia to be active agents in their own well-being. This could also help caregivers in their role and to have some respite, if the older adults need as little help as possible to use it as well as to provide professionals with a platform for different areas of intervention. Finally, the findings of this study could contribute to the future development and improvement in tablet platforms and apps that promote the integral health of this population.

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Capítulo 6: Discusión

En este capítulo se presentan los resultados obtenidos en la presente tesis, agrupándolos según los objetivos planteados y respondiendo a las hipótesis asociadas a tales objetivos. En los artículos publicados se encuentra la descripción de los análisis efectuados, los resultados sociodemográficos, así como las tablas de síntesis.

6.1 Medidas e instrumentos para evaluar en personas mayores con DCL o demencia la usabilidad y UX de intervenciones cognitivas basadas en las TIC

La revisión sistemática (publicación I) se centró en las intervenciones psicosociales dirigidas al dominio cognitivo (estimulación, entrenamiento y rehabilitación cognitiva) por ser de las más usadas (Irazoki et al., 2020; Pinto-Bruno et al., 2017) y que permitieran recabar mayor evidencia sobre las medidas e instrumentos para evaluar su usabilidad y UX en personas con DCL o demencia. Además, debido al debate científico sobre el solapamiento entre la usabilidad y UX por ser términos amplios (Sauer et al., 2020), en este estudio se consideró que la usabilidad tiene aspectos objetivos (eficacia y eficiencia) y aspectos subjetivos (satisfacción) para evaluar. También se consideró que la UX es una extensión de la usabilidad, porque la UX se centra en aspectos subjetivos como la satisfacción (ISO, 2019).

Para evaluar los aspectos objetivos de la usabilidad, en la revisión sistemática se encontraron 5 mediciones comunes y principales: (1) número de tareas completadas, (2) número de errores o acciones fallidas, (3) tiempo para completar las tareas, (4) número de acciones innecesarias y (5) número de intervenciones realizadas por el moderador. Las dos primeras corresponden a la eficacia, mientras que las 3 últimas a la eficiencia; coincidiendo con otras investigaciones (Bevan & Carter, 2016; Georgsson & Staggers, 2016).

Las medidas de eficacia y eficiencia identificadas pusieron de manifiesto que las personas mayores con deterioro cognitivo son capaces de completar las tareas de las intervenciones cognitivas, pero necesitan más tiempo y ayuda. Lo que concuerda con otros estudios en que dichas medidas informan sobre si el usuario logra o no resolver las tareas, lo fácil o difícil que le resultó completarlas y los recursos que utilizó (Georgsson & Staggers, 2016; ISO, 2019).

Para evaluar los aspectos subjetivos de la usabilidad, es decir la UX, en la revisión sistemática se hallaron 6 mediciones e instrumentos: (1) cuestionarios y escalas, (2)

verbalizaciones y comportamientos, (3) índices de asistencia, (4) entrevistas, (5) tiempo libre dedicado a la actividad y (6) número de tareas realizadas por los participantes cuando tuvieron libertad para hacer tantas como quisieron (independientemente de si estaban mal o bien ejecutadas). Las cuales permitieron recabar que los adultos mayores con deterioro cognitivo tienen experiencias positivas con las intervenciones cognitivas basadas en las TIC, a pesar de presentar ciertas dificultades con la interfaz. Hallazgos que son alentadores, porque si los usuarios reportan buenas experiencias con una tecnología, entonces es probable que la usen prolongadamente (Larbi et al., 2022).

Como puede observarse en el párrafo anterior, existe más variedad de medidas e instrumentos para evaluar la UX. Dentro de las cuales, los cuestionarios y escalas fueron los más utilizados. Las herramientas estandarizadas encontradas fueron: Modelo de Aceptación de la Tecnología, Escala de Afectos Positivos y Negativos, Cuestionario de Experiencia de Usuario, Escala de Fatiga de Piper y Cuestionario de Compromiso Tecnológico. Las herramientas no estandarizadas identificadas fueron escalas tipo Likert de satisfacción, motivación, afectividad, sostenibilidad, interés, facilidad de uso y aprendizaje. Las más usadas fueron las de satisfacción. Otras investigaciones coinciden con que esos elementos están relacionados y forman parte de la UX (Alexandre et al., 2018; Borsci et al., 2020).

Los resultados corroboran la hipótesis de que son similares las medidas e instrumentos para evaluar, en adultos mayores con DCL o demencia, la usabilidad y UX de intervenciones cognitivas basadas en las TIC. Si bien las medidas e instrumentos no son idénticos, especialmente para la evaluación de la UX que implica varios aspectos subjetivos, permiten recabar en conjunto información sobre la eficacia y eficiencia de las intervenciones cognitivas tecnológicas, así como la experiencia de estos usuarios.

6.2 Funciones y características de intervenciones cognitivas basadas en las TIC dirigidas a personas mayores con DCL o demencia

La revisión sistemática (publicación I) también hizo posible identificar las funciones y características de las intervenciones cognitivas basadas en las TIC para adultos mayores con DCL o demencia. Los estudios seleccionados consistían en estimulación y entrenamiento cognitivo; que son dos de los tres tipos en los que se agrupan comúnmente las intervenciones cognitivas (Irazoki et al., 2020). Sin embargo, no se encontraron estudios sobre la rehabilitación cognitiva. Esto pudo haber ocurrido, porque esta última se centra en mejorar la funcionalidad en las actividades de la vida diaria y no en tareas cognitivas (Oltra-Cucarella et al., 2018).

Las intervenciones encontradas coincidieron en presentarse en formato de ejercicios cognitivos o juegos serios. Estos últimos fueron incluidos, porque su objetivo no era entretener sino mantener o mejorar las funciones cognitivas, integrando los aspectos lúdicos de los videojuegos (Abd-Alrazaq et al., 2022; Manera et al., 2017). Otras investigaciones apoyan que la tecnología permite presentar las intervenciones de forma innovadora y dinámica, lo que promueve la motivación e implicación del usuario, así como su adherencia al tratamiento (Ahmad et al., 2022; Cho et al., 2022; Cohavi & Levy-Tzedek, 2022).

En cuanto al tipo de software, la mayoría eran programas mientras que los otros eran aplicaciones o plataformas web. No obstante, coincidieron en contener otras funciones como el entrenamiento físico, interacción social, musicoterapia y entornos asistidos. Otros estudios sostienen que los sistemas con múltiples funciones son más beneficiosos y rentables (Lazar et al., 2016) y que responden al interés de los adultos mayores hacia tecnologías que promuevan no solo su cognición, sino también su comunicación con el círculo social, ocio, etc. (LaMonica et al., 2017; Van Dijk, 2020). Sin embargo, hay investigaciones que sostienen que a través de abordar el dominio cognitivo se promueve el beneficio hacia otros dominios, como el físico (He et al., 2019; Mancioppi et al., 2019).

Respecto al hardware, los dispositivos en los que se ejecutaban los programas eran diferentes: ordenador, Tablet, teléfono inteligente o robot. Los tres primeros suelen ser las TIC comúnmente incorporadas en las intervenciones cognitivas por su portabilidad, accesibilidad y rentabilidad (Al Mahmud et al., 2019; García-Casal et al., 2017; Ten Brinke et al., 2017). El ordenador fue el dispositivo más utilizado en los estudios incluidos, que coincide con otras investigaciones por facilitar la interacción para los adultos mayores (Góngora Alonso, Toribio Guzmán, et al., 2020). Algunos estudios de la revisión sistemática especificaban que los dispositivos tenían pantallas táctiles. De hecho, este tipo de pantalla es recomendada por ser intuitiva y permitir la entrada de datos con tan solo tocar su superficie (Chang et al., 2022; Toribio-Guzmán et al., 2018).

Entre otras diferencias encontradas, una minoría de estudios emplearon accesorios como el monitor, mando/palanca de juego, sensores, ratón o cascos. Para los adultos mayores es aconsejable que las herramientas que deben manipular sean simples, debido al declive en sus funciones y su falta de experiencia con las tecnologías (Kuerbis et al., 2017). No obstante, la mayoría de los estudios presentaron la similitud de incluir un período de prueba para que las personas mayores se adaptaran al programa y a sus dispositivos. Otras investigaciones concuerdan en que es necesario un entorno que

apoye a los usuarios en su aprendizaje de las herramientas tecnológicas, porque impacta en su actitud y compromiso de utilizarlas (Chiu et al., 2016; Kuerbis et al., 2017).

En general, los resultados corroboran la hipótesis de que las intervenciones cognitivas basadas en las TIC presentan funciones y características semejantes, aunque cada una ofrece particularidades para considerar y elegir según las necesidades y preferencias de cada usuario.

6.3 Similitudes y diferencias en las percepciones de personas mayores con DCL, demencia leve, cuidadores, profesionales y personal de administración/gestión sobre la usabilidad y UX de ehcoBUTLER

En este apartado se expondrán los hallazgos de la publicación II y III sobre ehcoBUTLER, en las que participaron adultos mayores con DCL o demencia leve, cuidadores (familiares, amigos o vecinos), profesionales (de la salud, trabajador social o miembros de centros de actividades/asociaciones benéficas) y/o personal de administración/gestión (de empresas de telemedicina, teleasistencia, hospitales o compañías de seguros).

En la publicación II y III los participantes coincidieron en percibir ehcoBUTLER principalmente como interesante y útil. Otras investigaciones sostienen que los adultos mayores, cuidadores y profesionales muestran interés en TIC que los apoyen en los desafíos asociados al deterioro cognitivo (Ahmed et al., 2022); desafíos que han sido ampliamente documentados (Gauthier et al., 2022; Gauthier et al., 2021; Martin & Velayudhan, 2020; Petersen et al., 2014).

Además, los participantes en la publicación II y III estuvieron de acuerdo con que las personas mayores utilizaran un dispositivo tecnológico para ejecutar la plataforma. La publicación III evidenció su desacuerdo en cuanto al tipo de dispositivo: ordenador, Tablet o móvil. No obstante, concordaron en que el dispositivo tuviera una amplia pantalla táctil, fuera portátil y no caro. Como se ha mencionado en la sección anterior, el ordenador, Tablet y móvil se caracterizan por ser portátiles, accesibles y rentables (Al Mahmud et al., 2019; García-Casal et al., 2017; Ten Brinke et al., 2017), y la pantalla táctil se recomienda por su uso intuitivo (Chang et al., 2022; Toribio-Guzmán et al., 2018).

Los participantes en ambas publicaciones también mostraron apertura hacia pagar por echoBUTLER. Las personas mayores desearían pagar la menor cantidad en caso de no ser gratuito. Los cuidadores pagarían dependiendo de los módulos que necesitarían los

usuarios y de su mejora, e incluso esperarían que fuera financiado por el Sistema Nacional de Salud, centros o compañías. En ese sentido, el personal de administración/gestión era el que estaba dispuesto a pagar la mayor cantidad por la plataforma. La importancia de la financiación o que para las personas mayores sea de bajo costo radica en que sus ingresos disminuyen a medida que envejecen (Instituto de Mayores y Servicios Sociales [IMSERSO], 2021).

Si bien todos los módulos de ehcoBUTLER fueron percibidos positivamente por los participantes, en la publicación II el módulo social recibió la mayor puntuación positiva, mientras que en la publicación III fueron herramientas de diferentes módulos: 3 del módulo emocional, 2 del módulo de estilo de vida saludable y 1 del ergonómico. Esta diferencia pudo deberse a que en los grupos focales (utilizados en la publicación III) el moderador puede profundizar en las perspectivas de los participantes más allá del guion (Setia, 2017), mientras que en una encuesta (usada en la publicación II) los participantes solo responden a las preguntas (Cruz et al., 2020).

En general, los resultados indican una adecuada aceptabilidad de ehcoBUTLER y confirman la hipótesis de que las personas mayores con DCL, demencia leve, cuidadores, profesionales y personal de administración/gestión perciben positivamente la usabilidad y UX de la plataforma. No obstante, en las siguientes secciones se observarán sus matices en cuanto a sus fortalezas y aspectos por mejorar.

6.4 Fortalezas de ehcoBUTLER en su usabilidad y UX

La publicación II evidencia de que todos los módulos de ehcoBUTLER les parecieron a los participantes interesantes, útiles, necesarios, que satisfacen las expectativas y mejoran el cuidado. La publicación III coincide en mostrar su interés hacia su utilidad de manera general y también permite observar de qué manera les resultaría útil cada herramienta correspondiente a cada módulo. Estos resultados son alentadores y van en línea con el objetivo del diseño centrado en el humano: desarrollar sistemas interactivos que sean usables, productivos y beneficiosos (ISO, 2019).

Además, en la publicación III se refleja su disposición a que los adultos mayores usen ehcoBUTLER en un dispositivo tecnológico que se caracterice por tener pantalla táctil, ser portátil y no caro. En ese sentido, ehcoBUTLER se encuentra adaptado para usarlo en Tablet y ordenador, dispositivos que justamente cuentan con las características indicadas por los participantes (Al Mahmud et al., 2019; Chang et al., 2022; García-Casal et al., 2017; Ten Brinke et al., 2017; Toribio-Guzmán et al., 2018).

En cuanto a la apariencia de la interfaz de ehcoBUTLER, la publicación III evidencia que a varios participantes les gustó por sus colores claros, el tipo y tamaño de la letra, así como por el fondo que no estaba sobrecargado de elementos. Otras investigaciones sostienen que la estética es importante por influir en la percepción de la idoneidad de la tecnología (Greenhalgh et al., 2017) y que la herramienta tecnológica debe ser sencilla para que las personas mayores no se desorienten ni se abrumen (Kuerbis et al., 2017).

La publicación III también muestra que los participantes con DCL y aquellos con demencia les gustaría utilizar ehcoBUTLER todos los días, varias veces por semana o en su tiempo libre, durante una hora u hora y media. Otros estudios sostienen que los usuarios se sienten animados a utilizar tecnologías cuando estas se ajustan a sus preferencias y capacidades (Arthanat et al., 2019; Castilla et al., 2020; Cho et al., 2022; Wang et al., 2019).

Sin embargo, en la publicación III los cuidadores y profesionales aclararon que los adultos mayores utilizarían ehcoBUTLER cuando acudieran a un centro y no en casa, debido a su deterioro cognitivo, falta de conocimientos informáticos y que la plataforma era poco personalizada. Estas dificultades a las que se enfrentan los adultos mayores en el ámbito de las tecnologías también han sido plasmadas en otras investigaciones (Castilla et al., 2020; Van Dijk, 2020). Lo que indica que en ehcoBUTLER, pese a sus fortalezas e impresión positiva, hacen faltan mejoras para que los usuarios lo utilicen autónomamente y se ajuste más a sus necesidades y preferencias.

Los hallazgos encontrados confirman las hipótesis de que las percepciones de los adultos mayores con DCL, demencia leve, cuidadores, profesionales de la salud y personal de administración/gestión se complementaron identificando fortalezas en la usabilidad y UX de ehcoBUTLER y también aspectos por mejorar. Los aspectos por mejorar se detallarán a continuación.

6.5 Aspectos por mejorar en la usabilidad y UX de ehcoBUTLER

La publicación III hizo posible recabar las sugerencias de los participantes sobre cómo mejorar la usabilidad y UX de ehcoBUTLER. De hecho, fueron los profesionales y cuidadores los que aportaron principalmente las sugerencias, mientras que las personas mayores con DCL/demencia leve se centraron en expresar cómo se sentían sobre la plataforma.

En términos generales, los profesionales recomendaron que los usuarios recibieran formación para aprender a utilizar ehcoBUTLER y que lo pudieran utilizar sin necesitar Internet o mediante un USB. Nuevamente, se coincide con otras investigaciones en

proporcionar apoyo a las personas mayores en su aprendizaje con las tecnológicas (Chiu et al., 2016; Kuerbis et al., 2017). En cuanto a no necesitar la conexión a Internet, otras investigaciones apoyan alternativas similares como que los adultos mayores puedan descargar el contenido de las aplicaciones para acceder a ellas sin dicha conexión (LaMonica et al., 2017), debido a que suelen carecer de esta (Van Dijk, 2020) o son una minoría los que han usado Internet alguna vez (IMSERSO, 2021).

Además, los cuidadores recomendaron personalizar la plataforma según los intereses de cada usuario y los profesionales sugirieron iconos grandes y poco texto. Los cuidadores también recomendaron añadir otras actividades como rutas virtuales y llamadas por comandos de voz, mientras que algunos participantes con DCL les gustaría contar con ejercicios físicos y más ejercicios cognitivos. Estos hallazgos demuestran las aportaciones enriquecedoras de los usuarios finales y partes interesadas para desarrollar y adaptar apropiadamente una tecnología, tal y como lo han demostrado otros estudios (Dosso et al., 2022; Hitch et al., 2017; Holthe et al., 2018; Meiland et al., 2017; Menghi et al., 2019; Mulvenna et al., 2017; Rai et al., 2020; Wargnier et al., 2018). A continuación, se detallarán las recomendaciones de los participantes por módulo.

En cuanto al Módulo de Estilo de Vida Saludable, los profesionales sugirieron incorporar recordatorios de las citas que fueran llamativos y con sonidos para las personas mayores y sus familiares, aunque no estuvieran utilizando la plataforma. También sugirieron agregar notificaciones motivadoras de las nuevas recomendaciones de estilo de vida saludable, que se guardaran las anteriores y tuvieran acceso directo a estas.

En el Módulo de Tiempo Libre y Ocio, los profesionales aconsejaron que los cuidadores predeterminaran el acceso a aplicaciones y páginas de Internet para sus familiares y que dichos accesos fueran directos. Además, recomendaron que los usuarios pudieran tener la opción de acceder a sitios relacionados.

En el Módulo de Cuidado Emocional, los profesionales sugirieron que los usuarios expresaran sus recuerdos autobiográficos escribiendo, hablando o cantando, y que las fotografías fueran reales. Incluso, un cuidador aportó la idea de que la plataforma podría narrar dichos recuerdos. Respecto a la evaluación del estado de ánimo, los profesionales recomendaron que se realizara 1 vez al día o cada 12 horas para evitar preguntas repetitivas. Un cuidador recomendó que dichas preguntas y las opciones de respuesta se formularan oralmente y por escrito. En los ejercicios de relajación, los profesionales y cuidadores sugirieron que se acompañaran de escenarios con imágenes

reales, mientras que participantes con DCL les gustaría que se incorporaran documentales.

Respecto al Módulo de Cuidado Social, los profesionales y un cuidador recomendaron que los contactos de la videoconferencia y correo electrónico tuvieran un icono con su imagen y acceso directo. Además, sugirieron que los usuarios pudieran enviar su mensaje de correo electrónico a través de una nota de voz.

En cuanto al diseño ergonómico, profesionales y cuidadores recomendaron que la voz e imagen del avatar fueran de una persona real. Los profesionales también sugirieron que se pudiera elegir la forma en la que el avatar explicara las instrucciones: oralmente, por escrito o ambas.

Por otro lado, como se ha mencionado anteriormente, GRADIOR conforma el módulo cognitivo de ehcoBUTLER y también se encuentra disponible por sí solo. Por lo que en la siguiente sección se expondrán los resultados obtenidos sobre GRADIOR para facilitar su comprensión.

6.6 Similitudes y diferencias en las percepciones de personas mayores con DCL, demencia leve, cuidadores, profesionales y personal de administración/gestión sobre la usabilidad y UX de GRADIOR

En este apartado se expondrán los hallazgos de la publicación II y III correspondientes a GRADIOR. En ambas publicaciones los participantes coincidieron en percibir positivamente a GRADIOR en cuanto a su utilidad. Otras investigaciones exponen que la utilidad percibida es una de las variables más importantes que influye en la intención de utilizar una tecnología (Akritidi et al., 2022; Yau & Hsiao, 2022).

En ambas publicaciones, en las que GRADIOR formó parte de ehcoBUTLER, los participantes también concordaron en que dieron mayores puntuaciones positivas a otros módulos de ehcoBUTLER. Esto indica una preferencia hacia las otras actividades, en vez de las cognitivas. Lo que podría deberse a que las intervenciones cognitivas son mayormente utilizadas dentro de las intervenciones psicosociales y existe una variedad de programas de estimulación, estimulación y rehabilitación cognitiva (Irazoki et al., 2020; Pinto-Bruno et al., 2017). Por lo que su factor de novedad puede disminuir, orientando un mayor interés hacia otro tipo de actividades.

En la publicación III, los participantes dieron sus opiniones sobre las 2 versiones de GRADIOR en ehcoBUTLER: la versión gratuita caracterizada por ejercicios de estimulación y entrenamiento para mantener las funciones cognitivas activas en general;

y la versión posiblemente sujeta a pago, que consiste en el entrenamiento y rehabilitación de funciones cognitivas con alteraciones. Los participantes coincidieron en considerar la versión gratuita útil, especialmente para trabajar la memoria. En cuanto a la versión pagada, los participantes con DCL difirieron en que algunos no estaban dispuestos a pagar por ser pensionistas, mientras que otros pagarían media vez fuera un costo pequeño por dicha situación. Nuevamente, se evidencia la importancia de considerar que los ingresos se reducen en el envejecimiento (IMSERSO, 2021). Los profesionales apoyaron la idea de que las personas mayores pagaran una pequeña cantidad, mientras que los cuidadores estarían dispuestos a pagar según la mejoría que sus familiares presentaran.

Para continuar profundizando y ampliando el conocimiento sobre la usabilidad y UX de GRADIOR, se decidió comparar la percepción de los adultos mayores con DCL/demencia leve con la de otro grupo grande de usuarios de GRADIOR, que también tienen alteraciones cognitivas y problemas de dependencia: personas con esquizofrenia. Los hallazgos se detallarán a continuación.

6.6.1 Comparación de la usabilidad y UX de GRADIOR entre dos grupos significativos de usuarios: adultos mayores con DCL/demencia leve y personas con esquizofrenia

Este apartado se basará en los resultados del artículo enviado para su publicación (ver Apéndice). Tanto en la impresión general de GRADIOR como en su usabilidad y UX, los participantes coincidieron en valorarlo positivamente. No obstante, mostraron la diferencia de que los adultos mayores con DCL/demencia presentaron puntuaciones positivas más altas que las personas con esquizofrenia. Lo que indica que hacen falta mejoras por realizar en GRADIOR para las personas con esquizofrenia, pero también pudo haber influido su apatía, uno de los principales síntomas que les afecta frecuentemente (Raffard et al., 2019).

Respecto a la calidad de GRADIOR reflejada en el *benchmark*, los adultos mayores con DCL/demencia leve nuevamente tuvieron impresiones positivas superiores a las de las personas con esquizofrenia. Los adultos mayores lo consideraron excelente en la mayoría de las escalas (Atracción, Estimulación, Transparencia, Eficiencia y Novedad), excepto en Controlabilidad en donde lo clasificaron como bueno. En cambio, los participantes con esquizofrenia lo categorizaron como superior a la media en la mayoría de las escalas (Atracción, Transparencia, Estimulación y Novedad). Sin embargo, consideraron que estaba por debajo de la media en Eficiencia y Controlabilidad. Se

puede observar que ambos grupos de participantes coincidieron en dar puntuaciones más bajas en Controlabilidad.

Otros estudios apoyan que GRADIOR ha sido percibido positivamente por parte de adultos mayores con DCL/demencia leve y personas con esquizofrenia. No obstante, a la vez sugieren que algunos aspectos referentes a su usabilidad y UX podrían mejorarse (Góngora Alonso, Fumero Vargas, et al., 2020; Irazoki et al., 2021).

En base a los hallazgos reportados en el punto 6.6 y 6.6.1, se confirma la hipótesis de que los adultos mayores con DCL/demencia leve, personas con esquizofrenia, cuidadores, profesionales y personal de administración/gestión valoraron positivamente la usabilidad y UX de GRADIOR 4.5. Además, se confirman las hipótesis de que sus percepciones se complementaron, identificando fortalezas y aspectos por mejorar en la usabilidad y UX del programa. Las cuales se detallarán en las siguientes secciones.

6.7 Fortalezas de GRADIOR en su usabilidad y UX

En la publicación II, III y en el artículo enviado para su publicación (ver Apéndice) se evidencian diversas fortalezas de GRADIOR en su usabilidad y UX: fue percibido útil, interesante, necesario, que satisface las expectativas y mejora el cuidado. Además, el artículo enviado para su publicación aporta más fortalezas respecto a que a los adultos mayores con DCL o demencia leve lo consideraron organizado, que captura su atención y se les facilita familiarizarse con su aprendizaje y uso.

Otra investigación coincide con que GRADIOR ha recibido valoraciones positivas por parte de personas mayores con deterioro cognitivo en cuanto a resultarles atractivo, entretenido, motivante, apropiadamente organizado, fácil de usar y aprender, así como que satisface sus expectativas (Irazoki et al., 2021).

Los participantes con esquizofrenia en el artículo enviado para su publicación también mostraron resultados positivos sobre GRADIOR y concuerdan con otro estudio en que las personas con esquizofrenia perciben que captura su atención, tiene un buen funcionamiento, instrucciones comprensibles, satisface sus expectativas y es motivante (Góngora Alonso, Fumero Vargas, et al., 2020).

No obstante, las áreas en las que los adultos mayores con deterioro cognitivo dieron menores puntuaciones positivas y que en general las personas con esquizofrenia proporcionaron puntuaciones positivas inferiores a las de las personas mayores, contribuyen a identificar aspectos por mejorar en la usabilidad y UX de GRADIOR. Los cuales se puntualizarán en el siguiente apartado.

6.8 Aspectos por mejorar en la usabilidad y UX de GRADIOR

En el artículo enviado para su publicación (ver Apéndice), los adultos mayores con DCL/demencia leve presentaron una menor puntuación positiva en Novedad y Controlabilidad. De hecho, a la calidad de esta última también le otorgaron una puntuación positiva menor. Lo que indica que se requiere mejorar GRADIOR para que estos usuarios se sientan con mayor control de la interacción con el programa y que lo consideren con mayor invención.

Otro estudio coincide en que las personas mayores con deterioro cognitivo necesitan utilizar el hardware y software de GRADIOR de manera más autónoma (Irazoki et al., 2021). Lo que podría lograrse mediante un diseño más intuitivo (Jo et al., 2021). En cuanto al factor de Novedad, si bien en GRADIOR 4.5 se incorporaron más ejercicios, los resultados anteriores indican que se podrían presentar dichos ejercicios de nuevas formas, tales como la realidad virtual que tiene interfaces multisensoriales (Maggio & Calabrò, 2022).

En cuanto a la versión de GRADIOR incorporada en ehcoBUTLER, que podría estar sujeta a pago (publicación III), los profesionales sugirieron que formara parte de un paquete de cuidados en una residencia o centro de mayores, para hacerla más accesible con una tarifa plana al año. En ese sentido, existe la ley 39/2006, de 14 de diciembre, de Promoción de la Autonomía Personal y Atención a las personas en situación de dependencia, que otorga el derecho a servicios y prestaciones económicas a las personas que se encuentren en dicha situación (Boletín Oficial del Estado, 299, de 15/12/2006).

Sin embargo, la crisis económica ha influido en que la cobertura siga descansando principalmente en los cuidadores informales, que en su mayoría son familiares (Martínez Pizarro, 2020; Osorio Bayter et al., 2018). Disponer de medios económicos para adquirir una tecnología influye significativamente en aceptarla y tener la intención de usarla (Li et al., 2019), por lo que es fundamental superar la brecha de la financiación para que los usuarios de GRADIOR puedan disponer fácilmente de este.

En cuanto a los participantes con esquizofrenia, en el artículo enviado para su publicación se evidencia que se necesita mejorar el programa en términos de Atracción, Transparencia, Estimulación y Novedad, principalmente en Eficiencia y Controlabilidad. Otra investigación también encontró que las personas con esquizofrenia consideraron que GRADIOR podría mejorarse para que resultara más entretenido y que la cantidad

de elementos en los ejercicios se ajustaran, porque les resultaba difícil interactuar a la vez con varios de estos (Góngora Alonso, Fumero Vargas, et al., 2020).

La realidad virtual también es recomendada por otros estudios para las personas con esquizofrenia, porque muestra diversos estímulos de la intervención de manera atractiva, motivadora, divertida y realista, sin generar sobrecarga en el usuario. Además, tiene la flexibilidad de presentar los ejercicios de la intervención en formato de tareas o juegos (Adery et al., 2018; Devos et al., 2023). Si bien en GRADIOR 4.5 se incorporaron nuevos ejercicios e imágenes reales en el repertorio de ejercicios, nuevamente se observa que presentarlos de otra forma podría mejorar el programa. Además, se debe tomar en cuenta que personalizar las funciones y contenidos de los sistemas es vital para mejorar la satisfacción de los usuarios, así como para aumentar su eficiencia y comodidad (Ludden et al., 2015).

Por otro lado, debido a la frecuente apatía que padecen las personas con esquizofrenia (Raffard et al., 2019), podría ser útil que los terapeutas en el período que apoyan a los usuarios a familiarizarse con GRADIOR, también les aporten mayores explicaciones sobre el objetivo del programa. La percepción del beneficio del tratamiento por parte de los pacientes contribuye a su motivación, satisfacción y compromiso con la intervención (Treichler et al., 2019).

Capítulo 7: Conclusiones

A continuación, se hará referencia a los objetivos, hipótesis y resultados obtenidos para presentar las conclusiones correspondientes, así como recomendaciones de futuras líneas de investigación.

Respecto a identificar medidas e instrumentos para evaluar en adultos mayores con DCL/demencia la usabilidad y UX de intervenciones cognitivas basadas en las TIC (Objetivo 1.1), y la hipótesis sobre las características similares de dichas medidas e instrumentos (Hipótesis 1):

1. Las medidas e instrumentos para evaluar la usabilidad y UX se caracterizan por recabar datos objetivos (eficacia y eficiencia) y subjetivos (tales como la satisfacción), que proporcionan una visión integral para desarrollar y mejorar las intervenciones psicosociales basadas en las TIC, según las necesidades y preferencias identificadas en la población objetivo.

2. Los estudios existentes sobre usabilidad y UX en personas mayores con DCL/demencia, muestran que tienen una experiencia positiva con intervenciones cognitivas basadas en las TIC y logran completar las tareas, aunque presentan ciertas dificultades en su interacción. Se recomienda realizar más investigaciones que incluyan a este grupo poblacional en estudios de usabilidad y UX, así como un consenso sobre la relación de estos términos, para continuar progresando en la correcta adaptación de estas tecnologías.

En cuanto a determinar las características y funciones de intervenciones cognitivas basadas en las TIC dirigidas a personas mayores con DCL/demencia (Objetivo 1.2), y la hipótesis de la semejanza de estas intervenciones en sus características y funciones (Hipótesis 2):

3. Las semejanzas encontradas (programas de ordenador con pantalla táctil, ejercicios/juegos serios no solo cognitivos sino de otras áreas, período de familiarización con el programa), evidencian las características y funciones que pueden promover la usabilidad y UX de las intervenciones cognitivas basadas en las TIC en personas mayores con DCL/demencia. Sin embargo, es necesario que los estudios aporten más información sobre el software y hardware para tener una visión más enriquecedora en la evaluación de su usabilidad y UX.

En relación con conocer las similitudes y diferencias entre las percepciones de los adultos mayores con DCL, demencia leve, cuidadores, profesionales y personal de administración/gestión sobre la usabilidad y UX de ehcoBUTLER (Objetivo 2.1), y la hipótesis de que su valoración sería positiva (Hipótesis 3):

4. Los usuarios potenciales y partes interesadas percibieron positivamente ehcoBUTLER de manera general y cada uno de sus módulos. Por lo que su desarrollo en términos de usabilidad y UX está adecuadamente orientado. Aspectos que son fundamentales por promover el uso y futuro éxito de una intervención basada en las TIC.

5. La situación de pensionistas por parte de las personas mayores y el deseo de sus cuidadores de que ehcoBUTLER sea financiado por el Sistema Nacional de Salud, centros o compañías, indican que existe una brecha de inversión en productos dirigidos a adultos mayores con deterioro cognitivo. Es necesario superar dicha brecha para implementar eficazmente programas que promuevan su autonomía y bienestar.

Respecto a identificar las potenciales fortalezas de ehcoBUTLER en cuanto a su usabilidad y UX (Objetivo 2.2), y la hipótesis de que las percepciones de los participantes se complementarían en la identificación de dichas fortalezas (Hipótesis 4):

6. EhcoBUTLER presenta fortalezas en cuanto a la aceptabilidad de su apariencia, uso, dispositivo tecnológico, satisfacción de expectativas y percepción de ser útil, interesante, necesario y que mejora su cuidado. Las características y funciones de ehcoBUTLER pueden contribuir al desarrollo y mejora de otras intervenciones psicosociales basadas en las TIC para personas mayores con deterioro cognitivo.

En cuanto a determinar posibles aspectos por mejorar en la usabilidad y UX de ehcoBUTLER (Objetivo 2.3), y la hipótesis de que las percepciones de los participantes se complementarían en determinar tales mejoras (Hipótesis 5):

7. EhcoBUTLER necesita mejorar su usabilidad, accesibilidad y sostenibilidad (aplicaciones más intuitivas y personalizadas, formación previa para aprender a utilizarlas, contenidos *offline*/USB, formar parte de un paquete asistencial de coste asequible o ser gratuito). Las sugerencias de potenciales usuarios y partes interesadas promueven que las mejoras de ehcoBUTLER se orienten adecuadamente, de modo que en el futuro pueda beneficiar a todos: a las personas mayores para ser agentes activos de su salud; a los cuidadores, para

apoyarles en su papel y tener un respiro; y a los profesionales, para disponer de una plataforma de intervención multidominio.

Respecto a conocer las semejanzas y discrepancias en las percepciones de los adultos mayores con DCL, demencia leve, cuidadores, profesionales y personal de administración/gestión sobre la usabilidad y UX de GRADIOR (Objetivo 3.1), y la hipótesis de que su valoración sería positiva (Hipótesis 6):

8. La usabilidad y UX de GRADIOR fueron percibidas positivamente. Aspectos esenciales para promover la adherencia y efectividad de una intervención basada en las TIC. Sin embargo, si se compara GRADIOR con otros módulos de ehcoBUTLER, estos recibieron mayores puntuaciones positivas. Por lo que incorporar funciones sociales, emocionales y de entretenimiento podría incrementar la adherencia a intervenciones cognitivas basadas en las TIC, tales como GRADIOR.

9. Los adultos mayores no estaban dispuestos a pagar por GRADIOR o lo harían a un bajo costo, a pesar de considerarlo útil. Nuevamente, la situación de pensionistas de esta población hace un llamado a que el sistema sanitario también facilite el acceso a TIC que promuevan su cognición, área en declive en el envejecimiento y con riesgo de progresar a DCL y demencia.

En relación con ampliar el conocimiento sobre la usabilidad y UX de GRADIOR desde la perspectiva de otro grupo significativo de usuarios: personas con esquizofrenia. (Objetivo 3.1.1), y la hipótesis de que su valoración también sería positiva (Hipótesis 6):

10. Los adultos mayores con DCL/demencia y personas con esquizofrenia valoraron positivamente GRADIOR, siendo los adultos mayores quienes presentaron las puntuaciones positivas más altas. Por lo que la usabilidad y UX de GRADIOR esta adecuadamente desarrollada, principalmente para las personas mayores con deterioro cognitivo.

Referente a determinar las fortalezas de GRADIOR en su usabilidad y UX (Objetivo 3.2), y la hipótesis de que las percepciones de los participantes se complementarían en la identificación de dichas fortalezas (Hipótesis 7):

11. Las fortalezas de GRADIOR residen en que es percibido útil, interesante, motivante, necesario, que satisface las expectativas y mejora el cuidado. Además, captura la atención, es organizado, tiene un buen funcionamiento, instrucciones comprensibles y a los usuarios se les facilita familiarizarse con él.

Los elementos y funciones de GRADIOR pueden aportar ideas para desarrollar y mejorar otras intervenciones cognitivas basadas en las TIC para personas con deterioro cognitivo.

En cuanto a identificar aspectos por mejorar en la usabilidad y UX de GRADIOR (Objetivo 3.3), y la hipótesis de que las percepciones de los participantes se complementarían en determinar tales mejoras (Hipótesis 8):

12. GRADIOR necesita mejorar su usabilidad para que los usuarios se sientan con mayor control de su interacción, y su UX para resultarles con mayor invención. Lo que podría lograrse con una interfaz más intuitiva y presentar los ejercicios de nuevas maneras. De hecho, los presentes hallazgos de GRADIOR 4.5 y los encontrados cuando formó parte de ehcoBUTLER, impulsaron a que en GRADIOR 5 (la última versión) se haya incorporado la realidad virtual, se ampliara su abordaje hacia la estimulación multisensorial y regulación emocional, disponga de modalidad *offline* y pueda ejecutarse en Tablet, teléfono inteligente u ordenador.

13. Si bien los usuarios de GRADIOR comparten las características de padecer deterioro cognitivo y ser dependientes, se requiere una mayor personalización de las herramientas del programa y ofrecer tanto apoyo como información de su objetivo acorde a cada patología, para promover su aceptabilidad, usabilidad y experiencia de usuario.

Capítulo 8: Referencias

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Capítulo 9: Apéndice

A continuación, se presenta un resumen ampliado en castellano del artículo que se envió a *Health Informatics Journal* y que se encuentra bajo revisión por pares. También se incluye una copia completa de dicho artículo en el formato requerido por la revista. Los datos de *Health Informatics Journal*, según el *Journal Citation Report*s (2021) son:

- Factor de impacto: 2.934
- Nombre de la categoría: *Health Care Sciences & Services*
- Ranking en la categoría: 60/109
- Cuartil en la categoría: Q3

9.1 Artículo enviado para su publicación

Título:

Impresiones de usabilidad y experiencia de usuario de adultos mayores con deterioro cognitivo y personas con esquizofrenia sobre GRADIOR, un programa de rehabilitación cognitiva: Un estudio transversal

Resumen:

Introducción: los adultos mayores con demencia y las personas con esquizofrenia padecen de deterioro cognitivo y dependencia. Las intervenciones no farmacológicas, tales como la rehabilitación cognitiva, pueden retrasar o prevenir la conversión del DCL en demencia, así como beneficiar a las personas con esquizofrenia; ayudando a la vez a reducir el consumo y coste de los medicamentos y la institucionalización. Sin embargo, es necesario examinar si un software de rehabilitación cognitiva está adecuadamente adaptado a ellos, dada su falta de experiencia o uso de las tecnologías y deterioro cognitivo.

Objetivo: evaluar y comparar las impresiones de adultos mayores con demencia/DCL y personas con esquizofrenia sobre la usabilidad y UX de GRADIOR, un programa de rehabilitación cognitiva.

Método: en este estudio transversal se recabó una muestra de 82 sujetos (41 adultos mayores con demencia/DCL y 41 personas con esquizofrenia). Los participantes firmaron el consentimiento informado, cumplimentaron el formulario de datos sociodemográficos y el UEQ en compañía de un profesional, quien resolvió sus dudas en caso necesario.

Resultados: los participantes tuvieron una impresión general positiva de GRADIOR, así como de su usabilidad y UX. Los adultos mayores con demencia/DCL dieron puntuaciones positivas más altas que las personas con esquizofrenia. Ambos grupos de participantes coincidieron en que la calidad del programa era menor en Controlabilidad.

Conclusiones: GRADIOR está correctamente orientado para satisfacer las necesidades y preferencias de las personas mayores con DCL/demencia y personas con esquizofrenia. No obstante, se necesitan realizar mejoras para que se sientan con mayor control de su interacción. Además, para las personas con esquizofrenia se requieren mejorar otros aspectos de la usabilidad y UX. Lo que a su vez indica la importancia de personalizar las herramientas del programa para cada patología.

La evaluación de la usabilidad y UX permite comprobar la aceptabilidad de la tecnología, su funcionalidad y mejoras específicas para cada grupo de usuarios. Los hallazgos de este estudio pueden contribuir al desarrollo y mejora de tecnologías de rehabilitación cognitiva para adultos mayores con DCL/demencia y personas con esquizofrenia.

Palabras claves: DCL, demencia, esquizofrenia, usabilidad, software para la rehabilitación cognitiva

Usability and User Experience Impressions of Older Adults with Cognitive Impairment and People with Schizophrenia about GRADIOR, a cognitive rehabilitation program: A cross-sectional study

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Abstract

The cognitive impairment of older adults and people with schizophrenia, and their lack of experience/use of technologies, makes it necessary to examine whether a cognitive rehabilitation software is well adapted to them. We evaluated and compared the impressions of older adults with dementia/MCI (mild cognitive impairment) and people with schizophrenia about GRADIOR's usability, a computerized cognitive rehabilitation program, and their user experience (UX) through the User Experience Questionnaire. Older adults with dementia/MCI had more positive impressions than people with schizophrenia. Both agreed that its quality was lower in Dependability. GRADIOR is properly oriented to satisfy the needs and preferences of target users. Improvements are needed to make them feel more in control of its interaction. For people with schizophrenia, other aspects of usability and UX need to be improved. The evaluation of usability and UX allows to verify the technology acceptability, functionality, and specific improvements for each target user group.

Keywords: MCI, Dementia, Schizophrenia, Usability, Cognitive rehabilitation software

Introduction

Worldwide, dementia is one of the most important causes of disability and dependence among older people (World Health Organization [WHO], 2022). Dementia has psychological, physical, economic, and social consequences not only for those who have dementia, but also for their families, caregivers, and society in general (WHO, 2022). Non-pharmacological interventions can delay or prevent the conversion from mild cognitive impairment (MCI) to dementia, helping at the same time to reduce the consumption and the cost of medicine and institutionalization (Shao et al., 2022; Steinbeisser et al., 2020).

In schizophrenia there are also cognitive deficits, which are one of the main cause of disabilities in their everyday functioning (Harvey et al., 2019). The cognitive deficits are a major target for treatment; however, the effects of medications appear to be limited (Tripathi et al., 2018). Non-pharmacological interventions are gaining increasing interest and importance (Stević et al., 2022) and have been shown to benefit people with schizophrenia (Samochowiec et al., 2021).

Non-pharmacological interventions include cognitive, physical, and psychosocial activities, electrical stimulation, a combination of the above, etc. (Hegde et al., 2020; Lissek & Suchan, 2021). This article will focus on cognitive rehabilitation, which has been shown to be effective in slowing the progression of dementia (Amieva et al., 2016; Diaz Baquero et al., 2022), has promising positive effects in MCI (Ge et al., 2018), and promotes cognition in people with schizophrenia (Samochowiec et al., 2021). Cognitive interventions have a traditional pencil and paper format and require a face-to-face contact (Kueider et al., 2012).

Technological innovation has driven cognitive interventions to be presented in computer-based programs, which are more cost-effective and can reach populations that are homebound, lived at centers or who lived far away (Ge et al., 2018; Kueider et al., 2012). Computer-based programs also make it possible to create personalized and flexible treatments, adjusted to individual conditions (González-Palau et al., 2013; Irazoki et al., 2020). In addition, they provide real-time feedback and allow for more accurate recording of patient performance at each session (Toribio-

Guzmán et al., 2018). They also present the exercises in a more attractive and fun way, increasing people's motivation (González-Palau et al., 2013).

GRADIOR is a computer-based cognitive assessment and rehabilitation program aimed at training and recovering cognitive functions in people with cognitive deficits/impairment (e.g., dementia, mental illness, etc.), as well as for cognitive stimulation in healthy subjects. It was one of the pioneer programs in Spain (Toribio-Guzmán et al., 2018). Its first version was released in 1997 and has gone on improving since then (Franco-Martín et al., 2020). In version 4.5, the following improvements were made: a more intuitive user interface, supported by a touch screen computer, written and audio instructions, new exercises with real images and a renewed logo (Franco-Martín et al., 2020; Irazoki et al., 2021). It is planned that the next improvements will be to adapt the program for use on tablets and smartphones.

Older people perceive that technology can be a source of opportunities and benefits. However, they also believe that their advanced age and lack of skills/experience with technology may be disadvantages in using it (Pirhonen et al., 2020). It has also been found that people with schizophrenia do not usually handle modern technology (Góngora Alonso, Fumero Vargas, et al., 2020), due to their economic situation, cognitive difficulties, and symptoms (Lindberg et al., 2019). Apathy is one of the main symptoms that frequently affects them (Raffard et al., 2019). Nevertheless, they would be interested in receiving technological services that promote their health (Ben-Zeev et al., 2013). In the case of GRADIOR, the therapists regularly help the users at the beginning until they become familiar with the program (Irazoki et al., 2021).

An environment that supports users in learning to use technological tools is necessary (Chiu et al., 2016). It is also crucial that technologies are designed according to their needs, abilities, and preferences (Contreras-Somoza et al., 2020), so that they can use them easily, autonomously and achieve the therapeutic objectives (Contreras-Somoza et al., 2021). In addition to usability, it is essential that they have a pleasant user experience (UX) (Contreras-Somoza et al., 2021), because a positive experience encourages them to show acceptability towards the technology, to feel motivated and attracted to use it over time (Biduski et al., 2020).

Another decisive aspect for a positive UX is that the technology is perceived as useful and that it meets the expectations of the users (Biduski et al., 2020).

Therefore, users' perceptions and feedbacks on technologies are essential for their proper development and improvement (Contreras-Somoza et al., 2022). However, there are program designs that are based only on the opinion of physicians and researchers, which may differ from the opinion of the intended users of the program (Reeder et al., 2016). It is essential to involve the users, despite the challenge that they have difficulties in their cognitive ability (Lindberg et al., 2019).

In the case of GRADIOR, studies have been carried out to evaluate its usability and the level of satisfaction in users with mental illness (Góngora Alonso, Fumero Vargas, et al., 2020), elderly with cognitive impairment and health professionals (Irazoki et al., 2021). GRADIOR's usability has also been examinate in subjects with and without cognitive impairment in the Long Lasting Memories program, which also contains physical activities (Góngora Alonso, Toribio Guzmán, et al., 2020). However, the present study is the first to compare the UX and GRADIOR's usability in two groups with dependence and cognitive impairment of different etiology: elderly population with mild dementia/MCI and people with schizophrenia. Both are a large group of users, whose impressions are crucial to improve the program. Usability and UX are critical to the success and effectiveness of a program (Brade et al., 2017; Lau et al., 2019).

The objective of this study was to evaluate and compare the impressions of older adults with MCI/mild dementia and people with schizophrenia about the usability of GRADIOR (version 4.5) and their UX. The study findings will be important to identify strengths and areas for improvement in the program to better adapt it according to users' impressions. The findings could also provide important clues for developing and improving other computer-based cognitive rehabilitation programs targeting these populations.

Methods

Design

This is a cross-sectional study focused on evaluating and comparing the UX and GRADIOR's usability in two groups with dependence and cognitive impairment of different etiology.

The present study, focused on usability and UX, was part of a clinical trial [ISRCTN 15742788] that evaluated the efficacy of GRADIOR for cognitive rehabilitation in older subjects with MCI/mild dementia (Vanova et al., 2018). An extension of the clinical trial was conducted to evaluate the UX and usability of GRADIOR in people with schizophrenia (who were already GRADIOR's users for therapeutic purposes), because they are a large group of users whose impressions are also important to improve the program.

Participants

The experimental group of the clinical trial (older adults with MCI/mild dementia) and a group of people with schizophrenia (who were already GRADIOR's regular users) were recruited for this study. The participants inclusion criteria are detailed below.

People with MCI

Their recruitment came from the Memory Workshops and the Memory Clinic of INTRAS Foundation (located in Zamora and Valladolid, Spain), and from Rio Hortega University Hospital (Valladolid, Spain). Their inclusion criteria were the same as those of the clinical trial to which this study belongs (Vanova et al., 2018). Participants had to have been using GRADIOR (version 4.5) for 4 months. All had a cognitive assessment and had cognitive impairment based on a score of ≤ 27 on Mini-Mental State Examination (MMSE) (Arevalo-Rodriguez et al., 2015). A psychiatrist of the research team verified that they met the criteria of Petersen (Petersen et al., 1999, 2014).

People with mild dementia

These participants were recruited from the Memory Workshops and the Memory Clinic of INTRAS Foundation (located in Zamora and Valladolid, Spain), and from Rio Hortega University Hospital (Valladolid, Spain). The inclusion criteria were the same as those of the clinical trial to which this study corresponds (Vanova et al., 2018). Participants had to have a 4-month experience with the GRADIOR 4.5 version and have mild dementia. All of them had a cognitive assessment, where the MMSE cut-off point was < 25 points (Blesa et al., 2001). They also met the Diagnostic and Statistical Manual for Mental Disorders (DSM-5) criteria for major neurocognitive disorder, which is the current term for dementia (American Psychiatric Association, 2013). A psychiatrist of the research team confirmed the diagnoses.

People with schizophrenia

They were recruited from the INTRAS Foundation Residence (Toro, Spain), and from the Psychosocial Rehabilitation Center (Zamora, Spain), which is also part of the INTRAS Foundation. Participants were already diagnosed by a psychiatrist and met the DSM-5 criteria for schizophrenia (American Psychiatric Association, 2013). In addition, they had to be 18 years of age or older, be able to read and write, and to have mental stability during the present study. They were already GRADIOR users because it was part of their therapeutic activities in the centers. It was corroborated that they had at least 4-month experience using the program (version 4.5).

Materials

The informed consent and the sociodemographic data form corresponding to the 4-month study protocol was used (Vanova et al., 2018). The User Experience Questionnaire (UEQ) was also used because it is useful for quickly assessing usability (pragmatic) and UX (hedonic) aspects of interactive products (Rauschenberger et al., 2013), as well as the general impression of the users (Attractiveness), which is influenced by the above aspects (Schrepp et al., 2017b). The Spanish version of pencil and paper was used, which consists of 26 items grouped into 6 scales (Table 1).

Table 1. UEQ scales and items.

Aspect	Scale	Item	Item Nº
General impression	Attractiveness	annoying/enjoyable	1
		good/bad	12
		unlikable/pleasing	14
		unpleasant/pleasant	16
		attractive/unattractive	24
		friendly/unfriendly	25
Usability	Efficiency	fast/slow	9
		inefficient/efficient	20
		impractical/practical	22
		organized/cluttered	23
	Perspicuity	not understandable / understandable	2 4
		easy to learn/difficult to learn	13
		complicated/easy	21
		clear/confusing	
	Dependability	unpredictable/predictable	8
		obstructive/supportive	11
		secure/not secure	17
		meets expectations/does not meet expectations	19
User experience	Stimulation	valuable/inferior	5
		boring/exciting	6
		not interesting/interesting	7
		motivating/demotivating	18
	Novelty	creative/dull	3
		inventive/conventional	10
		usual/leading edge	15
		conservative/innovative	26

In a random order, half of the UEQ items start with a positive term, while the other half with a negative one; the participants answer using a 7-point Likert scale indicating their level of agreement with the positive or negative term (Schrepp et al., 2017b). The UEQ items are scaled from -3 (most negative answer) to +3 (most positive answer), and 0 is a neutral answer (Rauschenberger et al., 2013). Values above 0 imply a positive impression of the users, while values below 0 a negative one (Schrepp et al., 2017a). The most extreme values are infrequently observed, so values close to +2 represent a very positive impression, near to an optimal impression (Rauschenberger et al., 2013).

The UEQ version 10 has a benchmark data set, which contains 21,175 responses from 468 studies that have evaluated different products with the UEQ. This makes

it possible to further compare the quality of the evaluated product, as well as to identify its strengths and areas for improvement (Schrepp et al., 2017a). The benchmark has 5 categories to classify a product (Schrepp et al., 2017a):

- Excellent: the evaluated product is in the range of the 10% best results in the benchmark.
- Good: 10% of the benchmark results are better than the evaluated product, while 75% of the benchmark results are worse.
- Above average: 25% of the benchmark results are better than the evaluated product, and 50% of the benchmark results are worse.
- Below average: 50% of the benchmark results are better than the evaluated product, while 25% of the benchmark results are worse.
- Bad: the evaluated product is in the range of the 25% worst results in the benchmark.

Procedure

This study had the ethical approval of the Provincial Hospital of Zamora (Number: 387- E.C.). According to Rauschenberger et al. (2013), 30 participants are sufficient to acquire a valid impression on the UEQ. Therefore, an attempt was made to collect a sample ≥ 30 participants per group.

Participants were informed about the purpose of the study, the confidentiality of the data and that participation was voluntary. They agreed to sign the informed consent. Then, their sociodemographic data were obtained and, finally, the UEQ was applied. A member of the research team clarified the participants' doubts if necessary, and ensured that they completed the documents, thus avoiding missing data. All documents were completed individually in an accessible room. The material was kept in a security filing cabinet at the centers and only members of the research team had access to it.

The SPSS statistical program (version 25) was used to analyze the sociodemographic data of the participants (sample size, percentages, means and standard deviations). On the other hand, the UEQ Excel tool for data analysis (version 10) and for product comparison (version 4) were used to analyze the UEQ

data (scale means, standard deviations, confidence intervals, T-Test) and compare the impressions of both groups of participants.

Results

Participants

Of the experimental group of the clinical trial recruited (43 older adults with MCI/PWD), 2 individuals could not participate in this study due to travel or medical intervention. Of the group of people with schizophrenia recruited (n = 41), all participated in the present study.

A total of 82 subjects participated: older adults (32.9% with MCI, 17.1 % with mild dementia) and people with schizophrenia (50%). Most of the older adults with cognitive impairment were women, with primary education (mean age of 71.52 years in elderly with MCI, and 75.79 years in people with mild dementia). Most participants with schizophrenia were also women, but with secondary school education and their mean age was 51.63 years (Table 2).

Table 2. Participants' sociodemographic characteristics.

Participants		Sex	Age (S.D.)	Educational level
Older adults (n = 41)	**MCI** 27	Men 10 (37%) Women 17 (63%)	71.52 ± 6.33	Read and write 2 (7.4%) Primary school 18 (66.7%) Secondary school 7 (25.9%)
	MD 14	Men 5 (35.7%) Women 9 (64.3%)	75.79 ± 5.56	Read and write 1 (7.1%) Primary school 12 (85.7%) University degree 1 (7.1%)
People with schizophrenia (n = 41)		Men 19 (46.3%) Women 22 (53.7%)	51.63 ± 11.66	Read and write 3 (7.3%) Primary school 13 (31.7%) Secondary school 14 (34.1%) Bachelor/associate degree 6 (14.6%) University degree 5 (12.2%)

MCI = Mild Cognitive Impairment; MD = Mild Dementia; n = Sample; S.D. = Standard Deviation

There were no missing data, because a member of the research team corroborated participants completed all documents in their entirety.

UEQ

Overall results

Figure 1 shows the impressions of both groups of participants about GRADIOR on each of the UEQ scales. In the T-test, an Alpha level 0.05 was used.

[Insert Figure 1.]

On the Attractiveness scale, older adults with cognitive impairment had a very positive impression of GRADIOR, while people with schizophrenia had a positive impression of it. A significant difference was found in the T-Test (P = 0.0000), which means that older people with MCI/mild dementia liked the program more in terms of attractiveness, enjoyable and pleasing.

On the Perspicuity scale, elderly with cognitive impairment also showed a very positive impression of the program, while participants with schizophrenia impressions were just positive. The significant difference found in the T-Test (P = 0.0001) means that older adults with MCI/mild dementia found easier to become familiar with the program, understand it and learn how to use it.

Regarding Efficiency scale, older adults with cognitive impairment had a very positive impression of GRADIOR again, while people with schizophrenia showed a just positive impression. In the T-Test it was found that there was a significant difference (P = 0.0000). So, older people with MCI/mild dementia considered that GRADIOR's interface was more organized, faster, and allowed them to do the exercises without unnecessary effort.

On the Dependability scale, elderly with cognitive impairment gave a lower positive value to the program, but it was still a higher positive score than the participants with schizophrenia. A significant difference was found in the T-Test (P = 0.0002), meaning that older adults with MCI/mild dementia felt more confident and in control of the interaction with the program.

Regarding the Stimulation scale, older adults with cognitive impairment showed a very positive impression of GRADIOR, while people with schizophrenia presented just a positive impression. The significant different found in T-test (P = 0.0000),

means that people with MCI/mild dementia felt more motivated, excited, and interested in using GRADIOR.

On the Novelty scale, elderly with cognitive impairment gave a lower positive value to the program, but it was still a higher positive score than the participants with schizophrenia. A significant difference was found in the T-Test (P = 0.0001). So, older adults with MCI/mild dementia perceived the program design as more creative, innovative, and that captured their attention more.

The above meanings of the scales were obtained from Rauschenberger et al. (2013), and Schrepp et al. (2017b).

Results in each item

Figure 2 shows the mean of each item of the scales. The two groups of participants gave positives values to GRADIOR (older adults with cognitive impairment between 1.3 and 2.7 and people with schizophrenia between 0.2 and 2), except in item 8 where both presented a negative value.

[Insert Figure 2.]

On the attractiveness scale, the item Good had the highest mean in both groups of participants. Older adults with MCI/mild dementia gave the lowest positive score on the Pleasing and Friendly items, while people with schizophrenia on the Pleasing and Attractive items.

On the Perspicuity scale, the highest rated item by the older adults with cognitive impairment was Clear, and for participants with schizophrenia it was the Understandable item. Both groups agreed that the item with the lowest positive score was Easy to use.

On the Efficiency scale, the items most highly rated by the elderly with MCI/mild dementia were Efficient and Organized, and by people with schizophrenia it was Efficient. Both groups of participants scored the item Fast with the lowest positive score.

On the Dependability scale, the highest values given by the elderly with cognitive impairment were on the Secure and Meets expectations items, while by participants with schizophrenia it was on the Supportive item. The item 8 (Predictable) was the

only one with a negative mean on this scale in both groups of participants. This indicates that it could has been misinterpreted by them, outside the context if they can predict the program behavior.

On the Stimulation scale, the highest item scored by the older adults with MCI/mild dementia was Interesting and the lowest positive item was Exciting. People with schizophrenia gave the highest positive score to the Interesting item, and the lowest positive score to Motivating.

On the Novelty scale, in both groups of participants the Creative item had the highest mean and the Inventive item had the lowest positive mean.

Data Benchmarking

Older adults with MCI/mild dementia categorized GRADIOR as excellent in most of the scales, in the following order: Attractiveness, Stimulation, Perspicuity, Efficiency and Novelty. However, they categorized the program as good in Dependability (Figure 3).

[Insert Figure 3.]

On the other hand, people with schizophrenia categorized GRADIOR as above average in most of the scales, in the following order: Attractiveness, Perspicuity, Stimulation, and Novelty. In addition, they considered that the program was below average in Efficiency and Dependability (Figure 4).

[Insert Figure 4.]

Scales with inconsistent answers

In the UEQ, answers are considered inconsistent if there is a difference > 3 between the best and worst item on a scale. If this difference occurs in 2 or more scales, it indicates that participants have probably gave random/not serious answers and/or misinterpreted items.

In this study, 12 (29.3%) participants from the group of older adults with MCI/mild dementia showed inconsistencies in their responses on 2, 3 and/or 4 scales: 10 of them answered inconsistently on the Novelty scale, 6 on Dependability scale, 5 on Perspicuity scale, 5 on the Efficiency scale, and 1 on the Stimulation scale.

On the other hand, 14 (34.2%) participants from the group of people with schizophrenia presented inconsistencies in their responses on 2, 3, 4 and/or 5 scales: 11 of them answered inconsistently on the Perspicuity scale, 9 on Dependability scale, 9 on Novelty scale, 8 on Attractiveness scale, 7 on the Efficiency scale, and 5 on the Stimulation scale.

Discussion

The present study evaluated and compared the impressions of older adults with MCI/mild dementia and people with schizophrenia about the usability of GRADIOR (version 4.5) and their UX, through applying the UEQ. The results can provide important cues not only to improve GRADIOR, but also to improve other computer-based cognitive rehabilitation programs to these populations.

In this study, GRADIOR received very positive impressions and its quality was considered excellent in Attractiveness by the elderly with cognitive impairment. Other study supports that older people with cognitive impairment found GRADIOR attractive and enjoyable (Irazoki et al., 2021). Another research states that the pleasure that the elderly perceives when using technology are determining factors in their intention to use it (Macedo, 2017). This is also reflected in the present study, as most of the older adults with cognitive impairment completed 4 months using the program. It seems that the digital gap and fright for coping to the technology in older people (Pirhonen et al., 2020) is counterbalanced for the feeling of the attractiveness of the software.

On the other hand, participants with schizophrenia showed positive impressions of GRADIOR in Attractiveness and considered its quality as above average in the present study. Their impressions indicate that the program can be improved. Indeed, in another investigation, people with mental illness suggested making GRADIOR more enjoyable (Góngora Alonso, Fumero Vargas, et al., 2020). Van Der Krieke et al. (2012) found that many people with schizophrenia recommended that a technological tool could be more attractive and pleasing by using more colors, images, and multimedia elements, while others preferred a simple one. Therefore, they concluded that the interface should be customizable. Anyway, apathy regularly linked to schizophrenia (Raffard et al., 2019), could explain why this group had a

lower acceptability of GRADIOR. So, it could be useful to spend more time explaining to people with schizophrenia about the objective of the software and, even more, to develop special features for them, considering that their cognitive impairment has a different cause than that of the other group.

Regarding Perspicuity, the positive outcomes found in the present study are supported by other research works in both older adults with MCI/mild dementia (Góngora Alonso, Toribio Guzmán, et al., 2020; Irazoki et al., 2021) and people with schizophrenia (Góngora Alonso, Fumero Vargas, et al., 2020). It means that GRADIOR looks easy to learn and use, and that its instructions are enough clear and understandable. However, the fact that participants with schizophrenia had lower positive impressions than older adults with cognitive impairment in the present study, indicates that the system needs to be improved to guide their learning and use to a greater extent. Nevertheless, in most of the cases therapists must help users at the beginning to became familiar with GRADIOR (Irazoki et al., 2021). An environment that helps users to learn and use the technology is important (Chiu et al., 2016), it influences them to feel comfortable with technological tools with which they have little experience or use (Reeder et al., 2016).

Regarding Efficiency, older adults with cognitive impairment perceived that GRADIOR functioned adequately and that its organization was not cluttered. The simplicity of GRADIOR's interface is supported by Irazoki et al. (2021). Another study agrees that the simplicity helps older people stay focused, minimize their mistakes, and not burden their memory (Johnson & Finn, 2017). However, Irazoki et al. (2021) suggested improving the sensitivity of the touch screen to quickly capture the responses of GRADIOR users. This suggestion is in line with the present study because the Fast item received the lowest positive score on the Efficiency scale by these participants. The touch screen has proven to be an easy input device, but its surface must be sufficiently sensitive to touch to support usability, quality of use and user productivity (H. T. Chang et al., 2014).

On the other hand, participants with schizophrenia had a positive impression of GRADIOR on Efficiency. This finding is consistent with another study (Góngora Alonso, Fumero Vargas, et al., 2020), in which users with schizophrenia perceived good functionality and efficiency of GRADIOR. However, they felt that there was too

much content in the exercises. This observation may shed light in the present study on what could led the participants with schizophrenia to consider GRADIOR below average on this scale and that the organization of the exercise's contents should be improved for this population. Another aspect that could be improved would be the response speed of the interface, because the Fast item also received the lowest positive score by these participants.

In terms of Stimulation, elderly with MCI/mild dementia reach very positive impressions of GRADIOR and considered its quality as excellent. Other research supports that older adults with cognitive impairment felt that GRADIOR was fun, motivating, and entertaining (Irazoki et al., 2021). Participants with schizophrenia in the present study also perceived the program motivating, a finding that was also found in another research (Góngora Alonso, Fumero Vargas, et al., 2020). However, people with schizophrenia in the present study considered the quality of GRADIOR to be above average on Stimulation, which indicates that it can be improved. According to Lumsden et al. (2016), incorporating some elements of gamification into cognitive exercises can improve the engagement of people with psychiatric disorders. Such elements could be an avatar, interactive characters, bonuses to reward users for performance, scenarios change in response to their actions, etc. Probably, this is a way for exploring and developing in the close future.

In Novelty, both groups of participants had positive impressions of GRADIOR. This finding is consistent with other investigations on this program (Góngora Alonso, Fumero Vargas, et al., 2020; Irazoki et al., 2021), which highlights the importance of colors, images, and visual elements to capture their attention. Other research support that the colors (Punchoojit & Hongwarittorrn, 2017) and familiar images of the environment (Mol et al., 2021) contribute to user satisfaction. In that sense, one of the improvements of GRADIOR 4.5 was precisely real images. However, the fact that this category received a lower positive score by older adults with cognitive impairment and that participants with schizophrenia considered it as above average, indicates that further improvements can be made. The improvements could be in terms of inventiveness, as this item received the lowest positive score on this scale in both groups. Another improvement of GRADIOR 4.5 was the incorporation of new exercises, however the above finding suggests that this novelty effect may

diminish after continued use of the program. Maggio & Calabrò (2022) suggest that virtual reality is an innovative method for cognitive rehabilitation due to its multisensory interfaces. Perhaps presenting GRADIOR exercises in virtual reality could improve these scores.

Regarding Dependability, both groups of participants had positive impressions of GRADIOR. These findings are in line with other research in which this program met the expectations of users with schizophrenia (Góngora Alonso, Fumero Vargas, et al., 2020). In another study, a platform that included GRADIOR and physical exercises met the expectations of older adults with cognitive impairment, and made them feel comfortable using it (González-Palau et al., 2013). However, in the present study, both groups of participants gave lower positive scores on GRADIOR quality compared to the other scales, which indicates that improvements need to be done. Indeed, Irazoki et al. (2021) concluded that older adults needed to use the GRADIOR software and hardware more autonomously. A very intuitive design is essential for them to control technological features (Lee & Coughlin, 2015). In the case of people with schizophrenia, an investigation found that some users had difficulty interacting with different elements of GRADIOR at the same time (Góngora Alonso, Fumero Vargas, et al., 2020). Therefore, a simpler design could be an area for improvement for this population. In fact, it has been found that including elements, even if they are motivational, can cause stress or new cognitive demands when interacting with a program (Katz et al., 2014).

On the other hand, in the present study there were scales with inconsistent responses. This was expected, as participants suffer from cognitive difficulties that affect their functioning and accuracy (Keefe & Harvey, 2012; Schmitter-Edgecombe & Parsey, 2014). However, in the present study such inconsistencies represented a small percentage of the sample in both groups. Another finding was the difficulty for understanding the Predictable item in the context of Dependability. Misunderstanding or misinterpreting UEQ items can occur, even in populations with informatics students (Rauschenberger et al., 2013).

One of the limitations of the study may be the sample size. However, 30 participants are considered sufficient to obtain a valid impression and approach on the UEQ (Rauschenberger et al., 2013). Second, this is a transversal study and consequently

participants did not have the same length of time using GRADIOR; schizophrenic patients had been using it for 4 months or more. Nonetheless, participants' results were consistently positive, so it demonstrates a trend about their impressions of the program. Other limitation is that some participants may have felt committed to respond favorably to the UEQ because they were in the INTRAS Foundation centers, GRADIOR's main developer and promoter. Nevertheless, other studies support the results obtained.

For future work, more studies on usability and UX in older adults with cognitive impairment and people with schizophrenia are needed, not only from quantitative but also from qualitative techniques, to continue improving cognitive rehabilitation technologies according to their impressions. In addition, compare their impressions as users with the impression of professionals, caregivers and other users' groups would help to identify more potential barriers and solutions.

Conclusions

The positive impressions of the participants indicate that GRADIOR is adequately oriented to satisfy their needs and preferences, especially for older adults with MCI/mild dementia who showed higher positive scores. However, GRADIOR needs to be improved to make users feel more in control of the interaction with it. For people with schizophrenia other aspects of usability and UX need to be improved. Formally, GRADIOR was designed for cognitive impairment, no matter its cause. This study shows the need to develop special features for different pathologies. Apparently, cognitive impairment could be very similar, but the approach for each group of patients is different, so it is necessary to develop customizable features for each pathology.

Obtaining the impressions of these populations about technological tools can be a challenge due to their cognitive impairment/deficits, but it is necessary to do it. Currently, a good approach would be to apply simple questionnaires such as the UEQ. Involving users in the program improvement is necessary to provide them with better experiences, which will facilitate the use and adherence to the cognitive technology intervention. The findings of this study can help in the development and improvement of this kind of technologies aimed at these populations.

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Institutional Review Board Statement

The Ethics Committee of Zamora Provincial Hospital (Protocol Code 387-E.C) approved this study, which was conducted in accordance with the Declaration of Helsinki.

Informed Consent Statement

Informed consent was obtained from all subjects involved in the study.

Data availability statement

The data that support the findings of this study are available upon reasonable request from the corresponding author.

Conflicts of Interest

The authors J.M.T.-G., M.J.V.-R., S.G.-M., M.C.-A., E.L.C. and M.Á.F.-M. are linked to INTRAS Foundation, a non-profit entity, which is the main developer and promoter of GRADIOR, a cognitive rehabilitation software.

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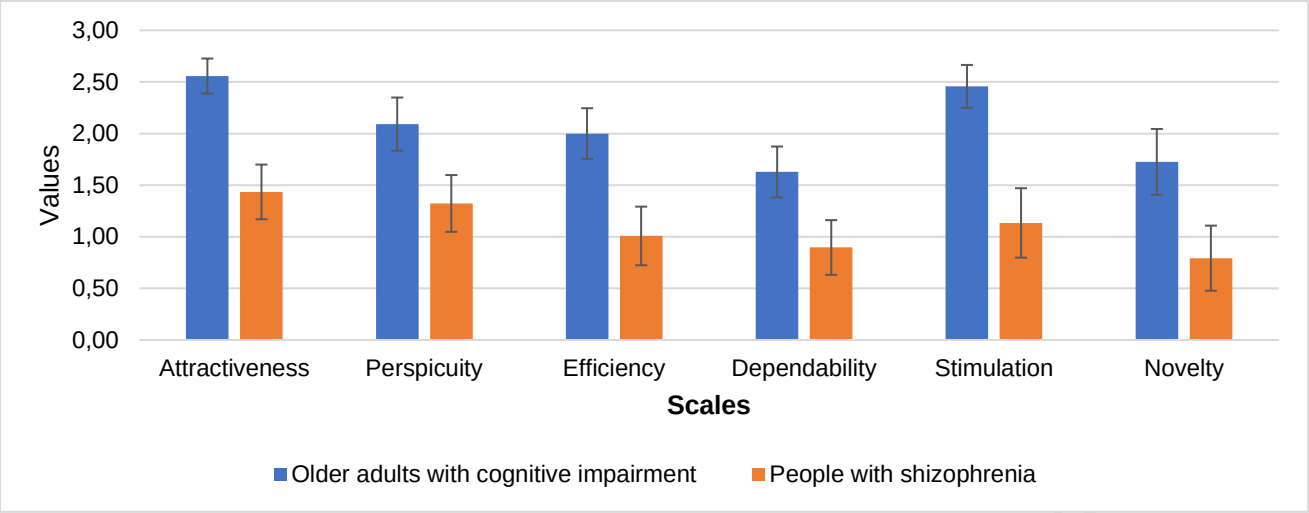

Figure 1. Participants' impressions of GRADIOR on the UEQ scales.

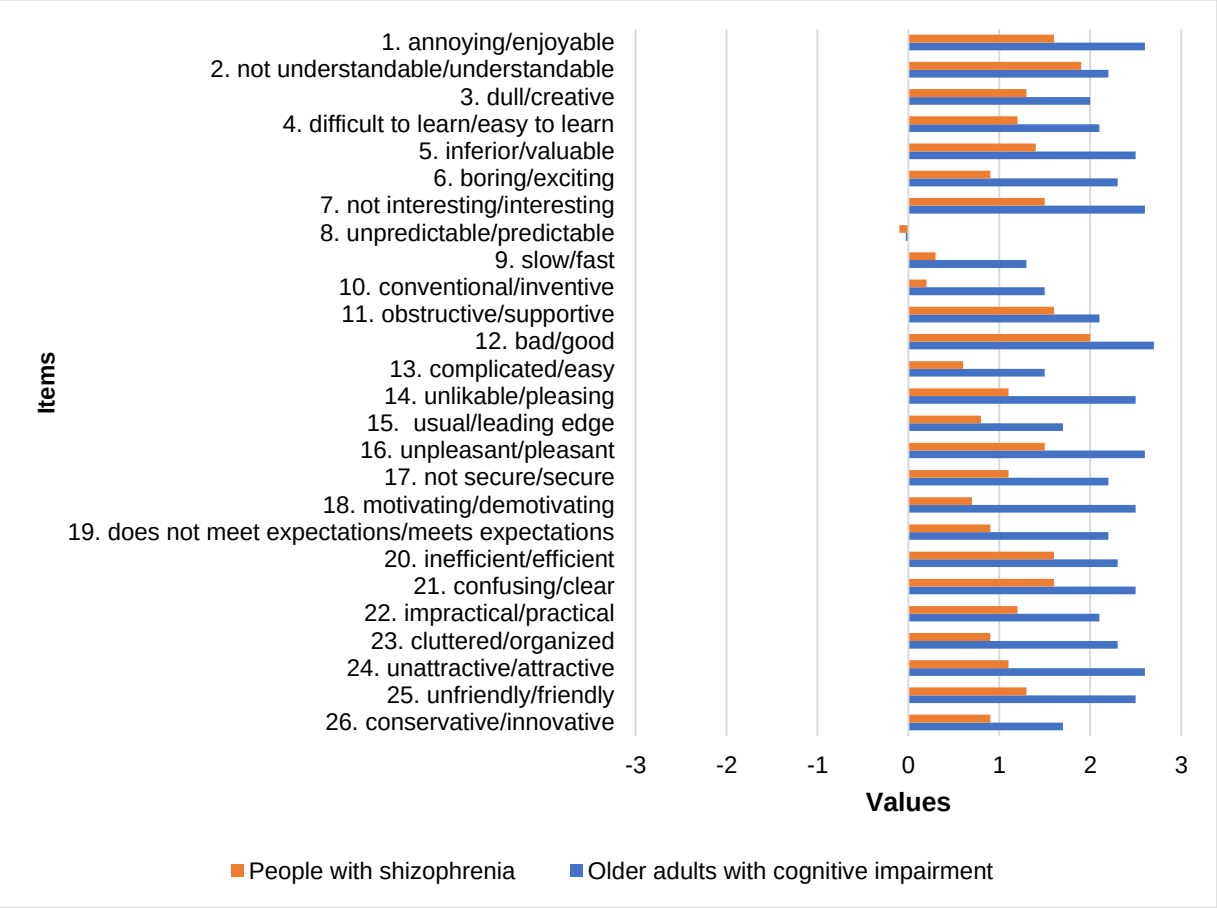

Figure 2. Participants' impressions of GRADIOR on each UEQ item.

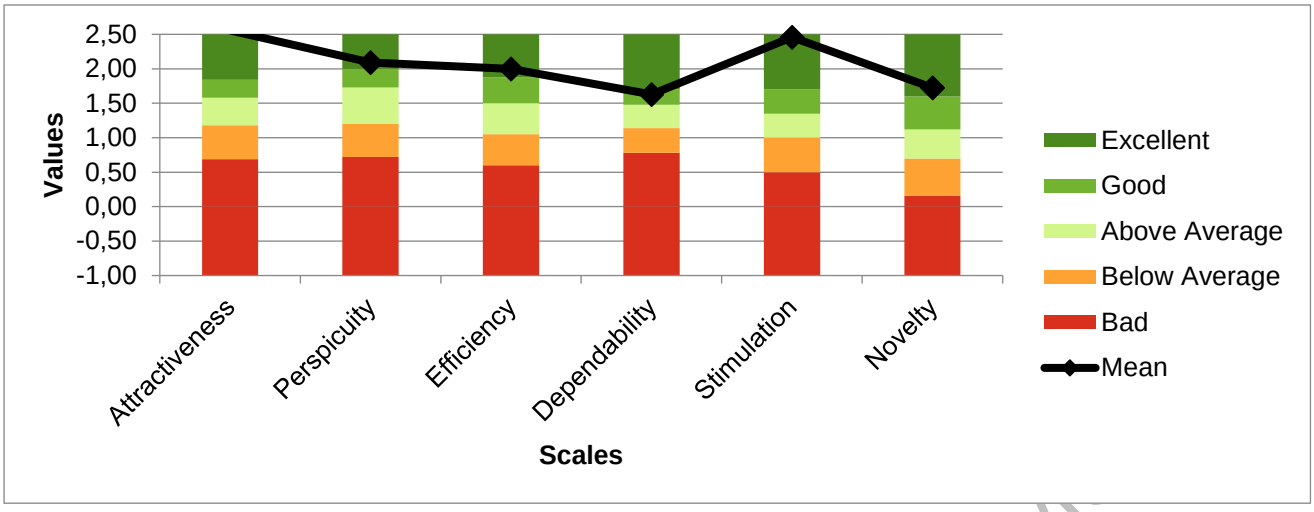

Figure 3. Older adults with cognitive impairment's impressions of GRADIOR with the benchmark.

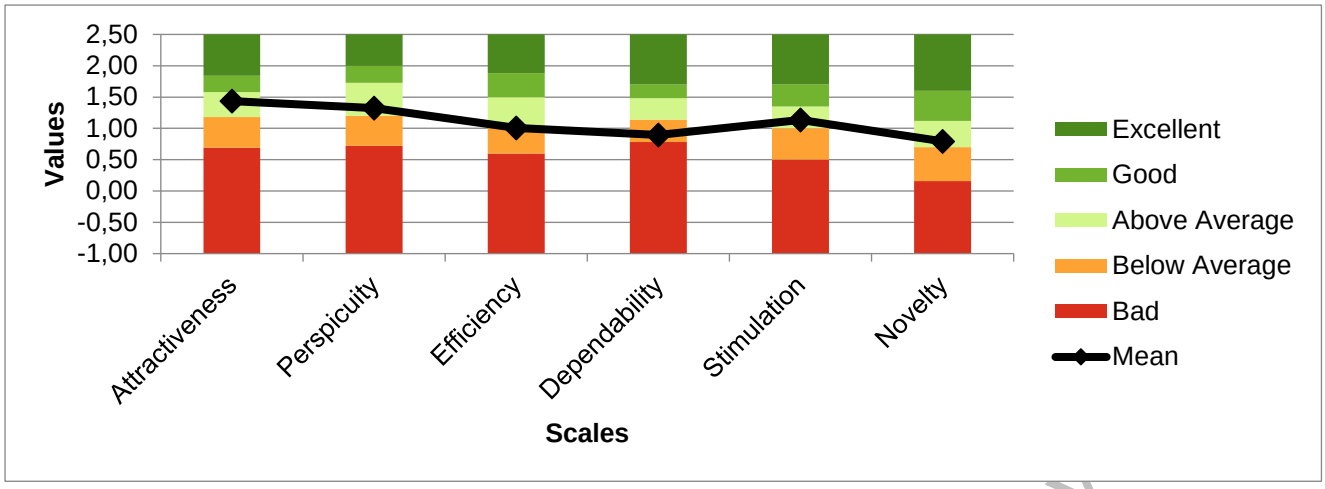

Figure 4. People with schizophrenia's impressions of GRADIOR with the benchmark.