# Modelos estadísticos aplicados al análisis de los fenómenos inexplicados y a las creencias pseudocientíficas en psicología

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# TESIS DOCTORAL

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| Título | Modelos estadísticos aplicados al análisis de los fenómenos inexplicados y a las creencias pseudocientíficas en psicología |
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# Dedicatorias

*"Sin el análisis de datos no seríais psicólogos, seríais unos charlatanes de feria"*

(En memoria a las enseñanzas que recibí del profesor Dr. Antonio Pardo Merino, de la Universidad Autónoma de Madrid)

*"Pasión por la psicología"*

(Dedicado a los miembros y compañeros de TEA Ediciones, S.A.U. Por todo lo que aprendí con ellos sobre psicometría, matemáticas y medición. Frase extraída del eslogan de TEA Ediciones, S.A.U.)

*"Adelante, Siempre Adelante"*

(Dedicado a la Congregación de RR. Concepcionistas. Por su testimonio, enseñanza y misión. Frase extraída del ideario fundacional de la Congregación de RR. Concepcionistas)

# Agradecimientos

La investigación y el método científico pueden ser objetivos e independientes de cualquier creencia u opinión. No obstante, quienes ejercen la actividad científica (entre los que me gustaría incluirme), estamos condicionados por nuestras propias formas de concebir la realidad y sus fenómenos. Ciertamente, es inevitable tener primeras impresiones, pero he aprendido que el reto de cualquier académico es prevenir y evitar que dichas impresiones, prejuicios y opiniones desvirtúen el ejercicio del método científico.

Cuando tomé la decisión de iniciar este proyecto de tesis sobre las creencias paranormales y pseudocientíficas, fueron varios los profesionales que me recomendaron investigar sobre algo "más útil" y "menos marginal" dentro de la comunidad académica. De hecho, tuve muchas dificultades para encontrar a profesores y expertos que pudieran dirigir o implicarse en este proyecto. Algunos también me dijeron "en este tema realizarás pocas publicaciones" y se desinteresaron de mi propuesta. En definitiva, en mi caso, el problema de las primeras impresiones fue este: algunos profesionales consideraban que no servía de nada investigar sobre esta temática/objeto, rechazando así mi oportunidad para investigar y realizar carrera académica.

Sin embargo, no estaba solo. A mi lado siempre hubo personas que confiaron en mí potencial y en mis competencias investigadoras. Este escrito va dirigido a todos ellos. Aunque no tengo suficientes palabras para expresar mis sentimientos de agradecimiento, me gustaría dedicarles este espacio como gesto de reconocimiento a su dedicación en el proyecto.

En primer lugar, a mis padres, *Montserrat Gascón* y *Gabriel Escolà*. A veces, lo importante no consiste en valorar cuantas cosas te dan, sino en cuánto amor hay en aquello que recibes. Su ejemplo, su apoyo afectivo y acompañamiento me permitieron tener la moral y persistencia necesaria para terminar este proyecto.

En segundo lugar, a mis codirectores de tesis, *Francesc-Xavier Marín Torné*, *Jordi Rusiñol Estragues* y *Josep Gallifa Roca*. Ellos confiaron en mí potencial investigador y me ofrecieron los recursos necesarios para poder desarrollar este proyecto. Les agradezco su confianza, enseñanzas y consejos.

En tercer lugar, a mis amigos/as, *Naia Cartañá Gamboa, Rosa Gamboa Aramburu, Judith García Yustes, Ramon Palau Torres y Cecilia Mayans Brun.* Me gustaría destacar su implicación, sus ánimos, sus consejos y su generosidad. Gracias por estar a mi lado y por todo el coraje que me habéis transmitido.

Finalmente, también me gustaría mencionar a todas aquellas organizaciones y profesionales independientes que también me ayudaron en la recogida de los datos: *MAGIC Internacional, S.A.*, *Congregación de Religiosas Concepcionistas Misioneras de la Enseñanza*, *Alfonso Trinidad*, *Isabel Miró*, *Madre Bárbara Ávila*, *Madre María Luz Martínez*, *Yolanda Romero de Tejada*, *Jaume Esteve*, *Manuel Lascasas, Víctor Fernández* y *Esther Mosquera*.

GRACIAS POR TRANSFORMAR
"ESTE TEMA NO SIRVE",
EN "ADELANTE, SIEMPRE ADELANTE"

# Índice

# 1. Glosario terminológico

En este glosario se definen los conceptos claves y reiterativos empleados en las distintas investigaciones y publicaciones que se adjuntan. Solamente se incluyen aquellos términos que podrían presentar distintos tipos de significados o concepciones, los cuales requieren establecer previamente cuál es su definición en el contexto psicológico, metodológico y estadístico de esta obra.

## Alucinación o alucinaciones

Alteración de los sentidos mediante la cual un sujeto percibe objetos físicos o estímulos sensoriales que no suceden o no existen de acuerdo con las características formales de la realidad objetiva (léase el tratado de psiquiatría de Ey et al., 1980). Las alucinaciones se diferencian de las ilusiones no patológicas en que no poseen objeto sensorial provocador (Jarne, 2010). Las ilusiones ocurren cuando el sujeto percibe un objeto o estimulo sensorial que sucede o existe en la realidad objetiva; el problema es que este objeto es percibido de forma distorsionada y se genera un engaño o error en la identificación y representación de dicho objeto (véase el manual de psicopatología de Jaspers, 1993).

## Continuum o modelo del continuum de las psicosis

Modelo teórico de la psicopatología que tiene como objetivo representar, explicar y predecir los síntomas psicóticos dentro de una graduación cuantitativa o función, la cual varía desde la sintomatología psicótica más atenuada hasta la más intensa o severa (p. ej. Johns y van Os, 2001; van os et al., 2009). Recibe el nombre de continuum porque representa y postula que los síntomas psicóticos observados en los pacientes clínicos también se presentan con distinta intensidad y frecuencia en la población general no patológica (Stefanis et al., 2004). Este modelo estima y predice la incidencia de los trastornos en el espectro de la esquizofrenia a partir de la manifestación subclínica de los síntomas psicóticos atenuados, los cuales ponen en riesgo y predisponen al individuo a padecer futuros cuadros psicóticos (léase Shapiro et al., 2019). Esta lógica predictiva implícita en el continuum de las psicosis recibe el nombre técnico de “fenotipo psicótico” (véase la definición de fenotipo psicótico de acuerdo con Nelson et al., 2013).

# Creencias paranormales

Las creencias paranormales pueden definirse de dos formas. Por un lado, según el enfoque tradicional de Tobacyk y Milford (1983) las creencias paranormales consisten en la aceptación de la existencia de supuestos fenómenos que contradicen las bases ontológicas del conocimiento científico, tienen atributos mágicos y su argumentación causal es irracional (véase también Tobacyk y Wilkinson, 1990; Tobacyk, 2004). Inicialmente, Tobacyk y Milford (1983) clasificaron estos supuestos fenómenos en las siguientes categorías conceptuales: (1) contenidos religiosos tradicionales; (2) contenidos relacionados con los fenómenos "psi"; (3) brujería; (4) supersticiones; (5) espiritismo; (6) formas extraordinarias de vida o seres fantásticos; y (7) precognición. Estos supuestos fenómenos reciben el nombre coloquial de "fenómenos paranormales", pero esta denominación suele desestimarse en el ámbito académico por ser excesivamente informal e incompatible con las bases epistemológicas del discurso científico (Gallagher et al., 1994; Cardeña et al., 2015).

Por otro lado, de acuerdo con el modelo fenomenológico y cognitivo de Irwin (2009), las creencias paranormales también se definen como un sistema de significados que permite al individuo representar e interpretar los eventos que suceden en la realidad objetiva (véase también Irwin, 1993, Irwin et al., 2018). En esta definición, el concepto de creencia no consiste en la aceptación o negación de un objeto; siguiendo las aportaciones de French y Stone (2014), las creencias son atributos o inferencias cognitivas que un sujeto realiza sobre su propia experiencia. En esta línea, la categorización sobre qué contenidos son o no paranormales, no es algo tan importante como en la concepción de Tobacyk y Milford (1983). Teniendo en cuenta el criterio de Irwin (2009), suelen considerarse atribuciones o inferencias paranormales aquellas interpretaciones que cumplen con las categorías citadas en el párrafo anterior, a excepción de las dimensiones "precognición" y "fenómenos psi". Según los meta-análisis realizados por Utts (1991, 2018), puede cuestionarse si es justa la categoría paranormal para estas dos dimensiones porque representan objetos de estudio que fueron investigados científicamente con resultados tanto a favor como en contra (p. ej. Irwin y Watt, 2007; Bem, 2011).

# Creencias pseudocientíficas

Acto de aceptar la existencia real de supuestos fenómenos que carecen de suficientes evidencias científicas que avalen su ontología o que validen los efectos que producen en la realidad observable (Alcock, 1998; Reber y Alcock, 2020). La expresión "carece de suficientes evidencias científicas" significa que el contenido representativo de la creencia no fue contrastado según el método científico y, en el caso de haberse contrastado, los resultados no fueron significativos (en términos de significación estadística), no fueron suficientemente significativos (en términos de

significación sustantiva) o no fueron replicados con éxito en otras investigaciones desarrolladas bajo las mismas condiciones de experimentación (véase Bunge, 2013; Pardo et al., 2015). Se utiliza el concepto "pseudocientífico" –que según Coromines (2009) etimológicamente quiere decir "falsamente científico"– porque en algunas ocasiones esta clase de creencias se presentan y se describen como "fenómenos demostrados científicamente", cuando en realidad carecen de tales evidencias científicas (léase también Shermer, 2011; Escolà-Gascón et al., 2020).

## Experiencias anómalas

Término que se utiliza en psicopatología y en el ejercicio de la psiquiatría para designar las alteraciones perceptivas subclínicas en sujetos sin antecedentes psicopatológicos diagnosticados (p. ej. Bell et al., 2005; Davies et al., 2017; Shapiro et al., 2019). Se diferencian de los fenómenos anómalos porque las experiencias anómalas no se consideran objetos inexplicados (Berenbaum et al., 2000). No obstante, el término anómalo sí está relacionado con la dificultad científica para clasificar y explicar la etiología de las alteraciones perceptivas en la población no-clínica (léase la definición del concepto "fenómenos anómalos" de este glosario para obtener más información) (p. ej. Gallagher et al., 1994).

## Falacia aristotélica de la afirmación del consecuente

Error lógico argumentativo el cual consiste en verificar o aceptar una consecuencia a partir de una causa incierta o no contrastable (Moldovan, 2009; Arp et al., 2018). Véase el siguiente ejemplo (tomado de Escolà-Gascón, 2020a): "El césped está mojado porque ha llovido". La consecuencia es "el césped está mojado". El antecedente causal incierto: "porque ha llovido". Este antecedente es incierto porque el césped puede haber sido mojado debido a múltiples causas; por ejemplo, puede estar mojado como producto del riego artificial o por algún tipo de fenómeno meteorológico alternativo a la lluvia, como el rocío o los fenómenos físicos relativos a la condensación. De acuerdo con Pardo y Román (2013) esta falacia es frecuente en las decisiones estadísticas relacionadas con los contrastes de hipótesis. Siguiendo a Escolà-Gascón (2020b), el hecho de no obtener resultados significativos no significa que los efectos a detectar no existan. Igualmente, el hecho de obtener resultados significativos puede apoyar los efectos que defiende la hipótesis alternativa del contraste, pero dichos resultados no son demostrativos en sí mismos. Siguiendo la lógica *falsacionista* de Popper (2008), esta idea quiere decir que los resultados significativos en sí mismos no demuestran la existencia empírica de los efectos que se detectaron mediante los procedimientos estadísticos empleados.

# Fenómenos Anómalos

En esta investigación, es un eufemismo equivalente a la expresión fenómenos inexplicados (léase la definición de fenómenos inexplicados de este glosario) (véase Mabbett, 1982). En el ámbito de la psicología clínica este concepto también se utiliza para denominar las alteraciones perceptivas subclínicas relativas a los síntomas positivos de las psicosis cuando están presentes en la población general (véase Davies et al., 2017; Shapiro et al., 2019; Kelsall-Foreman et al., 2020). Concretamente, desde la psiquiatría se emplea la palabra anómalo como un indicativo que refleja la extrañeza de la presencia de las deformaciones o engaños perceptivos y alucinaciones en sujetos sin antecedentes psicopatológicos diagnosticados (Schofield y Claridge, 2007). Según el modelo categórico y tradicional de la psicopatología, esta extrañeza hace referencia a que las alteraciones perceptivas son frecuentes en la población clínica, pero no deberían estar presentes en sujetos sanos (Esterberg y Compton, 2009). Por lo tanto, el término anómalo es un atributo que destaca la dificultad para explicar clínicamente por qué unos sujetos de la población no-patológica sí desarrollan alteraciones subclínicas de la percepción y otros no. Cuando los fenómenos anómalos tienen este significado clínico suelen denominarse percepciones anómalas o experiencias anómalas. Las palabras fenómenos anómalos suelen reservarse para designar fenómenos inexplicados científicamente (léase también la revisión de Radin, 2009).

# Fenómenos inexplicados

Los fenómenos inexplicados en psicología son aquellos comportamientos humanos o animales que son difíciles de explicar en términos científicos, tienen una causalidad incierta y cuestionan los límites del conocimiento aceptado por la ciencia (véase Mabbett, 1982; Utts, 2018; Escolà-Gascón, 2020c). La expresión difíciles de explicar científicamente significa que pueden ser explicados parcialmente por el uso del método científico, pero no en su totalidad (Utts, 1991; Radin, 2009). Tienen una causalidad incierta porque se pueden inferir hipótesis sobre la etiología o sobre los inputs antecedentes que desencadenarían el fenómeno inexplicado. No obstante, tales inferencias pueden realizarse en términos hipotéticos, correlacionales o mediante técnicas experimentales, pero en ningún caso deben incurrir en la *Falacia Aristotélica de la Afirmación del Consecuente*. Finalmente, los límites del conocimiento aceptado por la ciencia se fundamentan en los *Principios Básicos Delimitantes* establecidos por Broad (1949, 1953). Los fenómenos relativos al comportamiento humano o animal que no se ajusten a los PBDs pueden ser considerados fenómenos inexplicados y no paranormales, como se creía en un inicio (véase Beloff, 1993). La etiqueta inexplicados no significa que los fenómenos sean definitivamente y científicamente inexplicables. Esta denominación quiere decir que

los conocimientos actuales no son suficientemente exhaustivos para explicar la totalidad del respectivo fenómeno.

## Fenotipo psicótico

Nombre que recibe la caracterización variable y clínica de los síntomas psicóticos atenuados como estimadores de los trastornos en el espectro de la esquizofrenia (léase Fonseca-Pedrero et al., 2013; Grant y Hennig, 2020). Se denomina fenotipo debido a la variabilidad o a los distintos grados de gravedad sintomática que describen la tipología de las psicosis más severas (Nelson et al., 2013).

## Mediumnidad

Actividad que realizan determinados sujetos con el objetivo de contactar o comunicarse con los seres fallecidos (véase Beischel, 2007, 2014). La mediumnidad suele ser una actividad muy frecuente entre los sujetos que tienen creencias paranormales (véase la definición de creencias paranormales en este glosario) (véase también Gauld, 1982).

## Modelo estadístico

Es una expresión o ecuación matemática formada por un conjunto de parámetros que representa de forma resumida la relación entre dos o más variables (p. ej. Batista-Foguet y Coenders, 2012; Pardo y Ruiz, 2015). Los modelos estadísticos tienen como objetivo (1) describir, (2) explicar y (3) predecir la relación entre las variables/objetos de estudio. Los modelos matemáticos más simples son los lineales, los cuales también son los más frecuentes en las ciencias sociales y de la salud (véase también Pardo y San Martín, 2015).

## *Multivariable Multiaxial Suggestibility Inventory-2* (MMSI-2)

Nombre y expresión que recibe en inglés el *Inventario Multiaxial de Sugestibilidad Multivariable -2*. Es un cuestionario de rendimiento típico y de autoinforme que evalúa hasta 12 variables psicológicas que predicen los fenómenos inexplicados. Está formado por 174 ítems en su versión completa y 43 en la versión reducida. También dispone de 4 escalas que miden las experiencias anómalas y tiene 4 ejes subclínicos que analizan distintos tipos de comportamientos: rasgos de personalidad, síntomas-estados subclínicos, deformaciones perceptivas y detección de la mentira. El MMSI-2 fue justificado estadísticamente por Escolà-Gascón

(2020a, 2020b, 2021) y por Escolà-Gascón y Gallifa (2020). Algunos de estos artículos se incluyen en esta obra como parte esencial de la investigación realizada.

## Recepción anómala de la información (*Anomalous Information Reception*) (abreviado AIR)

Proceso mediante el cual un sujeto accede a contenidos sensoriales o eventos que sucedieron en el pasado, sin utilizar los mecanismos perceptivos convencionales avalados por las bases científicas de la psicología y psicobiología (p. ej. Beischel y Rock, 2009; Beischel et al., 2015). Dichos contenidos sensoriales o eventos están relacionados con la vida de otra persona —los cuales en este caso se denominarían contenidos de adivinación— o con un lugar específico —los cuales reciben el nombre de *haunting experiences*— (léase a Beischel y Zingrone, 2015). Las AIRs fueron relacionadas con la práctica de la *mediumnidad* y con los denominados médiums (Rock, 2013). Esta relación se justifica —aunque no es imprescindible— por que las personas que desarrollaron AIRs tienen la creencia de que dichos contenidos proceden de entidades sobrenaturales o seres fallecidos (léase Roe, 2019). Esta relación entre las AIRs y las creencias en la existencia de vida después de la muerte no implica bajo ningún concepto que las AIRs tengan un origen sobrenatural o paranormal (véase Escolà-Gascón, 2020b).

## Sistemas de creencias

Conjunto de esquemas cognitivos que reúnen las categorías y significados necesarios para representar mentalmente e interpretar los eventos que suceden en la realidad objetiva (véase Fishbein y Ajzen, 1975; Irwin, 2009). El contenido de las categorías o significados varía de acuerdo con las experiencias y aprendizajes que realiza cada individuo a lo largo de su desarrollo vital (léase la revisión original Fishbein y Raven, 1967).

# 2. Fundamentación teórica de los fenómenos inexplicados

## 2.1. Teoría del conocimiento científico e introducción histórica

El uso del método científico tiene como objetivo describir, explicar y predecir los sucesos que ocurren en la realidad objetiva (véase McGuigan, 1996). Desde el paradigma positivista, se asume que la realidad puede ser objetivable mediante la cuantificación y medición de los indicadores empíricos que representan a dichos sucesos o eventos (Crook y Garratt, 2014; Lewin, 2014). En esta línea, el método científico es aplicable a partir de dos corrientes de pensamiento predominantes en el positivismo: por un lado, se observa el *racionalismo cartesiano* (véase Descartes, 1641/1984), el cual postula la racionalidad cómo medio para describir, explicar y predecir la realidad objetiva (p. ej. Hjørland, 2005). Según el racionalismo, todos los fenómenos de la realidad externa son explicables desde los principios que fundamentan el discurso científico y no se admite la inexplicación o inexplicabilidad de los eventos incluidos en la realidad del cosmos (p. ej. Bachelard, 1985). En esta línea, el método científico es un procedimiento racional y la cuantificación refleja el valor objetivo de dicha racionalidad (p. ej. Tambiah, 1990). Por otro lado, también se encuentra el *empirismo lógico*, el cual postula que la realidad objetiva únicamente se puede describir, explicar y predecir mediante el escrutinio empírico (véase Popper, 2008). El empirismo antepone la ontología externa y material de los eventos que se observan en la realidad objetiva por encima de la racionalidad (p. ej. Richardson, 1996). En este modelo, la racionalidad se considera limitada y no puede explicar toda la complejidad de los fenómenos que ocurren en el universo (p. ej. Faneli, 2018). Partiendo de la teoría de las revoluciones científicas de Kuhn (1962) y como señala Mabbett (1982), en esta corriente sí se admite que determinados fenómenos sean inexplicados (que no inexplicables, ya que la inexplicación es un supuesto no contrastable en términos científicos). Entonces, el método científico es un procedimiento que pone a prueba el escrutinio empírico de los eventos observados en el cosmos y la cuantificación es su representación objetiva (op. cit. Richardson, 1996). Ambas formas de pensamiento están presentes en la aplicación y uso del método científico (véase Seising, 2007).

Originalmente, el término “paranormal” se utilizaba para describir aquellos contenidos que contradecían el racionalismo, la epistemología y el conocimiento científico contemporáneo del siglo XIX (véase la versión original de Bell, 1956; Truzzi, 2001). El problema que tenía esta concepción era la dificultad para

determinar cuáles eran los límites racionales del uso y la aplicación del método científico. Igualmente, también estaba el dilema sobre cuál era el significado y la interpretación de la expresión fenómeno científico (Bunge, 2013). Tradicionalmente, la palabra fenómeno científico estaba relacionada con aquellos eventos físicos o naturales que fueron probados y replicados con éxito mediante el uso de la metodología científica (Richardson, 1996). Esta definición procedía de las disciplinas *positivistas* (p. ej. la física) y tenía como inconveniente el *reduccionismo materialista* (Crook y Garratt, 2014). Esto implicaba que solamente los fenómenos con propiedades materiales objetivables en el medio físico podían ser investigados mediante el uso del método científico (véase también Potts, 2010). Esto era así porque el método científico se fundamentaba principalmente en el escrutinio empírico (Popper, 2008). En este contexto, lo paranormal servía para clasificar todo aquello que entraba en conflicto con la lógica del positivismo científico (léase Irwin, 2009 para una revisión más exhaustiva).

Siguiendo con esta concepción, otro significado del término paranormal estaba relacionado con la *metafísica* (véase Lett, 1991; Smith y Karmin, 2002). La metafísica puede definirse como una disciplina del saber (o sea, perteneciente a la filosofía) que tenía y tiene como objetivo estudiar los principios fundamentales y originales de la realidad (Neher, 1980; Audi, 2015). Este concepto es importante en este contexto porque todo aquello que no era accesible desde el escrutinio empírico pertenecía originalmente al campo de lo metafísico, incluida la denominada *metapsíquica* (Weisberg, 2004; Irwin y Watt, 2007). La metapsíquica era aquella disciplina encargada de estudiar los principios originales del psiquismo (Anderson, 1987). En aquella época, el psiquismo estaba relacionado con las prácticas espíritas (Beloff, 1993; Lamont, 2005). Las prácticas espiritas se definían (y continúan definiéndose) como aquellas actividades o ejercicios mediante los cuales un individuo trata de comunicarse con seres fallecidos (Beischel et al., 2015). Este punto es esencial para comprender el origen del concepto "paranormal". Debido a esta relación entre el psiquismo y espiritismo, los fenómenos o eventos supuestamente producidos por las prácticas espíritas recibían el nombre de fenómenos paranormales (Inglis, 1977). Del mismo modo, fue por este motivo que la metapsíquica era la terminología que se utilizaba para designar el estudio de los fenómenos paranormales (Gauld, 1982).

A modo de resumen, el concepto "paranormal" se refería a los supuestos fenómenos que se producían a partir de las prácticas espíritas, los cuales no eran accesibles desde el escrutinio empírico que caracterizaba al positivismo científico contemporáneo. Por lo tanto, de acuerdo con los referentes históricos, fueron dos problemas principales los que fomentaron el surgimiento de nuevas concepciones de lo paranormal (véase French y Stone, 2014): (1) cómo determinar los límites racionales de los fenómenos y del conocimiento científico y (2) cómo romper con la relación entre la metapsíquica y el espiritismo.

Inicialmente, en 1923 se celebró en Varsovia el II Congreso Internacional sobre Investigaciones Psíquicas en el cual se decidió separar oficialmente la

metapsíquica y la metafísica del espiritismo (Beloff, 1993). Esta decisión no tuvo un impacto significativo en la comunidad científica occidental y fue confusa (para más información véase Eysenck y Sargent, 1982). Concretamente, la confusión fue debida a la falta de claridad con respecto a qué grupo pertenecía la expresión paranormal y qué significaba para cada una de las dos corrientes (la metapsíquica y la espírita) (Inglis, 1977). Como resultado, ambas facciones siguieron utilizando por separado el término paranormal (Carter, 2012). Esto no fue positivo porque la definición del concepto "paranormal" no cambió hasta que Broad (1949) definió los *Principios Básicos Delimitantes* de la ciencia (de ahora en adelante PBDs). Estos principios tenían como objetivo definir qué fenómenos podían ser considerados científicos y cuáles no (véase también Broad, 1953). Cualquier fenómeno que contradijera los PBDs debía ser considerado como fenómeno paranormal y perdería su estatus hipotético-científico (Irwin, 2009). Los PBDs no fueron aceptados o reconocidos por toda la comunidad científica internacional y una parte de ella decidió que el problema recaía en el uso de la palabra "metapsíquica", la cual hacía uso de la expresión paranormal y no tenía una definición solida de su objeto de estudio (o sea, el psiquismo). Entonces, era necesario proponer el uso de nuevas expresiones que permitieran definir qué es el psiquismo y cómo estudiarlo científicamente.

Es importante destacar que en aquella época surgieron las teorías de la probabilidad y las teorías matemáticas del cálculo (Lewin, 2014). La unión de ambas teorías concluyó con el nacimiento de la estadística inferencial y el análisis de datos (léase Pardo et al., 2015). Este hecho fue importante porque hasta ese momento, solamente las disciplinas positivistas podían hacer uso del método científico a partir del escrutinio empírico materialista (Crook y Garratt, 2014). El análisis de datos y la estadística aportaron el método y las pruebas de contraste de hipótesis (Pardo y San Martín, 2015). Las pruebas de contraste de hipótesis pueden definirse como un conjunto de procedimientos matemáticos encargados de analizar si los datos obtenidos en una investigación se ajustan a una hipótesis planteada en términos de probabilidad y estadística (léase los textos originales de Fisher, 1925, 1955).

La aportación más importante de la estadística en el método científico se centró en la validez y medición de los indicadores empíricos indirectos de los fenómenos que ocurren en la realidad objetiva (Pardo et al., 2015). Más concretamente, los eventos que suceden en la realidad no siempre son observables directamente y se necesitan marcadores indirectos representados matemáticamente que permitan describir y explicar dichos fenómenos (Ramsay y Silverman, 2002). A modo de ejemplo, en el ámbito las ciencias físicas un fenómeno no observable directamente puede ser el viento o la temperatura (Bunge, 2013).No es posible observar directamente el comportamiento físico del viento, pero sí es posible medir matemáticamente determinados indicadores empíricos que aporten información válida y fiable sobre dicho comportamiento físico del viento (Hays, 1994). Los indicadores empíricos son propiedades observables y variables de un determinado

objeto de estudio (en este caso, el viento) (véase Hardy y Bryman, 2004). Un ejemplo de indicador empírico relativo al viento podría ser la fuerza o la velocidad (Bunge, 2013). Esta idea es esencial para entender las nuevas concepciones que surgieron de lo paranormal.

Se debe tener en cuenta que la mayoría de las disciplinas procedentes del ámbito de las ciencias sociales en aquel momento no tenían un estatus científico consolidado por las dificultades relacionadas con la aplicación del método científico y concretamente con el uso del escrutinio empírico (Velleman y Hoaglin, 2004). La psicología científico-experimental iniciada por Wundt (1832-1920) representa una de las pocas excepciones positivistas dentro del marco de las ciencias sociales (léase Boring, 1978). En realidad, la estadística inferencial generó nuevas oportunidades científicas de investigación que también fueron utilizadas por los profesionales que deseaban cambiar el término de metapsíquica y romper definitivamente con la vinculación espírita (Irwin y Watt, 2007).

Concretamente, Rhine (1965) se preguntó si en la metapsíquica se podía aplicar el método científico empleando las pruebas de contraste de hipótesis y la estadística inferencial. Sin embargo, incluir las aportaciones de las teorías del cálculo y de la probabilidad en la metapsíquica requería generar una nueva disciplina de estudio, ya que estas teorías matemáticas generaban un cambio en la epistemología y el método fundamental de las ciencias metafísicas (incluida la metapsíquica) (Shermer, 2011). Por lo tanto, a partir de las propuestas de Rhine (1965) se decidió proponer y oficializar el nombre de "parapsicología" para designar el estudio del psiquismo empleando las teorías del cálculo y de la probabilidad (véase también Carter, 2012). Rhine (1965) institucionalizó la cuantificación y medición probabilística de los fenómenos psíquicos (Cardeña et al., 2015). El término de metapsíquica quedó en desuso para los científicos experimentalistas y permaneció dentro del campo de la filosofía (Eysenck y Sargent, 1982). No obstante, todavía quedaba el reto con respecto a cómo diferenciar la parapsicología de lo paranormal.

## 2.2. Definición de fenómenos anómalos y fenómenos inexplicados

La definición científica más aceptada de parapsicología la ofrecen Cardeña et al. (2015), quienes se fundamentaron en las aportaciones de la The Parapsychologial Association (2020) —creada originalmente por Rhine (1965)—. Estos autores definen la parapsicología como el estudio científico de las anomalías del comportamiento. Esto tiene dos implicaciones y características: (1) que sea el estudio científico significa que se emplea la estadística inferencial como disciplina para desarrollar la aplicación del método científico; y (2) la expresión anomalías del comportamiento hace referencia a la conducta observada que la psicología y las ciencias afines no pueden explicar científicamente (véase Zingrone et al., 2015).

Desde las aportaciones de Rhine (1965) la expresión fenómenos paranormales se sustituyó por la expresión fenómenos anómalos, por ser una expresión no relacionada con el espiritismo (véase Beloff, 1993). A diferencia de lo paranormal, los fenómenos anómalos son comportamientos inexplicados científicamente (véase Mabbett, 1982). Es por este motivo que también reciben el nombre genérico de fenómenos inexplicados. Esto tiene dos características principales: (1) que los fenómenos anómalos no tengan explicación científica no significa que posean un origen sobrenatural o pseudocientífico (Irwin, 2009); y (2), que los fenómenos anómalos no tengan explicación científica y sean inexplicados, no quiere decir que sean definitivamente inexplicables (Carter, 2012). Se dice que son inexplicados porque la ciencia y la tecnología actual no ha logrado probar las explicaciones causales para algunos de estos fenómenos (léase la revisión de Utts, 2018).

Por lo tanto, de acuerdo con Cardeña et al. (2015) puede concluirse que la parasicología no es el estudio de lo paranormal. En la misma línea, la parapsicología se encarga de estudiar los comportamientos observados indirectamente y que son inexplicados (y no inexplicables) por parte de la psicología, empleando las teorías de la probabilidad y del cálculo (Radin, 2009).

## 2.3. Perspectivas científicas disidentes

Aunque según Cardeña et al. (2015) la definición de parapsicología parece ajustarse al marco académico y a la metodología científica basada en la estadística inferencial, fue y es todavía una expresión que no ha sido aceptada por todos los colectivos científicos (léase Carter, 2012). Uno de estos colectivos se denomina *Committe for Skeptical Inquiry* (de ahora en adelante CSI) y se fundamenta en el racionalismo y en el escepticismo filosófico para poner en duda aquellas evidencias estadísticas que entran en conflicto con el discurso racional de la ciencia (véase The Committe for Skeptical Inquiry, 2020). Por un lado, tal y como se ha explicado en el apartado 2.1., el racionalismo parte de la base que todos los fenómenos que suceden en el cosmos deben ser explicables por medio de la razón y la teoría científica (léase Bachelard, 1985). En esta corriente, los datos estadísticos o las evidencias empíricas por sí solas carecen de valor científico si no están apoyadas por la razón. Por otro lado, el escepticismo es un paradigma de la filosofía que parte del supuesto de que la "verdad" no es un contenido accesible al conocimiento humano (Popkin, 2003). Según este paradigma, ninguna explicación empírico-estadística es admisible a excepción de aquellas que están fundamentadas por el racionalismo científico (Shermer, 2011). El escepticismo acepta el discurso racional debido a la asunción lógica del *Principio de Razón Suficiente* (de ahora en adelante PRS) (Lovejoy, 2009). Este principio postula que todos los fenómenos que ocurren en el cosmos pueden ser explicados por una razón mínima y suficiente, incluidos aquellos fenómenos que en la actualidad tienen una causalidad desconocida (léase Pruss, 2011 para una revisión más detallada de este concepto).

No debe confundirse este concepto de escepticismo con el significado social-popular de la palabra escéptico. Aunque informalmente el escéptico es aquél que pone en duda los argumentos y los conocimientos implausibles, el escepticismo original asume que la verdad no es un contenido accesible para la ciencia (véase Le Morvan, 2011). Las actitudes de poner en duda los conocimientos o los argumentos tiene su origen en el *criticismo* (para el discurso *logos*, del que forma parte de la ciencia) y en el *agnosticismo* (para el discurso *mitos*, del que forma parte del dogma) (Popper, 2008). Este matiz es importante para comprender las bases ideológicas del CSI, ya que se trata de un movimiento académico fundamentado en el escepticismo filosófico. Las dos ideologías subyacentes en el CSI (escepticismo y racionalismo) promovieron que muchos académicos rechazaran la inclusión en el estatus científico de ciertos objetos de estudio que emergieron a mediados del siglo XX, entre ellos la parapsicología (Irwin y Watt, 2007).

No obstante, Cardeña et al. (2015) explicaron que los fenómenos anómalos —entendidos como los comportamientos psicológicos inexplicados— fueron reconocidos oficialmente como objetos científicos de estudio por la *American Psychological Association* (de ahora en adelante APA) (esta información puede verificarse en Cardeña et al., 2014). Igualmente, la *American Association for the Advancement of Science* (de ahora en adelante AAAS) (editora titular de la revista *Science*) reconoció a la PA como organización científica internacional y la incluyó en su lista de organizaciones científicas afiliadas (véase American Association for the Advancement of Science, 2020). Además la *United Nations Educational Scientific and Cultural Organization* (de ahora en adelante UNESCO) también reconoció en 1988 a la parapsicología como objeto científico de estudio oficial incluible en las universidades (esta información puede verificarse en United Nations Educational Scientific and Cultural Organization, 2020). Estos reconocimientos no aseguran que la parapsicología sea una disciplina científica, pero sí permiten y legitiman su investigación científica en el marco universitario (Cardeña et al., 2015).

En esta investigación, se parte de la base que la ciencia son todos aquellos conocimientos obtenidos a partir del método científico, incluyendo las mediciones empíricas directas (relacionadas con el escrutinio empírico) y las indirectas (pertenecientes a las teorías matemáticas y a la estadística inferencial) (léase McGuigan, 1996). Por lo tanto, los fenómenos anómalos serán abordados en este estudio siguiendo las clasificaciones oficiales de la UNESCO y de la APA.

## 2.4. Definición de creencias pseudocientíficas

Las diferencias entre el escepticismo o racionalismo (procedentes del CSI) y el paradigma empirista que también caracteriza el método científico (léase la subsección 2.1.), promovió el uso de conceptos alternativos al de parapsicología y creencias paranormales. Una propuesta muy extensa en la actualidad recae en el concepto de “creencias pseudocientíficas”.

Originalmente, la palabra pseudociencia se reservaba para designar aquellas afirmaciones que aparentemente eran análogas al discurso científico, pero que carecían de pruebas o evidencias plausibles que las respaldaran (véase Shermer, 2011). Sin embargo, en el ámbito de las ciencias del comportamiento, teniendo en cuenta las polémicas relacionadas con los usos de las expresiones paranormal o parapsicología, los académicos defensores del CSI y de sus ideologías, prefirieron el uso de una denominación alternativa que se ajustara al escepticismo y al *negacionismo* científico. En esta línea, Bunge (2012) propone la expresión creencias pseudocientíficas o "pseudociencias" como una categoría general que también incluiría cualquier contenido relacionado con lo paranormal o la parapsicología (véase también Pigliucci y Boudray, 2013). Así, las creencias pseudocientíficas pueden definirse como un eufemismo generalizado para describir y designar afirmaciones que aceptan la existencia de fenómenos o eventos implausibles de acuerdo a las bases ontológicas del discurso científico (p. ej. Lilienfeld et al., 2015).

En algunas ocasiones, determinados eventos (aunque sean o parezcan implausibles), sí que fueron sometidos al método científico y se obtuvieron resultados objetivos sobre su posible validez y evidencia –un ejemplo es la precognición y la recepción anómala de la información (véase Bem, 2011; Mossbridge et al., 2012; Beischel et al., 2015)–. No obstante, en este tipo de casos los distintos organismos científicos e incluso en las propias publicaciones más actuales (léase Cardeña, 2018; Butzer, 2020; Reber y Alcock, 2020) no alcanzaron ninguna conclusión con respecto a la validez científica de este tipo de fenómenos (p. ej. French y Stone, 2014). Esto significa que no se puede realizar ningún juicio conclusivo sobre el valor ontológico y realista sobre dicho tipo de fenómenos (Radin et al., 2012). En otros casos es posible que la afirmación pseudocientífica haya sido puesta a prueba científicamente sin éxito o que las replicaciones posteriores no fueran suficientemente consistentes con el fenómeno que se pretende validar. Estos son solamente algunos de los escenarios que suelen ser frecuentes en el ámbito de las pseudociencias (léase Bunge, 2012). Sin embargo, dado que los avances científicos se basan en la aplicación del método y en las evidencias empírico-estadísticas obtenidas en cada ámbito del conocimiento (léase a McGuigan, 1996), solamente será la propia práctica científica de la investigación y contraste de hipótesis la que permita recodificar qué contenidos pueden considerarse científicos y cuáles no.

Debe resaltarse que las creencias pseudocientíficas representan solamente una categoría general para referirse a las afirmaciones que entran en conflicto con las bases de la ciencia o con el propio método científico, pero en ningún momento presente ser un concepto definitivo sobre los contenidos que son acientíficos (Shermer, 2011). Este concepto varía según cada periodo, trayectoria y evolución del conocimiento científico (Bunge, 2013). Esto quiere decir que los contenidos que actualmente se consideran pseudocientíficos podrían llegar a dejar de serlo si las evidencias científicas respaldaran su validez y ontología. Por ejemplo, inicialmente el uso de la "infusión de valeriana" (como terapia natural para combatir el estrés)

se consideraba como una práctica pseudocientífica. No obstante, numerosas publicaciones científicas y ensayos clínicos validaron los efectos hipnóticos y relajantes de la valeriana en determinadas condiciones posológicas (léase Cerny y Schmid, 1999; Ziegler et al., 2002; Koetter et al., 2007; Shinjyo et al., 2020); sería pues un error creer que el uso de la valeriana para combatir los estados de ansiedad constituye una afirmación pseudocientífica (para más información véase la revisión realizada por Carter, 2012). Por lo tanto, es importante destacar la prudencia y la precisión en el uso de la expresión creencias pseudocientíficas.

# 3. Clasificación de los fenómenos anómalos según la *American Psychological Association* (APA)

De acuerdo con las clasificaciones de la APA y de la PA, los fenómenos anómalos que estudia la parapsicología se clasifican en el modelo hipotético *psi* (véase Cardeña et al., 2015; The Parapsychologial Association, 2020). El término "modelo hipotético psi" es una categoría que sirve para agrupar y clasificar 3 tipos de fenómenos anómalos específicos (Eysenck y Sargent, 1982): la *anticipación anómala de la información* (de ahora en adelante AAI), la *interacción mente-materia* (de ahora en adelante IMM) y la *comunicación mente-mente* (de ahora en adelante CMM) (léase también May et al., 2014). Esta categoría se denomina "psi" porque implica la activación de determinados mecanismos psicológicos-perceptivos que se suponen que son desconocidos.

La AAI también recibe el nombre de "precognición" y se define como aquel proceso perceptivo mediante el cual un sujeto anticipa estímulos futuros impredecibles sin emplear los canales sensorio-perceptivos convencionales abalados por la ciencia y la psicología (Cardeña et al., 2014). Suele utilizarse la expresión AAI en lugar de precognición porque se considera que el anacronismo AAI es más preciso en su nomenclatura (véase Mossbridge et al., 2012). La IMM se define como aquel proceso en el cual un sujeto genera cambios en las propiedades y cualidades de un objeto material sin emplear los medios físicos, manipulativos y causales reconocidos por la ciencia (léase Radin et al., 2012). La CMM se define como aquel proceso en el cual un sujeto transmite información o representaciones cognitivas a otro sujeto aislado y localizado en otro lugar en el espacio, sin emplear los medios físicos, tecnológicos y de comunicación aceptados por la ciencia (Cardeña, 2018).

La APA incluye en el APA Dictionary of Psychology (2021a) dentro de la parapsicología el estudio de la "clarividencia" y de la "mediumnidad". El propio APA Dictionary of Psychology (2021b) define la figura del "médium" como aquél

sujeto que actúa como medio de comunicación espiritual entre los seres vivos y los seres fallecidos. No obstante, dado que esta definición procede del ámbito de la psicología de la religión (p. ej. Maraldi et al., 2010), otros autores prefirieron matizarla indicando que la mediumnidad debía limitarse a cualquier práctica que tenga como fin la "supuesta comunicación" entre los seres vivos y fallecidos (independientemente de las creencias religiosas que se le puedan atribuir) (véase Beischel, 2007, 2014).

Con el objetivo de evitar el uso de la expresión "mediumnidad" por sus implicaciones espíritas y la confusión académica relacionada con esta terminología (léase la subsección 2.1.), Beischel y Rock (2009) propusieron estudiar el fenómeno de la mediumnidad empleando las teorías del cálculo y de la probabilidad y, lo denominaron neutralmente *recepción anómala de la información* (de ahora en adelante RAI) (véase el meta-análisis de Sarraf et al., 2020 para una revisión más completa de esta propuesta). La RAI debe definirse como un proceso perceptivo en el que un sujeto accede a información sensorial u obtiene conocimientos sobre eventos que sucedieron en el pasado, sin utilizar los mecanismos perceptivos convencionales avalados por las bases científicas de la psicología y psicobiología (Beischel y Rock, 2009; Beischel et al., 2015). Dado que los mecanismos perceptivos son desconocidos, algunos sujetos que creen en la existencia de lo paranormal tienden a inferir que dicha información sensorial o conocimientos son enviados por los seres fallecidos y son recibidos en el sujeto que practica la mediumnidad (léase la revisión de Rock, 2013). Sin embargo, debe quedar claro que esta inferencia no representa una hipótesis científica válida porque el hecho de que un fenómeno tenga una causalidad desconocida no significa que dicha causalidad deba ser paranormal (véase Escolà-Gascón, 2020b). Por lo tanto, aunque la RAI está relacionada con la mediumnidad, su relación debe limitarse a los sistemas culturales y de creencias que determinan la concepción sobre cómo cada individuo interpreta la casualidad de aquello que percibe (Roe, 2019).

Debe tenerse en cuenta que los artículos que se adjuntan en esta investigación se centraron en el análisis psicométrico y psicológico de la AAI, IMM, CMM, y RAI. En la siguiente subsección se describen los distintos modelos psicológicos que permiten explicar estos supuestos fenómenos de manera inclusiva dentro de las teorías psicológicas.

# 4. Modelos psicológicos de los fenómenos inexplicados

Si bien existe el debate sobre qué son y cómo conceptualizar los fenómenos inexplicados en las ciencias del comportamiento, también es cierto que existe la discusión con respecto a cómo medirlos matemáticamente (véase Irwin, 1993, 2009; Houran et al., 2019). Existen dos tipos de mediciones, las directas y las indirectas. Las mediciones directas son aquellas mediante las cuales se atribuye una observación matemática (o sea, un valor numérico) a los indicadores empíricos observables relativos a los fenómenos que suceden en la realidad objetiva (Abad et al., 2015). En cambio, las mediciones indirectas son aquellas en las que se realizan observaciones matemáticas de los indicadores empíricos de la realidad objetiva, pero a través de fuentes de información o medios que impiden realizar la observación directa de los respectivos fenómenos a cuantificar (Barbero et al., 2015). Aunque las teorías y modelos psicométricos incluyen ambos tipos de mediciones, en la práctica profesional de la psicología (ya sea en el ámbito clínico, educativo u organizacional) suelen emplearse mayormente las mediciones indirectas a través de los cuestionarios de autoinforme (léase Fernández-Ballesteros, 2013).

La investigación psicométrica proporciona distintas herramientas de evaluación que examinan los fenómenos inexplicados y las experiencias anómalas. Existen tres modelos predominantes (léase Belloch et al., 1995; Irwin, 2009; van Os et al., 2009): (1) el modelo clínico del continuum de las psicosis; (2) el modelo de las deformaciones perceptivas e ilusiones; y (3) el modelo fenomenológico o cognitivo.

El modelo del continuum de las psicosis es un constructo clínico y estadístico que tiene como finalidad explicar cuantitativamente el valor psicopatológico de los síntomas característicos de las psicosis en la población general (DeRosse y Karlsgodt, 2015). El continuum de las psicosis asume que los síntomas psicóticos identificados en pacientes también se presentan en la población no clínica con distinta intensidad e incidencia (Carden et al., 2018). Esta idea se fundamenta en el supuesto de que la sintomatología no es cualitativamente, categóricamente y exclusiva de los trastornos del espectro psicótico, sino que también se manifiesta de forma sutil en sujetos sanos (van Os et al., 2009; Shevlin et al., 2016). Así, este modelo propone la presencia de una degradación cuantitativa (y no solamente cualitativa) de los síntomas psicóticos que fluctúa entre dos polos: por un lado, el extremo más intenso y psicopatológico y, por el otro, el extremo en el que la sintomatología se expresa de forma atenuada (Chau et al., 2019). Igualmente, la cuantificación de la sintomatología psicótica mitigada permite definir el concepto de *fenotipo psicótico* (véase Kaymaz y van Os, 2010). El fenotipo psicótico establece que los sujetos que viven síntomas psicóticos poco intensos poseen más

riesgos clínicos para desarrollar futuros cuadros psicóticos severos con respecto a los individuos que no los padecen (van Os et al., 2000).

En este contexto, el continuum de las psicosis es un modelo que clasifica y concibe los fenómenos inexplicados como experiencias alucinatorias del individuo (véase Powers et al., 2016). Las alucinaciones son alteraciones de la percepción en las que el sujeto advierte información sensorial (o sea, a través de los sentidos) que no existe o no forma parte de las características formales que componen la realidad objetiva (Jarne, 2010; Linscott y van Os, 2010). Por lo tanto, según este modelo los fenómenos inexplicados son producciones perceptivas irreales, no poseen ningún valor ontológico material y, además, teniendo en cuenta el fenotipo psicótico, constituyen también conductas de riesgo clínico (véase Shapiro et al., 2019).

En segundo lugar, el modelo de las deformaciones perceptivas recibe el nombre de "engaños perceptivos" o "ilusiones" y describe un conjunto de alteraciones de la percepción que no son psicopatológicas (Jaspers, 1993; Freeman, 2006). Una deformación perceptiva sucede cuando un objeto sensorial presente en la realidad objetiva es percibido de tal forma que sus características formales y empíricas no coinciden con las características de la representación elaborada por el sujeto (Ey et al., 1980; Belloch et al., 1995; Telles-Correia et al., 2015). Este fenómeno se diferencia de las alucinaciones en que el sujeto no produce una percepción irreal, sino que distorsiona los elementos formales que definen el objeto sensorial provocador (Lincoln y Keller, 2015). Entonces, en las alucinaciones no existe ontológicamente un objeto sensorial provocador de la alteración y en las deformaciones perceptivas tal objeto sí existe, pero es percibido de forma distorsionada. De acuerdo con este modelo, los fenómenos inexplicados son engaños, ilusiones o deformaciones de la percepción presentes en la población general clínica y no clínica (Babkoff et al., 1989). Por lo tanto, las mismas causas que explican las deformaciones perceptivas (p. ej. las ilusiones *hipnagógicas* e *hipnopómpicas*) son las mismas causas que podrían explicar los fenómenos inexplicados (léase Parker, 1999; Bell et al., 2008).

Como punto tercero se debe destacar el modelo fenomenológico y cognitivo. Este modelo puede definirse y explicarse desde distintas perspectivas (Drinkwater et al., 2013). Teniendo en cuenta la temática de esta investigación la definición estará basada en la teoría de las atribuciones causales (véase Irwin, 1993; Matute et al., 2015). Esta teoría postula que las inferencias causales están implícitamente condicionadas por los esquemas cognitivos o los sistemas de creencias que aprende el sujeto a lo largo de su desarrollo vital y que le permiten representar la realidad objetiva en la que vive (Blanco et al., 2015).

Este modelo postula que los procedimientos perceptivos en sí mismos finalizan con la representación cognitiva y la interpretación causal que hace el sujeto sobre el objeto sensorial percibido (Irwin et al., 2018). Esto significa, que lo importante no recae en si hay o no hay objeto sensorial provocador en la experiencia/conducta. En este modelo, tampoco es prioritario cuantificar o analizar las discrepancias entre la percepción distorsionada del individuo y las características formales del estímulo

sensorial (Irwin et al., 2014). El modelo fenomenológico se centra en el juicio y en la interpretación cognitiva que hace el individuo (Drinkwater et al., 2017). Por lo tanto, este enfoque consiste en el análisis de los sistemas de creencias (entendidos como esquemas cognitivos de significados) que el sujeto utiliza para elaborar los juicios o inferencias relativas al contenido del objeto que percibe (Irwin et al., 2013). El modelo fenomenológico concibe los fenómenos inexplicados como inferencias, juicios y constructos individuales, siendo el individuo quien atribuye –de acuerdo con su sistema de significados– el valor de "inexplicado" o "explicado" a la experiencia. Entonces, en sí mismas, las creencias paranormales no consistirían solamente en la aceptación real de fenómenos inverosímiles con el conocimiento científico (léase Irwin, 2009; Betsch et al., 2020). En este modelo cualquier creencia o sistema de creencias es el medio o la forma cualitativa que el individuo utiliza para interpretar y explicar la causalidad de los eventos que suceden en su entorno.

Los tres modelos anteriores son inclusivos sobre cómo clasificar o entender los fenómenos inexplicados (Powell y Moseley, 2021). En realidad, se elaboraron distintos instrumentos psicométricos de autoinforme para cada uno de los modelos que se encargan de medir con validez y fiabilidad los fenómenos inexplicados (p. ej. Gallagher et al., 1995; Stefanis et al., 2004; Bell et al., 2005; Schofield y Claridge, 2007; Kelsall-Foreman et al., 2020;). Sin embargo, en lugar de emplear la denominación fenómenos inexplicados, es muy frecuente la utilización de la expresión "experiencias anómalas" o "percepciones anómalas". La razón es que estas percepciones o experiencias están muy relacionadas con la sintomatología subclínica de las psicosis y también son comportamientos difíciles de explicar en términos científicos (véase Escolà-Gascón y Gallifa, 2020). En esta línea, el concepto de experiencias anómalas es un eufemismo psicológico para incluir la evaluación de los fenómenos inexplicados dentro de los tres modelos explicados anteriormente.

No obstante, dentro del campo de la psicometría todavía se debate sobre como poder medir y predecir los fenómenos anómalos de manera eficaz, permitiendo la discriminación psicológica entre lo que representa una alucinación (modelo del continuum), una deformación perceptiva (modelo semiológico de la percepción) y una atribución causal (modelo fenomenológico) (p. ej. Houran et al., 2019; Maraldi y Krippner, 2019). Este debate también impacta sobre otra discusión: qué criterio científico (o sea, basado en la evidencia) se debe seguir para clasificar una experiencia anómala como psicopatológica o no patológica (Wright et al., 2018). Y también, debe recordarse en este punto de la introducción, qué si las evidencias estadísticas presentan resultados a favor de un supuesto fenómeno inexplicado como puede ser la comunicación mente-mente (CMM) –véanse las publicaciones del *Psychological Bulletin* de la APA, concretamente en Bem y Honorton (1994) y Storm y Ertel (2001)– surge el interrogante sobre cómo distinguir entre la supuesta ontología del fenómeno de la CMM y los tres tipos de clasificaciones distinguidas en esta sección. Al fin y al cabo –en términos matemáticos– debe tenerse en cuenta que una medición es una observación

numérica atribuida a un determinado fenómeno o contenido (léase Abad et al., 2015). Medir un fenómeno inexplicado como una alucinación puede tener validez y fiabilidad métrica, pero eso no significa que pueda explicarse causalmente como una alucinación (véase la revisión de Aynsworth et al., 2017). Lo mismo sucede con las deformaciones perceptivas y las inferencias causales.

Los tres primeros artículos que se adjuntan en esta investigación presentan la justificación estadística de un nuevo enfoque métrico (denominado modelo empírico-estadístico) que integra los tres modelos anteriores y tiene como propósito comprobar qué variables psicológicas (estados, rasgos, sesgos, etc.) pueden predecir y explicar causalmente los fenómenos inexplicados (se trata de una explicación causal solamente a nivel de control estadístico y no desde una causalidad entendida dentro de los diseños experimentales puros). Los objetivos e hipótesis de la investigación se fundamentan en estas cuestiones y los efectos psicológicos de las creencias pseudocientíficas en la población general española.

# 5. Objetivos e hipótesis

## 5.1. Objetivos relacionados con los fenómenos anómalos.

El propósito de la investigación se basa en la construcción, desarrollo y justificación estadística de un instrumento de evaluación psicológica que permita medir y predecir las experiencias anómalas o los fenómenos inexplicados percibidos por la población general no clínica. Igualmente, el objetivo específico consiste en definir un conjunto de factores psicológicos subclínicos que sean variables independientes o antecedentes de los fenómenos inexplicados. Esto quiere decir, que los factores deberán explicar y predecir los fenómenos anómalos, lo cual permitirá refutar la hipótesis nula de que los fenómenos anómalos no tienen explicación o no son predecibles empleando variables psicológicas subclínicas.

Considerando el debate con respecto a los fenómenos anómalos y especialmente a la discusión de la recepción anómala de la información (RAI), otro objetivo es examinar si los recuentos de aciertos sobre la RAI –realizados en condiciones de doble ciego– superan o difieren significativamente de la esperanza matemática estimada según las leyes de la probabilidad (azar). Este último objetivo implica replicar los procedimientos estadísticos y metodológicos de otras investigaciones previas que analizaron este objetivo anteriormente.

## 5.2. Objetivos relacionados con las creencias pseudocientíficas

La finalidad de esta investigación también se centra en el análisis psicológico y estadístico del impacto de las creencias pseudocientíficas en la población general española sin antecedentes psiquiátricos. En este caso, el objetivo subyacente recae en proporcionar ayudas conceptuales, instrumentales y terapéuticas a los profesionales de la salud mental e investigadores académicos que deban confrontarse con este tipo de creencias o fenómenos. Teniendo en cuenta el contexto de emergencia internacional causado por la pandemia de la COVID-19, estos objetivos estarán caracterizados por los cambios socio-políticos, sanitarios y económicos aplicados como consecuencia o como medidas de prevención de la crisis del coronavirus.

## 5.3. Hipótesis planteadas

Considerando los objetivos planteados, se formulan las siguientes hipótesis de investigación:

(1) Los fenómenos anómalos pueden medirse y predecirse válida y fiablemente.

(2) Los fenómenos anómalos basados en la recepción anómala de la información (RAI) medida mediante ensayos experimentales de aciertos o errores no difiere de la esperanza matemática estimada.

(3) Las creencias pseudocientíficas aumentaron tras el primer confinamiento social durante la pandemia de la COVID-19.

(4) Las creencias pseudocientíficas están relacionadas con los estilos de afrontamiento de las personas ante los cambios, medidas y restricciones sanitarias implementadas en la crisis del coronavirus.

(5) Las creencias pseudocientíficas son más frecuentes y prevalentes en las grandes ciudades (municipios con más de 10.000 habitantes), frente a los municipios rurales.

# 6. Métodos

Se aplicaron varios modelos estadísticos que se distribuyen para cada artículo de la siguiente manera:

(1) En el artículo de *Heliyon* se analizó la validez y fiabilidad del *Multivariable Multixial Suggestibility Inventory-2* (MMSI-2). Se utilizaron técnicas de agrupación de variables basadas en el análisis factorial exploratorio (de ahora en adelante AFE). Dado que las respuestas se codificaban siguiendo el modelo de

escalamiento de tipo Likert, se decidió realizar un primer AFE sobre la matriz de correlaciones *policóricas* entre los ítems y otro AFE de segundo orden sobre los factores extraídos. El método de extracción de los factores fue el de *mínimos cuadrados no ponderados*. Como criterio de retención de los factores se empleó el método del *análisis paralelo*. Igualmente, se aplicaron rotaciones oblicuas de los ejes (empleando el método *oblimín directo* y *promax*). Los índices de fiabilidad que se utilizaron se basaron la transformación ordinal del coeficiente *alpha de Cronbach* a partir de la propuesta de McDonald (1999).

(2) El artículo publicado en el *Anuario de Psicología* ofrece la justificación estadística del MMSI-2-R. Se trata de la versión reducida del cuestionario MMSI-2. En esta investigación también se aplicó un AFE sobre la matriz de correlaciones *policóricas* entre los ítems. El método de extracción fue el de *factorización principal* y también se utilizó el análisis paralelo para la retención óptima del número de factores. Se calcularon los coeficientes *alpha de Cronbach* y *omega de McDonald* para el análisis de la fiabilidad.

(3) En el artículo de *Current Research in Behavioral Sciences* se presenta la validez de constructo del MMSI-2 y se analiza la invarianza factorial en dos grupos de sujetos. Se utilizaron los *modelos de ecuaciones estructurales* con el método de estimación de *máxima verosimilitud*. Del mismo modo, se replicaron nuevamente los índices de fiabilidad mediante el coeficiente *omega de McDonald*.

(4) En la publicación de *Explore* se desarrolló un diseño experimental en el que se puso a prueba si los participantes (médiums y no creyentes) podían adivinar el contenido seleccionado aleatoriamente de varias imágenes procedentes de la *Geneva Affective Picture Database* (en adelante GAPED). Se aplicaron pruebas de contraste de hipótesis tanto frecuentistas (basadas en el análisis de la varianza, distribución *binomial* y *t de Student*) como bayesianas (basadas en los *Bayes factors*).

(5) El artículo de *Global Health* analiza longitudinalmente el aumento de las creencias pseudocientíficas después de los 57 días de cuarentena social impuestos en toda España durante la crisis del coronavirus. Se aplicó la prueba *t de Student*, se estimó el *Bayes Factor* y las probabilidades *a posteriori*.

(6) En *Frontiers in Psychology* se publicó el desarrollo de la *COVID Reaction Scales* (COVID-RS). Esta escala mide los estilos de afrontamiento de la población general durante la crisis del coronavirus e incluye las creencias pseudocientíficas como característica del estilo desorganizado. En esta investigación se utilizaron los AFEs y los *modelos de ecuaciones estructurales*. La fiabilidad se analizó mediante el coeficiente *omega de McDonald*.

(7) Finalmente, en el informe de *Psychiatry Research* se examinó el impacto de la información pseudocientífica sobre el coronavirus tanto en poblaciones rurales como en los núcleos urbanos. Se emplearon pruebas de contraste de hipótesis basadas en la *t de Student* y el análisis de la varianza. También se utilizaron los *Bayes factors* y los coeficientes de correlación.

# 7. Resultados: artículos publicados

Se resume a continuación la contribución del doctorando en cada uno de los artículos:

I. Escolà-Gascón, Á. (2020). Researching unexplained phenomena: empirical-statistical validity and reliability of the Multivariable Multiaxial Suggestibility Inventory-2 (MMSI-2). *Heliyon, 6*(7). Article e04291. https://doi.org/10.1016/j.heliyon.2020.e04291
El doctorando es el único autor; concibió la investigación, recolectó la muestra, analizó los resultados y escribió todo el manuscrito.

II. Escolà-Gascón, Á., & Gallifa, J. (2020). Psychology of Anomalous Experiences: psychometric properties of the Multivariable Multiaxial Suggestibility Inventory-2 Reduced (MMSI-2-R). *Anuario de Psicología, 50*(3), 115-126. https://doi.org/10.1344/anpsic2020.50.11
Son dos autores. El doctorando fue el primer autor, concibió la investigación, recolectó la muestra, analizó los resultados y escribió el manuscrito en colaboración y bajo la supervisión del Dr. Josep Gallifa.

III. Escolà-Gascón, Á. (2020). Researching unexplained phenomena II: new evidences for anomalous experiences supported by the Multivariable Multiaxial Suggestibility Inventory-2 (MMSI-2). *Current Research in Behavioral Sciences, 1*. Article 100005. https://doi.org/10.1016/j.crbeha.2020.100005
El doctorando es el único autor; concibió la investigación, recolectó la muestra, analizó los resultados y escribió todo el manuscrito.

IV. Escolà-Gascón, Á. (2020). Forced-choice experiment on Anomalous Information Reception and correlations with states of consciousness using the Multivariable Multiaxial Suggestibility Inventory-2 (MMSI-2). *EXPLORE*. Advance online publication. https://doi.org/10.1016/j.explore.2020.11.009
El doctorando es el único autor; concibió la investigación, recolectó la muestra, analizó los resultados y escribió todo el manuscrito.

V. Escolà-Gascón, Á., Marín, F., Rusiñol, J., & Gallifa, J. (2020). Pseudoscientific beliefs and psychopathological risks increase after COVID-19 social quarantine. *Globalization and Health, 16*(1). https://doi.org/10.1186/s12992-020-00603-1
Son 4 autores. El doctorando fue el primer autor, concibió la investigación, recolectó la muestra, analizó los resultados y escribió el manuscrito en colaboración y bajo la supervisión de los profesores Dr. Francesc-Xavier Marín, Dr. Jordi Rusiñol y Dr. Josep Gallifa.

VI. Escolà-Gascón, Á., Marín, F., Rusiñol, J., & Gallifa, J. (2020). Measuring Psychosocial Reactions to COVID-19: The COVID Reaction Scales (COVID-RS) as a New Assessment Tool. *Frontiers in Psychology, 11*. https://doi.org/10.3389/fpsyg.2020.607064
Son 4 autores. El doctorando fue el primer autor, concibió la investigación, recolectó la muestra, analizó los resultados y escribió el manuscrito en colaboración y bajo la supervisión de los profesores Dr. Francesc-Xavier Marín, Dr. Jordi Rusiñol y Dr. Josep Gallifa.

VII. Escolà-Gascón, Á., Marín, F., Rusiñol, J., & Gallifa, J. (2021). Evidence of the psychological effects of pseudoscientific information about COVID-19 on rural and urban populations. *Psychiatry Research, 295*. Article 113628. https://doi.org/10.1016/j.psychres.2020.113628
Son 4 autores. El doctorando fue el primer autor, concibió la investigación, recolectó la muestra, analizó los resultados y escribió el manuscrito en colaboración y bajo la supervisión de los profesores Dr. Francesc-Xavier Marín, Dr. Jordi Rusiñol y Dr. Josep Gallifa.

En las próximas páginas se adjuntan los 7 artículos publicados.

Heliyon 6 (2020) e04291

Contents lists available at ScienceDirect

Heliyon

journal homepage: www.cell.com/heliyon

Research article

# Researching unexplained phenomena: empirical-statistical validity and reliability of the Multivariable Multiaxial Suggestibility Inventory-2 (MMSI-2)

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ARTICLE INFO

*Keywords:*
Psychology
Psi phenomena
Anomalous experiences
Hallucination
Parapsychology
Schizotypy
Paranormal belief

ABSTRACT

Anomalous phenomena are unexplained occurrences, such as paranormal experiences, that challenge the ontological bases of current scientific knowledge and are considered scientifically impossible. Problematically, some scientific research yields significant statistical results in favor of the existence of *telepathy*, *precognition*, *mind-matter interaction*, and *mediumship*. The current study presents and statistically justifies the Multivariable Multiaxial Suggestibility Inventory-2 (MMSI-2), a new psychological instrument to measure and detect the main psychological explanations for anomalous experiences. A nonprobabilistic sample of 3,224 subjects without a psychiatric history were recruited from the general population of Spain. Exploratory factor analysis (EFA) was used to examine the internal structure of the MMSI-2's 174 items. Direct oblimin and promax oblique rotations were applied as criteria for axis rotation. Cronbach's alpha coefficients and their ordinal transformation were also calculated, and gender-differentiated scales for the raw MMSI-2 scale scores were developed. The first-order factorial solution yielded a total of 16 factors that explained 92.84% of the variance. Of these, 10 corresponded to the psychological variables cited in the background literature, four classified the anomalous phenomena according to their sensory mode, and two represented prototype control scales for this class of psychometric inventory. The higher-order EFA grouped the MMSI-2 scales into four macrofactors that together explained 97.737% of the variance. Satisfactory reliability rates were obtained (alphas>0.8). The full version of the MMSI-2 with 174 items is a valid and reliable psychometric instrument for evaluating anomalous phenomena and the theoretically concomitant psychological variables. Similarly, the scaling of scores can be used in psychological assessment as a screening tool to identify clinically suspected psychological variables.

## 1. Introduction

Some experiences reported by patients in clinical interviews contradict the ontological bases of current scientific knowledge and are considered "unexplained" by psychology and psychiatry (e.g., Bobrow, 2003). "Paranormal" experiences are such cases, which are formally referred to as *anomalous phenomena* (e.g., French and Stone, 2014). The current study introduces a new psychometric instrument to detect and assess possible psychological explanations for experiences of anomalous phenomena, called the Multivariable Multiaxial Suggestibility Inventory-2 (MMSI-2).

### 1.1. Theoretical background

Scientific research of anomalous phenomena is complex. The main problem is that the challenge raised regarding anomalous phenomena is also based on previously published scientific evidence (e.g., Bem, 2011; Bem et al., 2016; Mossbridge et al., 2012). This means that it is not just an ideological and epistemological debate (e.g., Carter, 2012). The most serious problem can be observed in the fact that some scientific research yields significant results in favor of the existence of these alleged anomalous phenomena (e.g., Beischel et al., 2015; Kelly and Arcangel, 2011; Schwartz and Russek, 2001) and contradicts conventional scientific knowledge related to the psychology of perception, sensation and cognition (e.g., Álvarez, 2007; Bunge, 2013; Reber and Alcock, 2019). This is an example of *'psi' phenomena*, which include *precognition*,

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https://doi.org/10.1016/j.heliyon.2020.e04291
Received 7 February 2020; Received in revised form 18 May 2020; Accepted 19 June 2020

*telepathy*, *mediumship* and *anomalous mind-matter interaction* (see Jinks, 2019). These behaviors are also classified as *beliefs in the paranormal* because they are considered impossible phenomena according to the scientific canon (e.g., Irwin, 2009). Although there are reasons to deny the scientific validity of these investigations that support the existence of 'psi' phenomena (e.g., O'Keeffe and Wiseman, 2005; Reber and Alcock, 2019; Wagenmakers et al., 2011), the fact that studies with significant results exist also requires that such research be replicated through the use of the scientific method (e.g., Popper, 2008; Storm and Ertel, 2001; Storm et al., 2013).

En the field of psychological assessment, anomalous behaviors in which the patient believes they can read other people's minds (e.g., telepathy) or feel the presence of dead beings (e.g., mediumship) are behaviors whose clinical value could be both pathological and non-pathological (see Irwin, 2009). Psychological models justifying 'psi' phenomena and other anomalous phenomena can be summarized as follows: (1) the *continuum model* of psychoses, which justifies 'psi' phenomena as hallucinatory and delirious symptoms (e.g., Johns and van Os, 2001; Stefanis et al., 2002; van Os et al., 2009); (2) the *semiotic model* of perception (see Ey et al., 1980), which explains these phenomena as perceptual errors (e.g., cognitive biases or perceptual deformations) (e.g., Barberia et al., 2018; El-Mallakh and Walker, 2010); and (3) the *phenomenological model,* which defines these behaviors as cognitive and verbal representations based on the subject's systems of meanings (e.g., Font, 2016; French and Stone, 2014; Irwin, 1993, 2000, 2003, 2009). Unlike the other models, the phenomenological model does not assume that the etiology of these behaviors is necessarily related to the pathological or symptomatic, nor does it accept that they are caused by errors or mistakes made by the individual (see Irwin et al., 2013; Irwin and Watt, 2007). As some research suggests, systems of meaning and cognitive structures define the way of perceiving, thinking about, and interpreting stimuli in the environment (e.g., Fishbein and Ajzen, 1975). Therefore, the phenomenological model assumes that the etiology of these abnormalities can be observed in the patient's psychological profile, which can justify why a person thinks and acts in a certain way (e.g., Groth-Marnat, 2009; Jaspers, 1993).

The most relevant research takes into account, as predictive factors, certain subclinical personality traits, usually based on paranoid, narcissistic, histrionic and schizotypic attributes, that are positively correlated with anomalous experiences (e.g., López-Rodrigo et al., 1996; Roe and Morgan, 2002; Simmonds-Moore et al., 2019). There are also numerous papers that identify variables influencing anomalous phenomena with very high effects—in statistical terms of effect size (see Cohen, 1988)—related to substance use or *substance abuse* (e.g., Luke, 2012; Sideli et al., 2019; Wilkins et al., 2012). Other variables with significant results are alternating states of *exhaustion/anxiety* (e.g., Roe and Bell, 2016; Simmonds-Moore, 2009; Williams et al., 2007) and *thrill-seeking* (e.g., Gow et al., 2004; Smith et al., 2009). Another extensively studied variable is that of *traumatic experiences in childhood*, which are prevalent among subjects who report anomalous phenomena (e.g., Lawrence et al., 1995; Lynn and Rhue, 1988; Parra, 2019).

Some studies focus on *simulation and fraud* behaviors (see Álvarez, 2007; Leonard and Williams, 2019; Stieger and Hergovich, 2013). Taking as a reference the semiotics of perception, these works examine the psychological biases that would justify the invention of false memories or elements that would trigger lying as the principal mediator (e.g., French, 2003; Wilson and French, 2006). One of the biases that has been corroborated is the *Barnum effect* (e.g., O'Keeffe and Wiseman, 2005). According to Shermer (2011), this effect is observed in overly general statements that seek to validate the anomalous phenomenon, causing the subject to easily identify with the elements presented and accept them as true. Based on the contributions of Boyce and Geller (2002), this effect can be considered verbal conduct that incites deception and should be measured as a control variable. Measurement of this factor in psychometric instruments is not common; however, its inclusion seems necessary to prevent not only the bias derived from the Barnum effect but also deception and simulation behaviors (see Tombaugh, 2011). Conventional clinical evaluation tests have chosen to measure only unconscious lying as a result of image manipulation (e.g., in response to the social desirability or negative presentation of a behavior) (e.g., Ben-Porath and Tellegen, 2019; Millon, 1994; Morey, 2011). However, the control of only variables associated with image manipulation is not sufficient to evaluate lying (see Cardona, 2002; Vrij et al., 2019). On their own, are not effective indicators for the detection of deception (see Fernández-Ballesteros, 2011). In reality, the assessment of lying requires the incorporation of new measures that respond to its complexity and focus more specifically within the area of simulation and fraud (e.g., MacNeil and Soper, 2019).

Other works point to variables that are less consistent but have equally significant positive correlations (French and Stone, 2014). These variables are *creativity*, *intuition*, *extraversion* and *dissociative disorders* (e.g., Czekóová et al., 2018; Rabeyron et al., 2018; Thalbourne and Haraldsson, 1980). However, these variables present unstable statistical behavior because other research has not demonstrated significant correlations (e.g., Maraldi, 2019; Swami et al., 2011). For example, Francis et al. (2010) found no association between extraversion and anomalous phenomena. A more recent study comparing two groups—one comprising those who did not believe in the paranormal or had not had anomalous experiences and another comprising subjects who considered themselves mediums—noted that levels of dissociation were higher for the group of nonbelievers (e.g., Vencio et al., 2018). Similarly, another publication found positive correlations between paranormal beliefs and critical thinking (e.g., Musch and Ehrenberg, 2002). In reality, both analytical and critical thinking traditionally constitute attributes that are antagonistic to belief in the paranormal (e.g., Hergovich and Arendasy, 2005). It does not seem sufficiently rigorous to explain these differences and contradictions as methodological errors or statistical artifacts (Irwin, 2009).

More behavioral approaches focus on the analysis of models related to processes of suggestion (e.g., Gibson and Heap, 1991). This approach has two aspects: on the one hand, some professionals understand suggestion as a process of *alteration of consciousness* that can be varied and manipulated through *hypnosis* techniques (e.g., Hambleton, 2008). On the other hand, another very different approach investigates suggestion as a psychological predisposition or trait that describes the emotional lability of a subject as a result of environmental influences (e.g., Hefferline et al., 1972). Along these lines, suggestibility is the degree to which a subject tends to change—presumably automatically—the typology and intensity of their emotional reactions based on the effects produced by environmental stimuli (e.g., Linton and Sheehan, 1994). This approach describes three types of suggestibility: (1) *interrogative suggestibility*, (2) *primary suggestibility* and (3) *secondary suggestibility*. The first of these refers to the degree of emotional lability induced in the subject exclusively by stimuli derived from social interaction (e.g., Gudjonsson, 1984, 2003). The issue lies with—and this is what determines interrogative suggestibility—how much social persuasion is needed to generate changes in the emotional reactions of the interlocutor subject. High suggestibility is observed when there are low levels of persuasion and high levels of emotional lability (e.g., Polczyk, 2005). Primary suggestibility, in contrast, refers to ideomotor and psychobiological markers that predict the degree of emotional lability. This is in contrast to secondary suggestibility, which refers to the levels of vivid imagination needed to predict such emotional lability (e.g., Eysenck, 2017). Studies that relate levels of suggestion to anomalous experiences take into account altered states of consciousness and secondary suggestibility (e.g., Eysenck and Sargent, 1982). Regarding altered states of consciousness, it should be noted that, with higher levels of alteration, there are more perceived anomalous experiences (e.g., Luke, 2012; Maij et al., 2017; Moreira-Almeida and Lotufo-Neto, 2017). Likewise, the greater the secondary suggestibility, the greater the propensity to develop anomalous phenomena (e.g., Eysenck, 2017; Terhune and Smith, 2006; Wiseman et al., 2003). There are also works with positive correlations that address primary suggestibility and

interrogative suggestibility, but the consistency of their results is questionable (e.g., Brugger and Mohr, 2008; Haraldsson, 1985; Hergovich, 2003). Along these lines, it appears that secondary suggestibility and altered states of consciousness are the most frequently researched types of suggestibility and hence the best predictors of anomalous phenomena (Eysenck and Sargent, 1982).

As mentioned at the outset, the identification of variables concomitant with anomalous phenomena faces a major challenge: in some cases, the existing scientific literature is not entirely clear as to which variables correlate with anomalous phenomena and belief in the paranormal (e.g., Houran and Lange, 2004; Houran et al., 2019). Some of the trends highlighted in the preceding paragraphs have been replicated, with different results, and measurement instruments that effectively assess the correlated factors have not been confirmed in the scientific literature.

Another problem is that of which psychological variables to evaluate and how to measure the correlation between anomalous phenomena and these variables (e.g., Cameron, 2016; Lawrence, 2016). In fact, no conventional clinical questionnaires have been prepared or validated to relate previously known psychological variables to perceived anomalous phenomena (e.g., Pasricha, 2011). One of the criticisms of the instruments most commonly used in clinical diagnosis is that the items examine only pathological symptoms and do not express more attenuated indicators of the evaluated disorders (e.g., Hueso, 2011; Shiah et al., 2014). This suggests that these instruments are valid for samples of patients with an underlying psychopathology, but although they present normative scales for the general nonclinical population, the content of the items does not change categorically and remains qualitatively pathological (e.g., Butcher et al., 1995; Williams and Lally, 2017). Another very obvious difficulty is that the most widely recognized questionnaires in clinical practice conceive of anomalous experiences as exclusively psychopathological symptoms and do not allow a quantitative analysis beyond their pathological condition (e.g., Irwin, 1993, 2009). It should be noted that nonclinical questionnaires exist that do allow the examination of anomalous perceptions and belief in the paranormal at the psychometric level (e.g., Bell et al., 2006; Mason and Claridge, 2006; Stefanis et al., 2002), but they do not take into account possible concomitant psychological variables that allow clinical, psychological and forensic decisions to be made regarding the etiology of the perceived anomalous phenomena (e.g., Irwin, 2009). Practically speaking, if the evidence published does not guarantee the formulation of a conceptually sound explanatory theory, there is a need to examine and replicate – at least from an exploratory standpoint (see Gallagher et al., 1994) – the methodological bases of scientific precedents (e.g., Utts, 2018).

### 1.2. Research objectives

The interests of this research can be summarized by two questions. First, what behavioral variables relate to, explain, and allow us to understand anomalous phenomena? Second, are these variables operative enough to validate a new psychometric test?

Accordingly, the study's objective is to propose and develop an empirical-statistical tool to identify, evaluate, and measure causes that could explain experiences of anomalous phenomena. The study thus created, developed, and examined the validity and reliability of the Multivariable Multiaxial Suggestibility Inventory-2 (MMSI-2), an innovative psychometric instrument that examines anomalous phenomena based on various causal factors cited in the scientific literature.

## 2. Materials & methods

### 2.1. Human ethics

Participants gave their written consent to use their anonymous data for statistical purposes. All of them were over 18 years old and voluntarily collaborated without receiving any financial compensation. The procedures were carried out in compliance with the institutional regulations of the university and the Spanish Government Data Protection Law 15/1999. The *Committee of Ethical Guarantees of Ramon Llull University* reviewed, favorably evaluated and approved this research. Similarly, all procedures adhere to the Helsinki Declaration of 1975, revised in 2013.

### 2.2. Participants

This study used a nonprobabilistic convenience sample and was conducted between 2013 and 2019 (N = 3,224). The sample comprised both men (49.5%) and women (50.5%), all adults (>18; mean = 34.64; SD = 14.791) without a reported psychiatric history (i.e., no previous psychiatric diagnosis and, therefore, no officially recognized mental disorder).

Following the sampling representativity criteria proposed by Muñiz (2003), the subjects came from three different Spanish communities. The groups were: (1) The Community of Madrid (N = 1,102; with mean ages = 34.32; SD = 14.416), (2) The Autonomous Community of Catalonia (N = 1,338; with mean ages = 35.46; SD = 15.549), and (3) The Community of Castilla-La Mancha (N = 784; with mean ages = 33.70; SD = 13.902). Two additional sociodemographic variables were recorded to further characterize the sample. Socioeducational level was evaluated based on the standards proposed in Spain's *National Institute of Statistics* and was classified into five levels: (1) no schooling (0.2%), (2) elementary education (2%), (3) compulsory secondary education or basic vocational training (14.5%), (4) baccalaureate or higher vocational training (40.4%), and (5) university or higher education (40.8%).

Each participant was consulted to determine their self-reported belief in the existence of paranormal phenomena based on three ordinal categories: 0 = 'I do not believe at all' ($29.1\%_{Total}$, $32.8\%_{Madrid}$, $44.2\%_{Catalonia}$, $23\%_{Castilla\text{-}La\ Mancha}$); 1 = 'I question it' ($36.1\%_{Total}$, $34.9\%_{Madrid}$, $38.2\%_{Catalonia}$, $26.9\%_{Castilla\text{-}La\ Mancha}$); and 2 = 'I believe completely' ($34.8\%_{Total}$, $34.6\%_{Madrid}$, $42.7\%_{Catalonia}$, $22.7\%_{Castilla\text{-}La\ Mancha}$). All subjects voluntarily agreed to participate in the study and signed informed consent on paper or digitally.

### 2.3. Procedure

Figure 1 summarizes all phases involved in the psychometric and methodological development of the MMSI-2.

The first phase took place in 2012. A research project was initiated that sought to quantitatively examine perceived anomalous phenomena by relating them to possible psychological history variables. During the first year of research, the necessary bibliographic sources were consulted, and a theoretical framework was designed to inform the drafting of the items.

The second phase occurred in 2013. An initial bank of items (N = 223) was created based on the scientific literature cited above and the behavioral indicators associated with each variable found in the literature. References to possible clinical behaviors were taken from the *DSM-IV-TR* (American Psychiatric Association, 2002) and the *DSM-V* (American Psychiatric Association, 2013). The items were written exclusively by the author of the manuscript. The items consisted of affirmative and negative phrases that addressed anomalous phenomena (e.g., 'I have been able to sense the thoughts of other people') and psychological attributes correlated with anomalous behaviors, including personality traits, clinical trends, anxiety states, and cognitive biases (e.g., 'I allow my emotions to affect my thoughts'). After a review of form and content by the research team at the time, the 223 items were sent to 22 professional psychologists with different specializations (including a specialization in methodology and research). The qualitative evaluation method used was that proposed by Hambleton (1980). The procedure involved assessing the degree of fit between the content of each item and the intended object of study. The judges were asked to specify the rational quality of the fit for each item using a graduated scale from 0 to 5 (where 0 = 'the contents of the item do not conform to the variable they intend to

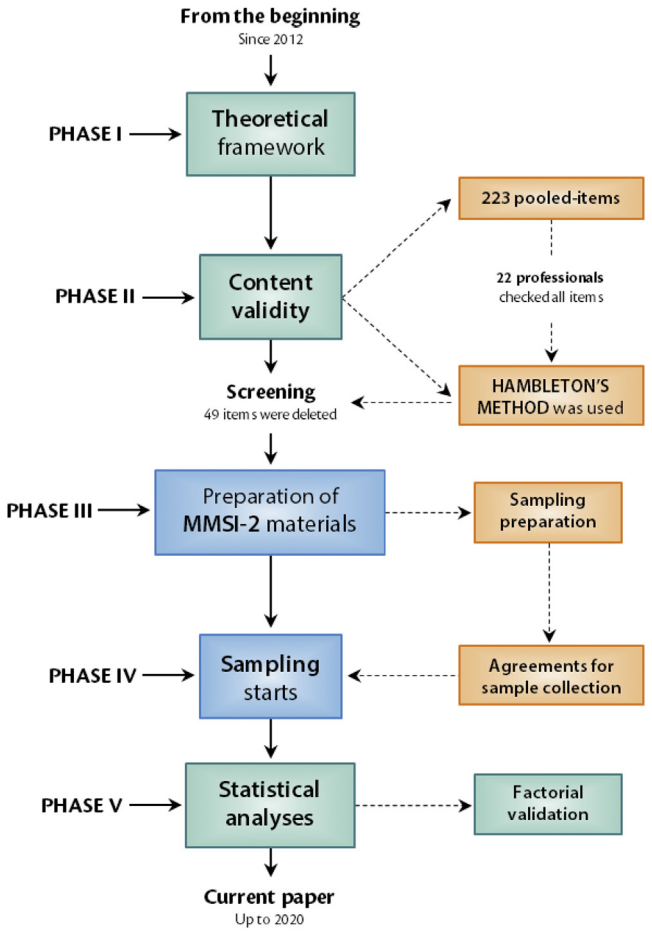


**Figure 1.** Flowchart summarizing the phases in development and creation of the MMSI-2. The contents available in the manuscript are highlighted in **green**, while **blue** contents are available under prior contact with the author and **orange** contents are methodological and logistical decisions.

measure' and 5 = 'the contents of the item are fully in line with the construct'). Note that the MMSI is a multiaxial test because it evaluates multiple psychological constructs. This means that during the content validity process, a single construct did not exist for all items. Each item was compared to the construct to which it referred. The constructs that were initially specified were (1) perceptual alterations, (2) histrionism, (3) schizotypy, (4) paranoia, (5) narcissism, (6) cognitive biases/Barnum effect, (7) social desirability, (8) substance use, (9) anxiety states, (10) suggestibility, (11) predisposition toward fraud, (12) thrill-seeking and (13) the participant's level of collaboration with the study. Childhood trauma, creativity, intuition, extraversion, and dissociative disorders were omitted as elements of the MMSI-2 because of the low statistical consistency of their results when tested among nonclinical samples. Although these constructs were based on the scientific literature cited in the previous section, no previous theoretical model was defined given the inconsistencies of some of the published evidence.

Items that yielded an average value equal to or greater than three points on the scale were included in the final version, while items with a lower average score were omitted from the final version of the test. Of the 223 items, 49 were eliminated, leaving a total of 174. Once the items were drafted and screened, a decision was made regarding how the responses should be coded to facilitate the valid and reliable quantification of scores. Following the recommendations of Kline (1999), a Likert-type scale with a range of response options from 1 to 5 was selected. This system allowed subjects to indicate their level of agreement according to each statement, with 1 = *strongly disagree*, 2 = *disagree*, 3 = *agree*, 4 = *very much agree* and 5 = *strongly agree*. Of the 174 items, 139 were positive statements, and 35 were negative statements. For the items consisting of negative statements, responses were reverse coded: 1 = *strongly agree*, 2 = *very much agree*, 3 = *somewhat agree*, 4 = *disagree*, and 5 = *strongly disagree*. As Price and Mueller (1986) suggest, when a psychometric test is excessively long, it is appropriate to alternate between the two types of items to avoid biases related to acquiescence, neutrality and systematic denial. Thus, the distribution of the 174 items that comprised the experimental version of the test was not entirely random. Rather, two criteria were applied: (1) affirmative and negative items were alternated; and (2) items expressing the level of collaboration with the evaluation were placed at the end of the questionnaire. The items intended to measure the participant's level of collaboration expressed impossible or absurd content that, under normative or nonpathological conditions, would force the subject to be completely at odds with what the sentence says. An example is item 153 in this version: 'Red Riding Hood is a real person.' If the participant has collaborated with the assessment and does not present any psychiatric pathology, they should not agree with item 153. Consequently, responses should fluctuate between values of 1 and 2 or be equal to 1. This criterion was included based on the statistical contributions of Guildford (1954), who originally noted the presence of a progressive decrease in levels of attention as a length of tests increases. This alteration is due to fatigue resulting from the length of the questionnaire, which promotes comprehension errors and random responses (e.g., Schmitt and Stults, 1985). Both errors and random responses could impair the validity of responses to the MMSI-2. One way to identify presumably random responses is by measuring the participant's level of collaboration (e.g., Morey, 2011). As suggested by Butcher et al. (2019), the level of collaboration measured for this purpose assumes that errors in comprehension or random responses will be observed for the later items on the questionnaire and for the items occurring early in the measurement. For this reason, items similar to item 153 were located starting at item 52.

The third phase of the research took place in January and March of 2014. During this period, the test application materials and informed consent forms were prepared, and the sociodemographic variables to be recorded to ensure the heterogeneity and representativeness of the sample were chosen. Based on the contents of the items and the suggestions of the team of experts, it was concluded that the MMSI, despite having a relationship with clinical evaluation, would not serve a diagnostic/psychopathological purpose (other, more suitable instruments already exist for this) and hence, the decision was made to apply it only to subjects without a reported psychiatric history. Collaboration agreements were signed with the psychological centers and companies involved in the collection of the sample (see acknowledgments). The evaluation materials were designed in both pencil-and-paper and digital formats. The format used was left to the discretion of the collaborating groups that were to use the materials.

The fourth phase of research took place between 2014 and 2016. During this phase, data collection began, and an initial matrix was prepared and refined based on the participants' responses. Cases were disregarded if the responses contained missing values or were unclear or had excessive strikethroughs or corrections. A first pilot analysis was conducted in November 2016 to determine the heterogeneity of the sample responses. Coefficients of variation were mainly used to examine the responses and the sociodemographic variables recorded. The results showed no sample biases.

Finally, the fifth phase of research was carried out in 2017 and 2019. In this part of the procedure, the sampling, drafting and debugging of the final data matrices was completed, and the analysis of the collected data began.

### 2.4. Instruments

The instrument used was the 174-item version of the MMSI that remained after the 223 original items were refined; this version was labeled the MMSI-2. The MMSI-2 examines 16 first-order factors:

*Inconsistencies* (K), *Lies* (L), *Fraud* (F), *Simulation* (Si), *Neurasthenia* (Nt), *Substance Use* (Cs), *Suggestibility* (Su), *Thrill-Seeking* (Be), *Histrionism* (Hi), *Schizotypy* (Ez), *Paranoia* (Pa), *Narcissism* (Na), *Anomalous Visual/Auditory Phenomena* (Pva), *Anomalous Tactile Phenomena* (Pt), *Anomalous Olfactory Phenomena* (Po) and *Anomalous Cenesthetic Phenomena* (Pc). The responses are coded using a scale of 1–5, on which the participant must indicate his or her level of agreement with what is stated in each item. It should be kept in mind that some items are scored in reverse; these reverse-scored items are those marked with an asterisk in the factorial solution presented in Tables 1, 2, 3, 4, 5, 6, and 7. The MMSI-2 also contains four higher-order factors: *Clinical Personality Tendencies* (CPT), *Anomalous Perceived Phenomena* (APP), *Incoherent Manipulations* (IMA), and *Altered States of Consciousness* (ASC). The calculation of the macrofactors is obtained from the sum of the direct scores of the corresponding first-order factors for each higher-order factor. The higher the scores for each attribute, the greater the frequency and intensity of those characteristics in the participant.

### 2.5. Data analysis

The statistical design of this research was *multivariable* and was based on the development of both a first-order and higher-order *exploratory factor analysis* (henceforth EFA).

The first-order EFA was applied to the matrix of correlations among the 174 test items. The extraction of the factors was performed using the *unweighted least squares* procedure, which is considered the most robust method because it does not require prior estimation of the commonalities of the items (see Harman and Jones, 1966). To optimize the factorial solution, *direct oblimin* oblique rotation was used (with $\delta = 0$). This decision was based on the theoretical background that shows intercorrelations between the different factors that were extracted (see French and Stone, 2014). According to Pedhazur and Schmelkin (2001), in the social sciences, and especially psychometrics, oblique rotations are recommended because they assume interdependence among latent factors. Moreover, absolute independence among the extracted factors themselves is not an insurable assumption (e.g., Abad et al., 2015). Given the logic of oblique rotations, in this type of solution, unlike with orthogonal rotations, it is not advisable to provide the explained variance for each extracted first-order factor since each explained variance would be overlapping (and hence biased) by the intercorrelations among the factors (e.g., Gorsuch, 1983). Consequently, we noted only the corresponding original eigenvalues for each factor and the total explained variance of the EFA, which does not consist of the summation of the explained variances of each factor. The total number of factors was established based on the *parallel analysis method* rather than the classic Guttman-Kaiser method, which is less accurate for the retention of factors (e.g., Reise et al., 2000). Following the recommendations of Mulaik (2018), the saturation matrix offered and analyzed in this report corresponds to the *pattern matrix*, which is much easier to interpret than the *structure matrix*. Likewise, this matrix shows the ordered saturations greater than or equal to 0.4. Following Thompson (2004), if an item had a saturation of >0.4 on two or more factors, it was removed from the test. The theoretical classification of the extracted factors was carried out based on the recommendations of Borsboom et al. (2004), who proposed the analysis of the contents of the items grouped within the same factor as a criterion. Subsequently, according to the common conceptual characteristics of each group of items, the corresponding labels for each factor were decided. For these analyses, the statistical programs JAMOVI® and MPLUS 5.2 were used, which allow the calculation of the matrix of polychoric correlations and the use of the parallel analysis method.

For the application of the second-order EFA, the correlation matrix for the primary factors extracted in the previous EFA was analyzed. On this occasion, the correlation matrix was not polychoric, since the scores for each factor represent quantitative interval values. Thus, the linear correlations matrix was determined for the 16 variables. The criterion for the extraction of the new factors was the same as that used in the first-order EFA. However, as Gorsuch (1983) states, the rotation of the axes was carried out using the *promax* method ($\kappa = 1$). This rotation initially combines orthogonal rotations to complete the application of oblique rotations of the axes (see Martínez-Arias et al., 2006). Regarding second-order factors, there is a possibility that they are less correlated with each other, resulting in more independent behavior compared with the primary factors. This does not mean that the second-order factors are completely independent of each other, and therefore, it would not make sense *a priori* to apply a purely orthogonal rotation. In this EFA, the Guttman-Kaiser criterion was used to determine the number of second-order factors to retain. Taking into account the logic of O'Connor (2000), the parallel analysis method was rejected because the eigenvalue of the first factor excluded by the classical method (which was factor 5) was substantially removed from 1 ($\lambda_5 = 0.161$). This indicates that the factors extracted from factor number 4 were irrelevant due to their low variability (see also Mulaik, 2018). Therefore, in this context, it would not make sense to apply parallel analysis to determine whether it was necessary to include another factor. For the analysis of the saturations and the theoretical categorization of the secondary factors, the same procedures were used as in the first-order EFA. For the latter EFA, SPSS 25 was used.

Regarding the reliability of the test, for the 16 first-order factors, the ordinal transformation of *Cronbach's alpha* coefficient was chosen based on the contributions of McDonald (1999):

$$\alpha = \frac{n}{n-1}\left[\frac{n(\bar{\lambda})^2 - \bar{\lambda}^2}{n(\bar{\lambda})^2 + (\mu^2)}\right] \quad [1]$$

where

$\bar{\lambda}$ is the arithmetic mean of the factorial loads,

$\bar{\lambda}^2$ is the square arithmetic mean of the factorial loads,

and

$\mu^2$ is the arithmetic mean of the single variance.

*Cronbach's alpha* coefficient was used to calculate the reliability of the macrofactors since the scores of the 16 factors are quantitative. For these calculations, Microsoft Excel spreadsheets and the program SPSS 25 were used.

Finally, gender-differentiated general scales were created based on the *standard derived scores* (PT or simply T) and the sample *percentiles* (abbreviated as Pcs).

## 3. Results

### 3.1. First-order exploratory factor analysis

Prior to the application of the EFA, there was a need to check whether the items were sufficiently correlated with each other. For this purpose, the Kaiser-Meyer-Olkin (KMO) sample adequacy test was used. Bartlett's test of sphericity was not applied based on the transformation of the *chi square* from the determinant of the polychoric correlation matrix because this statistic is highly sensitive to sample size (e.g., Ruiz, 2000). The KMO index yielded a favorable result regarding the use of the EFA technique (KMO = 0.941). The results of the factorial solution by means of *direct oblimin* rotation are presented in Tables 1, 2, 3, 4, 5, 6, and 7. The sedimentation graph is also presented, with the simulated average eigenvalues for 100 random samples (representing the parallel analysis method) (See Figure 2). As shown, crossing the two curves retained 16 primary factors. To illustrate and more easily indicate the crossing point, the graph is presented only for the first 30 factors (which were the most significant for this statistical decision).

The solution extracted a total of 16 factors that together explained 92.84% of the variance. Factor 1 consisted of 11 items that expressed visual and auditory perceptual alterations. This factor was classified as *Anomalous Visual/Auditory Phenomena* (Pva) and obtained an eigenvalue of 46.472. Factor 2 included 6 items that reflected tendencies related to

**Table 1.** First-order exploratory factor analysis with oblimin rotation.

| Items | Extracted factors | | |
|---|---|---|---|
| | 1 | 2 | 3 |
| | Pva | Si | L |
| Pva 39 | 0.653 | | |
| Pva 47 | 0.651 | | |
| Pva 148 | 0.648 | | |
| Pva 111 | 0.646 | | |
| Pva 25 | 0.645 | | |
| Pva 1 | 0.642 | | |
| Pva 130 | 0.641 | | |
| Pva 96 | 0.634 | | |
| Pva 117 | 0.632 | | |
| Pva 84 | 0.629 | | |
| Pva 143 | 0.593 | | |
| Si 67 | | 0.895 | |
| Si 144 | | 0.886 | |
| Si 61 | | 0.885 | |
| Si 14 | | 0.878 | |
| Si 38 | | 0.858 | |
| Si 114 | | 0.858 | |
| L 172* | | | -0.946 |
| L 42* | | | -0.922 |
| L 93* | | | -0.912 |
| L 164* | | | -0.908 |
| L 36* | | | -0.904 |
| L 106* | | | -0.904 |
| L 63 | | | 0.903 |
| L 21* | | | -0.903 |
| L 136 | | | 0.899 |
| L 11* | | | -0.897 |
| L 168* | | | -0.894 |
| L 160* | | | -0.892 |
| Eigenvalue | 46.472 | 28.778 | 22.043 |

Note: This table has several extensions included in the following tables. Factor loadings under 0.4 were eliminated (N = 3,224). *Pva= Anomalous Visual/Auditory Phenomena; Si= Simulation; L= Lies*. *Items are scored in reverse.

**Table 2.** First-order exploratory factor analysis with oblimin rotation.

| Items | Extracted factors | | |
|---|---|---|---|
| | 3 | 4 | 5 |
| | L | Nt | Hi |
| L 131 | 0.892 | | |
| L 78 | 0.891 | | |
| L 29 | 0.882 | | |
| L 7 | 0.879 | | |
| L 15 | 0.876 | | |
| L 86 | 0.874 | | |
| L 150* | -0.870 | | |
| L 70 | 0.869 | | |
| L 119 | 0.860 | | |
| L 163* | -0.819 | | |
| L 49* | -0.810 | | |
| Nt 108 | | 0.925 | |
| Nt 74 | | 0.925 | |
| Nt 76 | | 0.924 | |
| Nt 115* | | -0.923 | |

**Table 2** (*continued*)

| Items | Extracted factors | | |
|---|---|---|---|
| | 3 | 4 | 5 |
| | L | Nt | Hi |
| Nt 100 | | 0.920 | |
| Nt 161 | | 0.919 | |
| Nt 118* | | -0.918 | |
| Nt 43 | | 0.914 | |
| Nt 166* | | -0.908 | |
| Nt 5 | | 0.900 | |
| Nt 123 | | 0.898 | |
| Nt 155* | | -0.892 | |
| Nt 56 | | 0.880 | |
| Nt 165 | | 0.876 | |
| Nt 50 | | 0.869 | |
| Hi 122 | | | 0.932 |
| Hi 158 | | | 0.929 |
| Hi 37 | | | 0.926 |
| Eigenvalue | 22.043 | 14.819 | 10.622 |

Note: Factor loadings under 0.4 were eliminated (N = 3,224). *L= Lies; Nt= Neurasthenia; Hi= Histrionism*. *Items are scored in reverse.

**Table 3.** First-order exploratory factor analysis with oblimin rotation.

| Items | Extracted factors | | |
|---|---|---|---|
| | 5 | 6 | 7 |
| | Hi | K | F |
| Hi 8 | 0.924 | | |
| Hi 94 | 0.920 | | |
| Hi 73 | 0.917 | | |
| Hi 169 | 0.915 | | |
| Hi 44 | 0.912 | | |
| Hi 171 | 0.897 | | |
| Hi 88 | 0.896 | | |
| Hi 121 | 0.888 | | |
| Hi 137 | 0.881 | | |
| Hi 129 | 0.874 | | |
| K 132 | | 0.895 | |
| K 153 | | 0.892 | |
| K 75 | | 0.875 | |
| K 154* | | -0.871 | |
| K 52* | | -0.862 | |
| K 99 | | 0.858 | |
| K 128* | | -0.855 | |
| K 127 | | 0.850 | |
| K 140* | | -0.834 | |
| K 87* | | -0.832 | |
| K 147 | | 0.795 | |
| K 62* | | -0.670 | |
| F 101 | | | 0.872 |
| F 53 | | | 0.868 |
| F 141 | | | 0.867 |
| F 107 | | | 0.867 |
| F 157* | | | -0.867 |
| F 23* | | | -0.866 |
| Eigenvalue | 10.622 | 7.857 | 6.415 |

Note: Factor loadings under 0.4 were eliminated (N = 3,224). *Hi= Histrionism; K= Inconsistencies; F= Fraud*. *Items are scored in reverse.

**Table 4.** First-order exploratory factor analysis with oblimin rotation.

| Items | Extracted factors | | |
|---|---|---|---|
| | 7 | 8 | 9 |
| | F | Cs | Su |
| F 133* | -0.866 | | |
| F 146 | 0.866 | | |
| F 9* | -0.865 | | |
| F 72* | -0.864 | | |
| F 30* | -0.864 | | |
| F 81* | -0.863 | | |
| F 170 | 0.862 | | |
| F 120 | 0.860 | | |
| F 71* | -0.858 | | |
| F 6 | 0.856 | | |
| F 167* | -0.848 | | |
| F 98* | -0.844 | | |
| F 174* | -0.841 | | |
| F 112* | -0.779 | | |
| Cs 32 | | 0.781 | |
| Cs 57 | | 0.745 | |
| Cs 3 | | 0.735 | |
| Cs 46 | | 0.689 | |
| Cs 90 | | 0.678 | |
| Cs 24 | | 0.667 | |
| Cs 65 | | 0.442 | |
| Su 4 | | | 0.988 |
| Su 22 | | | 0.985 |
| Su 41 | | | 0.982 |
| Su 109 | | | 0.980 |
| Su 80 | | | 0.975 |
| Su 95 | | | 0.955 |
| Su 51 | | | 0.946 |
| Eigenvalue | 6.415 | 5.586 | 4.681 |

Note: Factor loadings under 0.4 were eliminated (N = 3,224). *F= Fraud; Cs= Substance Use; Su= Suggestibility*. *Items are scored in reverse.

**Table 5.** First-order exploratory factor analysis with oblimin rotation.

| Items | Extracted factors | | |
|---|---|---|---|
| | 10 | 11 | 12 |
| | Pa | Pt | Po |
| Pa 55 | 0.910 | | |
| Pa 110 | 0.908 | | |
| Pa 138 | 0.906 | | |
| Pa 45 | 0.905 | | |
| Pa 64 | 0.899 | | |
| Pa 10 | 0.893 | | |
| Pa 26 | 0.884 | | |
| Pa 116 | 0.879 | | |
| Pa 40 | 0.875 | | |
| Pa 142 | 0.865 | | |
| Pt 18 | | 0.873 | |
| Pt 85 | | 0.856 | |
| Pt 13 | | 0.852 | |
| Pt 152 | | 0.851 | |
| Pt 34 | | 0.838 | |
| Pt 134 | | 0.833 | |
| Pt 54 | | 0.811 | |

**Table 5** (*continued*)

| Items | Extracted factors | | |
|---|---|---|---|
| | 10 | 11 | 12 |
| | Pa | Pt | Po |
| Po 16 | | | 0.845 |
| Po 58 | | | 0.843 |
| Po 31 | | | 0.835 |
| Po 48 | | | 0.832 |
| Po 79 | | | 0.818 |
| Po 77 | | | 0.818 |
| Po 89 | | | 0.805 |
| Eigenvalue | 3.639 | 2.973 | 2.294 |

Note: Factor loadings under 0.4 were eliminated (N = 3,224). *Pa= Paranoia; Pt= Anomalous Tactile Phenomena; Po= Anomalous Olfactory Phenomena.*

**Table 6.** First-order exploratory factor analysis with oblimin rotation.

| Items | Extracted factors | |
|---|---|---|
| | 13 | 14 |
| | Na | Pc |
| Na 12 | 0.744 | |
| Na 162 | 0.741 | |
| Na 20 | 0.740 | |
| Na 145 | 0.739 | |
| Na 126 | 0.738 | |
| Na 159 | 0.738 | |
| Na 149 | 0.737 | |
| Na 104 | 0.734 | |
| Na 27 | 0.731 | |
| Na 68 | 0.730 | |
| Na 60 | 0.729 | |
| Na 103 | 0.727 | |
| Pc 91 | | 0.740 |
| Pc 66 | | 0.739 |
| Pc 33 | | 0.730 |
| Pc 97 | | 0.724 |
| Pc 173 | | 0.713 |
| Pc 59 | | 0.712 |
| Pc 83 | | 0.704 |
| Pc 2 | | 0.693 |
| Pc 105 | | 0.664 |
| Eigenvalue | 1.845 | 1.413 |

Note: Factor loadings under 0.4 were eliminated (N = 3,224). *Na= Narcissism; Pc= Anomalous Cenesthetic Phenomena.*

the Barnum effect. It obtained an eigenvalue of 28.778 and was classified as *Simulation* (Si). Factor 3 included 23 items that coincide with behaviors typical of social desirability. It yielded an eigenvalue equal to 22.043 and was classified as *Lies* (L). Factor 4 described behaviors associated with states of anxiety and acute fatigue. It included 15 items that demonstrated an eigenvalue equal to 14.819 and was classified as *Neurasthenia* (Nt). Factor 5 was classified as *Histrionism* (Hi) as it included 13 items whose behaviors may be associated with attenuated symptoms typical of histrionic personality disorder. It had an eigenvalue of 10.622. Factor 6 contained 12 items and demonstrated an eigenvalue of 7.857. These items had two types of content in common. On the one hand, some items described beliefs that are present in individuals without prior psychopathological diagnosis (e.g., item K-154: 'I believe I deserve to be respected'). On the other hand, there were items that contained absurd and impossible content (e.g., Item K-153: 'Red Riding Hood is a real

**Table 7.** First-order exploratory factor analysis with oblimin rotation.

| Items | Extracted factors | |
|---|---|---|
| | 15 | 16 |
| | Be | Ez |
| Be 92 | 0.914 | |
| Be 124 | 0.728 | |
| Be 82 | 0.722 | |
| Be 17 | 0.563 | |
| Ez 28 | | 0.679 |
| Ez 135 | | 0.678 |
| Ez 102 | | 0.677 |
| Ez 69 | | 0.677 |
| Ez 35 | | 0.675 |
| Ez 113 | | 0.673 |
| Ez 151 | | 0.672 |
| Ez 156 | | 0.672 |
| Ez 19 | | 0.671 |
| Ez 139 | | 0.666 |
| Ez 125 | | 0.665 |
| Eigenvalue | 1.156 | 0.961 |

Note: Factor loadings under 0.4 were eliminated (N = 3,224). *Be= Thrill-Seeking; Ez= Schizotypy.*

person') and were closely related to the participant's degree of collaboration and the identification of potential inconsistencies in each subject's responses. For this reason, Factor 6 was classified as *Inconsistencies* (K). Factor 7 had an eigenvalue of 6.415 and included 20 items. It described behaviors that indicate tendencies involving low morals, manipulation, and deviousness (e.g., Item F-9: 'If my best friend committed fraud, I would not report it'). Thus, it was classified as *Fraud* (F). Factor 8 included seven items related to substance use and abuse. It had an eigenvalue of 5.586 and was categorized as *Substance Use* (Cs). Factor 9 showed an eigenvalue of 4.681 and comprised seven behaviors associated with emotional lability and permeability resulting from environmental influences. Thus, this variable was classified as *Suggestibility* (Su). Factor 10 included 10 items related to distrust, skepticism, and certain attenuated symptoms of paranoid personality disorder. It had an eigenvalue of 3.639 and was classified as *Paranoia* (Pa). Factor 11 included 7 items describing perceptual distortions of a tactile nature. It obtained an eigenvalue of 2.973 and was classified as *Anomalous Tactile Phenomena* (Pt). Factor 12 had an eigenvalue of 2.294 and included 7 items related to perceptual distortions of an olfactory nature. For this reason, it was classified as *Anomalous Olfactory Phenomena* (Po). Factor 13 comprised 12 items expressing attenuated symptoms characteristic of narcissistic personality disorder. It had an eigenvalue of 1.845 and was categorized as *Narcissism* (Na). Factor 14 comprised 9 items that allude to hallucinatory experiences related to depersonalization and derealization. It had an eigenvalue of 1.413 and was classified as *Anomalous Cenesthetic Phenomena* (Pc). Factor 15 was classified as *Thrill-Seeking* (Be) and included just four items with an eigenvalue of 1.156. The final first-order factor included 11 items associated with social withdrawal, magical thinking and isolation. These traits are characteristic of schizotypic personality disorder and were also expressed in a subtle or attenuated manner; hence, this factor was classified as *Schizotypy* (Ez). Its eigenvalue was 0.961.

The descriptive statistics for this first EFA are shown in Table 8, which also includes the descriptive statistics for the higher order factors and the *alpha* reliability coefficients, which will be discussed in the following paragraphs.

### 3.2. Second-order exploratory factor analysis

Once the 16 primary factors were defined, a second-order EFA was applied to empirically justify the macrofactors. A favorable KMO was obtained for the use of a higher-order EFA (KMO = 0.837). This analysis

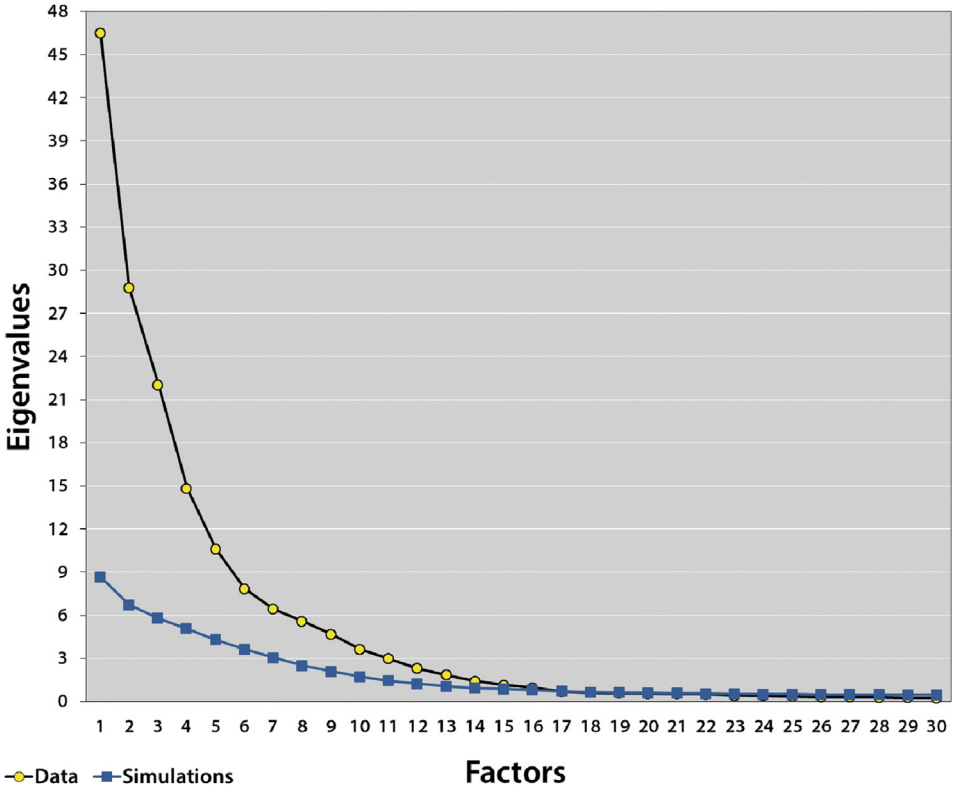


**Figure 2.** Scree-plot of *parallel analysis* of the first-order EFA.

**Table 8.** Descriptive statistics of MMSI-2 scales and alpha coefficients (N = 3,224).

| F | Minimum and Maximum direct scores | M | SD | Asymmetry (Error = 0.043) | Kurtosis (Error = 0.086) | Alphas |
|---|---|---|---|---|---|---|
| K | 12–60 | 18.13 | 5.758 | 3.350 | 16.129 | 0.973* |
| L | 23–115 | 48.64 | 20.365 | 1.289 | 1.007 | 0.994* |
| F | 20–100 | 42.76 | 18.407 | 1.130 | 0.603 | 0.993* |
| Si | 6–30 | 16.05 | 4.202 | 0.577 | 0.577 | 0.996* |
| Nt | 15–75 | 33.34 | 13.755 | 1.097 | 0.397 | 0.997* |
| Cs | 7–35 | 13.95 | 5.659 | 1.435 | 2.023 | 0.878* |
| Su | 7–35 | 18.57 | 5.517 | 0.124 | -0.157 | 0.995* |
| Be | 4–20 | 11.64 | 3.366 | 0.224 | -0.435 | 0.865* |
| Pva | 11–55 | 20.01 | 8.714 | 1.679 | 2.691 | 0.996* |
| Pt | 7–35 | 14.87 | 5.915 | 1.420 | 1.908 | 0.988* |
| Po | 7–35 | 15.68 | 5.813 | 1.082 | 0.863 | 0.996* |
| Pc | 9–45 | 19.09 | 7.390 | 1.276 | 1.431 | 0.994* |
| Hi | 13–65 | 38.22 | 8.661 | 0.179 | 0.434 | 0.993* |
| Ez | 11–55 | 32.00 | 7.805 | 0.194 | 0.347 | 0.997* |
| Pa | 10–50 | 30.05 | 8.609 | -0.318 | -0.180 | 0.991* |
| Na | 12–60 | 36.53 | 8.965 | -0.248 | 0.093 | 0.997* |
| IMA | 61–305 | 125.63 | 48.172 | 1.309 | 1.468 | 0.870** |
| APP | 34–170 | 69.65 | 27.743 | 1.397 | 1.764 | 0.988** |
| ASC | 22–110 | 47.29 | 19.358 | 1.186 | 0.810 | 0.819** |
| CPT | 57–285 | 167.00 | 42.481 | -0.048 | -0.075 | 0.979** |

Note: *F= Factors; M = Means; SD = Standard Deviations; * = McDonald's alpha; ** = Cronbach's alpha; CPT = Clinical Personality Tendencies; APP = Anomalous Perceived Phenomena; IMA = Incoherent Manipulations; ASC = Altered States of Consciousness.*

also did not apply Bartlett's sphericity test for the same reason that it was not used in the first-order EFA. Tables 9 and 10 show the correlation matrix for the 16 primary factors on which the adequacy of EFA is based. Table 11 shows the factor loads of the second-order EFA with the axes rotated. The descriptive statistics for the macrofactors are provided in Table 8.

The Guttman-Kaiser method retained four factors that in total explained 97.737% of the model's variance. The first factor had an eigenvalue of 8.879, included the Na, Pa, Ez, Hi, Su, and Be scales, and was classified as *Clinical Personality Tendencies* (CPT). The second factor had an eigenvalue of 3.857, included the perceptual scales Po, Pc, Pt, and Pva, and was classified as *Anomalous Perceived Phenomena* (APP). The third factor had an eigenvalue of 1.714, included the Si, F, L, and K scales,

**Table 10.** Lineal correlations between MMSI-2 scales.

| Items | Pva | Pt | Po | Pc | Hi | Ez | Pa | Na |
|---|---|---|---|---|---|---|---|---|
| K | | | | | | | | |
| L | | | | | | | | |
| F | | | | | | | | |
| Si | | | | | | | | |
| Nt | | | | | | | | |
| Cs | | | | | | | | |
| Su | | | | | | | | |
| Be | | | | | | | | |
| Pva | - | | | | | | | |
| Pt | 0.990 | - | | | | | | |
| Po | 0.985 | 0.990 | - | | | | | |
| Pc | 0.993 | 0.994 | 0.996 | - | | | | |
| Hi | -0.196 | -0.115 | -0.065 | -0.104 | - | | | |
| Ez | -0.198 | -0.118 | -0.067 | -0.107 | 0.998 | - | | |
| Pa | -0.206 | -0.124 | -0.070 | -0.110 | 0.980 | 0.982 | - | |
| Na | -0.210 | -0.127 | -0.074 | -0.114 | 0.991 | 0.992 | 0.994 | - |

**Table 11.** Second-order exploratory factor analysis.

| Items | Extracted factors | | | |
|---|---|---|---|---|
| | 1 | 2 | 3 | 4 |
| | CPT | APP | IMA | ASC |
| Ez | 0.924 | | | |
| Hi | 0.923 | | | |
| Na | 0.918 | | | |
| Pa | 0.905 | | | |
| Be | 0.899 | | | |
| Su | 0.894 | | | |
| Pc | | 0.998 | | |
| Po | | 0.997 | | |
| Pt | | 0.993 | | |
| Pva | | 0.987 | | |
| L | | | 0.915 | |
| F | | | 0.913 | |
| Si | | | 0.861 | |
| K | | | 0.813 | |
| Cs | | | | 0.961 |
| Nt | | | | 0.927 |
| Eigenvalue | 8.879 | 3.857 | 1.714 | 1.188 |

Note: Factor loadings under 0.4 were eliminated (N = 3,224).

**Table 9.** Lineal correlations between MMSI-2 scales.

| Items | K | L | F | Si | Nt | Cs | Su | Be |
|---|---|---|---|---|---|---|---|---|
| K | - | | | | | | | |
| L | 0.897 | - | | | | | | |
| F | 0.889 | 0.998 | - | | | | | |
| Si | 0.888 | 0.962 | 0.970 | - | | | | |
| Nt | -0.313 | -0.319 | -0.320 | -0.353 | - | | | |
| Cs | -0.288 | -0.282 | -0.283 | -0.310 | 0.986 | - | | |
| Su | -0.600 | -0.649 | -0.653 | -0.692 | 0.541 | 0.466 | - | |
| Be | -0.603 | -0.655 | -0.661 | -0.710 | 0.511 | 0.433 | 0.991 | - |
| Pva | 0.181 | 0.185 | 0.185 | 0.187 | -0.085 | -0.078 | -0.193 | -0.187 |
| Pt | 0.112 | 0.121 | 0.121 | 0.121 | -0.047 | -0.044 | -0.114 | -0.109 |
| Po | 0.079 | 0.089 | 0.090 | 0.089 | 0.003 | 0.006 | -0.063 | -0.059 |
| Pc | 0.111 | 0.118 | 0.118 | 0.120 | -0.026 | -0.022 | -0.103 | -0.098 |
| Hi | -0.629 | -0.656 | -0.658 | -0.712 | 0.497 | 0.423 | 0.950 | 0.956 |
| Ez | -0.628 | -0.657 | -0.661 | -0.715 | 0.493 | 0.420 | 0.950 | 0.957 |
| Pa | -0.630 | -0.671 | -0.671 | -0.705 | 0.529 | 0.466 | 0.954 | 0.949 |
| Na | -0.643 | -0.669 | -0.670 | -0.710 | 0.511 | 0.445 | 0.955 | 0.955 |

**Table 12.** T Scores and Percentiles of MMSI-2 scales (men).

| Pc | Scales | | | | | | | | T |
|---|---|---|---|---|---|---|---|---|---|
| | K | L | F | Si | Nt | Cs | Su | Be | |
| 99 | 42–60 | 110–115 | 96–100 | 28–30 | 72–75 | 33–35 | 33–35 | 20 | 73 |
| 98 | 37–41 | 106–109 | 93–95 | 27 | 69–71 | 31–32 | 31–32 | 19 | 71 |
| 97 | 33–36 | 102–105 | 89–92 | 25–26 | 67–68 | 30 | 29–30 | 18 | 69 |
| 96 | 30–32 | 98–101 | 86–88 | - | 65–66 | 28–29 | 28 | - | 68 |
| 95 | 29 | 94–97 | 83–85 | 23–24 | 64 | 27 | - | - | 66 |
| 90 | 22–28 | 81–93 | 71–82 | 21–22 | 55–63 | 22–26 | 25–27 | 16–17 | 63 |
| 85 | 21 | 71–80 | 63–70 | 20 | 49–54 | 19–21 | 24 | 15 | 60 |
| 80 | 20 | 63–70 | 57–62 | 19 | 45–48 | 17–18 | 23 | - | 58 |
| 75 | 19 | 58–62 | 52–56 | 18 | 41–44 | 16 | 22 | 14 | 57 |
| 70 | - | 52–57 | 48–51 | - | 38–40 | 15 | - | 13 | 56 |
| 65 | 18 | 49–51 | 45–47 | 17 | 34–37 | - | 21 | - | 54 |
| 60 | - | 46–48 | 42–44 | - | 32–33 | 14 | 20 | 12 | 53 |
| 55 | 17 | 44–45 | 40–41 | 16 | 30–31 | 13 | 19 | - | 51 |
| 50 | - | 41–43 | 36–39 | - | 28–29 | - | - | - | 50 |
| 45 | - | 39–40 | 34–35 | 15 | 27 | 12 | 18 | 11 | 49 |
| 40 | 16 | 38 | 33 | - | 26 | - | 17 | - | 47 |
| 35 | - | 37 | 31–32 | 14 | 25 | 11 | - | 10 | 46 |
| 30 | - | 35–36 | 30 | - | 24 | - | 16 | - | 44 |
| 25 | 15 | 34 | 28–29 | 13 | 23 | 10 | 15 | 9 | 43 |
| 20 | - | 33 | 27 | 12 | 22 | 9 | 13–14 | - | 42 |
| 15 | 14 | 31–32 | 25–26 | - | 21 | - | 12 | 8 | 40 |
| 10 | 13 | 28–30 | 24 | 11 | 19–20 | 8 | 10–11 | 7 | 37 |
| 5 | - | 27 | 23 | 10 | 18 | 7 | 9 | 6 | 34 |
| 4 | 12 | 26 | 22 | - | - | - | - | - | 32 |
| 3 | - | 25 | - | 9 | 17 | - | 8 | - | 31 |
| 2 | - | 24 | 21 | - | - | - | - | - | 29 |
| 1 | - | 23 | 20 | 6–8 | 15–16 | - | 7 | 4–5 | 27 |
| N | 1,596 | 1,596 | 1,596 | 1,596 | 1,596 | 1,596 | 1,596 | 1,596 | N |
| Mean | 18.15 | 48.61 | 42.73 | 16.05 | 33.41 | 13.97 | 18.57 | 11.64 | Mean |
| SD | 5.80 | 20.32 | 18.36 | 4.19 | 13.78 | 5.67 | 5.53 | 3.37 | SD |

Note: *Pc= Percentiles; T= T Scores; N= sample; M= Means; SD= Standard Deviations.*

and was classified as *Incoherent Manipulations* (IMA). The final factor had an eigenvalue of 1.188, included the Cs and Nt scales, and was classified as *Altered States of Consciousness* (ASC).

### 3.3. Reliability and scaling of direct scores

The reliability rates of the primary factors and macrofactors are shown in Table 8. According to the classification by George and Mallery (2003), all of them were satisfactory and excellent (>0.8). These results suggested that no item or scale should be deleted from the test to optimize its internal consistency.

Following the recommendations of Muñiz (2003), scaling of the MMSI-2 was carried out based on two normative groups differentiated by gender. The percentiles (Pc) and standard derived scores (or simply T scores) were used. Tables 12, 13, 14, 15, and 16 present the standardized scales with corresponding direct scores for both PT and Pc.

## 4. Discussion

The initial objective of this research was to examine the psychometric properties of the MMSI-2. A secondary objective was to analyze the factorial covariation among indicators that measure anomalous

**Table 13.** T Scores and Percentiles of MMSI-2 scales (men).

| Pc | Scales | | | | | | | | T |
|---|---|---|---|---|---|---|---|---|---|
| | Pva | Pt | Po | Pc | Hi | Ez | Pa | Na | |
| 99 | 51–55 | 34–35 | 33–35 | 43–45 | 62–65 | 53–55 | 49–50 | 58–60 | 73 |
| 98 | 47–50 | 32–33 | 31–32 | 41–42 | 59–61 | 50–52 | 47–48 | 55–57 | 71 |
| 97 | 44–46 | 31 | 30 | 38–40 | 56–58 | 49 | 46 | 53–54 | 69 |
| 96 | 41–43 | 30 | 29 | 37 | 54–55 | 47–48 | 45 | 52 | 68 |
| 95 | 39–40 | 29 | 28 | 35–36 | 53 | 46 | 44 | 51 | 66 |
| 90 | 33–38 | 24–28 | 24–27 | 30–34 | 49–52 | 42–45 | 40–43 | 47–50 | 63 |
| 85 | 28–32 | 20–23 | 21–23 | 26–29 | 47–48 | 39–41 | 37–39 | 45–46 | 60 |
| 80 | 25–27 | 18–19 | 20 | 24–25 | 45–46 | 38 | 36 | 43–44 | 58 |

(*continued on next page*)

**Table 13** (*continued*)

| Pc | Scales | | | | | | | | T |
|---|---|---|---|---|---|---|---|---|---|
| | Pva | Pt | Po | Pc | Hi | Ez | Pa | Na | |
| 75 | 23–24 | 17 | 18–19 | 22–23 | 43–44 | 36–37 | 35 | 42 | 57 |
| 70 | 21–22 | 16 | 17 | 21 | 42 | 35 | 34 | 41 | 56 |
| 65 | 20 | 15 | 16 | 20 | 41 | 34 | - | 40 | 54 |
| 60 | 19 | 14 | - | 19 | 40 | 33 | 33 | 39 | 53 |
| 55 | 18 | - | 15 | 18 | 39 | - | - | 38 | 51 |
| 50 | 17 | - | 14 | 17 | 38 | 32 | 32 | 36–37 | 50 |
| 45 | - | 13 | - | 16 | 37 | 31 | 31 | - | 49 |
| 40 | 16 | - | 13 | - | 36 | 30 | 29–30 | 35 | 47 |
| 35 | 15 | 12 | - | 15 | 35 | 29 | 28 | 34 | 46 |
| 30 | - | - | 12 | - | 34 | 28 | 26–27 | 32–33 | 44 |
| 25 | 14 | 11 | - | 14 | 32–33 | 27 | 23–25 | 30–31 | 43 |
| 20 | 13 | 10 | 11 | 13 | 31 | 25–26 | 21–22 | 28–29 | 42 |
| 15 | - | 9 | 10 | 12 | 29–30 | 23–24 | 18–20 | 25–27 | 40 |
| 10 | 12 | - | 9 | 11 | 25–28 | 20–22 | 15–17 | 22–24 | 37 |
| 5 | - | 8 | 8 | 10 | 24 | 19 | 14 | 20–21 | 34 |
| 4 | 11 | - | - | - | 23 | 18 | 13 | 19 | 32 |
| 3 | - | 7 | - | - | 21–22 | 17 | 12 | 17–18 | 31 |
| 2 | - | - | - | 9 | 18–20 | 15–16 | 11 | 15–16 | 29 |
| 1 | - | - | 7 | - | 13–17 | 11–14 | 10 | 12–14 | 27 |
| N | 1,596 | 1,596 | 1,596 | 1,596 | 1,596 | 1,596 | 1,596 | 1,596 | N |
| Mean | 19.96 | 14.84 | 15.65 | 19.05 | 38.22 | 32.00 | 30.05 | 36.53 | Mean |
| SD | 8.65 | 5.88 | 5.78 | 7.35 | 8.66 | 7.81 | 8.61 | 8.97 | SD |

Note: *Pc= Percentiles; T= T Scores; N= sample; M= Means; SD= Standard Deviations.*

**Table 14.** T Scores and Percentiles of MMSI-2 scales (women).

| Pc | Scales | | | | | | | | T |
|---|---|---|---|---|---|---|---|---|---|
| | K | L | F | Si | Nt | Cs | Su | Be | |
| 99 | 50–60 | 110–115 | 97–100 | 29–30 | 72–75 | 33–35 | 33–35 | 20 | 73 |
| 98 | 39–49 | 106–109 | 93–96 | 27–28 | 69–71 | 31–32 | 31–32 | 19 | 71 |
| 97 | 33–38 | 102–105 | 89–92 | 25–26 | 67–68 | 29–30 | 29–30 | 18 | 69 |
| 96 | 30–32 | 98–101 | 86–88 | - | 65–66 | 28 | 28 | - | 68 |
| 95 | 29 | 94–97 | 83–85 | 24 | 64 | 27 | - | - | 66 |
| 90 | 22–28 | 81–93 | 71–82 | 22–23 | 55–63 | 22–26 | 25–27 | 16–17 | 63 |
| 85 | 21 | 71–80 | 63–70 | 20–21 | 49–54 | 19–21 | 24 | 15 | 60 |
| 80 | 20 | 63–70 | 57–62 | 19 | 45–48 | 17–18 | 23 | - | 58 |
| 75 | 19 | 58–62 | 52–56 | - | 41–44 | 16 | 22 | 14 | 57 |
| 70 | - | 53–57 | 48–51 | 18 | 37–40 | 15 | - | 13 | 56 |
| 65 | 18 | 49–52 | 45–47 | 17 | 34–36 | - | 21 | - | 54 |
| 60 | - | 46–48 | 42–44 | - | 32–33 | 14 | 20 | 12 | 53 |
| 55 | 17 | 44–45 | 40–41 | 16 | 30–31 | 13 | 19 | - | 51 |
| 50 | - | 41–43 | 36–39 | - | 28–29 | - | - | - | 50 |
| 45 | - | 39–40 | 34–35 | 15 | 27 | 12 | 18 | 11 | 49 |
| 40 | 16 | 38 | 33 | - | 26 | - | 17 | - | 47 |
| 35 | - | 37 | 31–32 | 14 | 25 | 11 | - | 10 | 46 |
| 30 | - | 35–36 | 30 | - | 24 | - | 16 | - | 44 |
| 25 | 15 | 34 | 28–29 | 13 | 23 | 10 | 15 | 9 | 43 |
| 20 | - | 32–33 | 27 | 12 | 22 | 9 | 13–14 | - | 42 |
| 15 | 14 | 31 | 25–26 | - | 21 | - | 12 | 8 | 40 |
| 10 | 13 | 28–30 | 24 | 11 | 19–20 | 8 | 10–11 | 7 | 37 |
| 5 | 12 | 27 | 23 | 10 | 18 | 7 | 9 | 6 | 34 |
| 4 | - | 26 | 22 | - | - | - | - | - | 32 |
| 3 | - | 25 | - | 9 | 17 | - | 8 | - | 31 |
| 2 | - | 24 | 21 | - | - | - | - | - | 29 |
| 1 | - | 23 | 20 | 6–8 | 15–16 | 6 | 7 | 4–5 | 27 |
| N | 1,628 | 1,628 | 1,628 | 1,628 | 1,628 | 1,628 | 1,628 | 1,628 | N |
| Mean | 18.20 | 48.67 | 42.79 | 16.06 | 33.28 | 13.92 | 18.56 | 11.64 | Mean |
| SD | 5.98 | 20.42 | 18.46 | 4.22 | 13.74 | 5.65 | 5.51 | 3.37 | SD |

Note: *Pc= Percentiles; T= T Scores; N= sample; M= Means; SD= Standard Deviations.*

**Table 15.** T Scores and Percentiles of MMSI-2 scales (women).

| Pc | Scales | | | | | | | | T |
|---|---|---|---|---|---|---|---|---|---|
| | Pva | Pt | Po | Pc | Hi | Ez | Pa | Na | |
| 99 | 52–55 | 34–35 | 34–35 | 43–45 | 62–65 | 53–55 | 49–50 | 58–60 | 73 |
| 98 | 47–51 | 33 | 31–33 | 41–42 | 59–61 | 50–52 | 47–48 | 55–57 | 71 |
| 97 | 44–46 | 31–32 | 30 | 39–40 | 56–58 | 49 | 46 | 54 | 69 |
| 96 | 42–43 | 30 | 29 | 37–38 | 54–55 | 47–48 | 45 | 52–53 | 68 |
| 95 | 39–41 | 29 | 28 | 35–36 | 53 | 46 | - | 51 | 66 |
| 90 | 33–38 | 24–28 | 24–27 | 30–34 | 49–52 | 42–45 | 40–44 | 47–50 | 63 |
| 85 | 28–32 | 20–23 | 22–23 | 26–29 | 47–48 | 39–41 | 37–39 | 45–46 | 60 |
| 80 | 25–27 | 18–19 | 20–21 | 24–25 | 45–46 | 38 | 36 | 43–44 | 58 |
| 75 | 23–24 | 17 | 18–19 | 22–23 | 44 | 36–37 | 35 | 42 | 57 |
| 70 | 21–22 | 16 | 17 | 21 | 42–43 | 35 | 34 | 41 | 56 |
| 65 | 20 | 15 | 16 | 20 | 41 | 34 | - | 40 | 54 |
| 60 | 19 | 14 | - | 19 | 40 | 33 | 33 | 39 | 53 |
| 55 | 18 | - | 15 | 18 | 39 | - | - | 38 | 51 |
| 50 | 17 | - | 14 | 17 | 38 | 32 | 32 | 36–37 | 50 |
| 45 | - | 13 | - | - | 37 | 31 | 31 | - | 49 |
| 40 | 16 | - | 13 | 16 | 36 | 30 | 29–30 | 35 | 47 |
| 35 | 15 | 12 | - | 15 | 35 | 29 | 28 | 34 | 46 |
| 30 | - | - | 12 | - | 34 | 28 | 26–27 | 32–33 | 44 |
| 25 | 14 | 11 | - | 14 | 32–33 | 27 | 23–25 | 30–31 | 43 |
| 20 | 13 | 10 | 11 | 13 | 31 | 25–26 | 20–22 | 28–29 | 42 |
| 15 | - | - | 10 | 11–12 | 28–30 | 23–24 | 18–19 | 25–27 | 40 |
| 10 | 12 | 9 | 9 | - | 25–27 | 20–22 | 15–17 | 22–24 | 37 |
| 5 | - | 8 | 8 | 10 | 24 | 19 | 14 | 20–21 | 34 |
| 4 | 11 | - | - | - | 23 | 18 | 13 | 19 | 32 |
| 3 | - | 7 | - | - | 21–22 | 17 | 12 | 17–18 | 31 |
| 2 | - | - | - | - | 19–20 | 15–16 | 11 | 15–16 | 29 |
| 1 | - | - | 7 | 9 | 13–18 | 11–14 | 10 | 12–14 | 27 |
| N | 1,628 | 1,628 | 1,628 | 1,628 | 1,628 | 1,628 | 1,628 | 1,628 | N |
| Mean | 20.06 | 14.90 | 15.71 | 19.13 | 38.21 | 31.99 | 30.04 | 36.53 | Mean |
| SD | 8.78 | 5.95 | 5.84 | 7.43 | 8.66 | 7.81 | 8.61 | 8.97 | SD |

Note: *Pc= Percentiles; T= T Scores; N= sample; M= Means; SD= Standard Deviations.*

**Table 16.** T Scores and Percentiles of MMSI-2 scales (men and women).

| Pc | Second-order scales | | | | | | | | T |
|---|---|---|---|---|---|---|---|---|---|
| | Men | | | | Women | | | | |
| | IMA | APP | ASC | CPT | IMA | APP | ASC | CPT | |
| 99 | 276–305 | 161–170 | 105–110 | 265–285 | 286–305 | 163–170 | 105–110 | 265–285 | 73 |
| 98 | 263–275 | 151–160 | 100–104 | 260–264 | 266–285 | 152–162 | 100–104 | 260–264 | 71 |
| 97 | 249–262 | 143–150 | 97–99 | 254–259 | 249–265 | 144–151 | 96–99 | 254–259 | 69 |
| 96 | 239–248 | 137–142 | 93–96 | 250–253 | 239–248 | 138–143 | 93–95 | 250–253 | 68 |
| 95 | 229–238 | 131–136 | 91–92 | 248–249 | 230–238 | 131–137 | 91–92 | 242–249 | 66 |
| 90 | 195–228 | 111–130 | 77–90 | 223–247 | 196–229 | 111–130 | 77–90 | 222–241 | 63 |
| 85 | 175–194 | 95–110 | 68–76 | 207–222 | 175–195 | 96–110 | 68–76 | 207–221 | 60 |
| 80 | 159–174 | 87–94 | 62–67 | 199–206 | 159–174 | 87–95 | 62–67 | 199–206 | 58 |
| 75 | 147–158 | 80–86 | 57–61 | 193–198 | 148–158 | 80–86 | 57–61 | 193–198 | 57 |
| 70 | 137–146 | 75–79 | 53–56 | 184–192 | 138–147 | 75–79 | 52–56 | 184–192 | 56 |
| 65 | 129–136 | 71–74 | 49–52 | 183 | 129–137 | 71–74 | 49–51 | 183 | 54 |
| 60 | 123–128 | 68–70 | 46–48 | 179–182 | 123–128 | 68–70 | 46–48 | 179–182 | 53 |
| 55 | 117–122 | 65–67 | 43–45 | 173–178 | 117–122 | 65–67 | 43–45 | 173–178 | 51 |
| 50 | 108–116 | 61–64 | 40–42 | 169–172 | 108–116 | 62–64 | 40–42 | 169–172 | 50 |
| 45 | 103–107 | 59–60 | 39 | 160–168 | 103–107 | 59–61 | 39 | 160–168 | 49 |
| 40 | 100–102 | 56–58 | 37–38 | 154–159 | 100–102 | 56–58 | 37–38 | 154–159 | 47 |
| 35 | 97–99 | 55 | 36 | 148–153 | 97–99 | 55 | 36 | 148–153 | 46 |
| 30 | 92–96 | 52–54 | 34–35 | 141–147 | 92–96 | 52–54 | 34–35 | 141–147 | 44 |
| 25 | 88–91 | 48–51 | 32–33 | 132–140 | 88–91 | 48–51 | 32–33 | 132–140 | 43 |

(*continued on next page*)

**Table 16** (*continued*)

| Pc | Second-order scales | | | | | | | | T |
|---|---|---|---|---|---|---|---|---|---|
| | Men | | | | Women | | | | |
| | IMA | APP | ASC | CPT | IMA | APP | ASC | CPT | |
| 20 | 85–87 | 45–47 | 31 | 123–131 | 84–87 | 46–47 | 31 | 122–131 | 42 |
| 15 | 79–84 | 42–44 | 29–30 | 110–122 | 79–83 | 43–45 | 29–30 | 110–121 | 40 |
| 10 | 74–78 | 39–41 | 26–28 | 95–109 | 73–78 | 39–42 | 26–28 | 95–109 | 37 |
| 5 | 71–73 | 38 | 25 | 89–94 | 71–72 | 38 | 25 | 89–94 | 34 |
| 4 | 69–70 | 37 | - | 84–88 | 69–70 | 37 | - | 84–88 | 32 |
| 3 | 67–68 | 36 | 24 | 78–83 | 67–68 | 35–36 | 24 | 78–83 | 31 |
| 2 | 65–66 | 35 | - | 71–77 | 65–66 | - | - | 68–77 | 29 |
| 1 | 61–64 | 34 | 22–23 | 57–70 | 61–64 | 34 | 22–23 | 57–67 | 27 |
| N | 1,596 | 1,596 | 1,596 | 1,596 | 1,628 | 1,628 | 1,628 | 1,628 | N |
| Mean | 125.53 | 69.49 | 47.38 | 167.02 | 125.72 | 69.81 | 47.20 | 166.98 | Mean |
| SD | 47.99 | 27.57 | 19.39 | 42.49 | 48.37 | 27.92 | 19.33 | 42.49 | SD |

Note: *Pc= Percentiles; T= T Scores; N= sample; M= Means; SD= Standard Deviations.*

**Table 17.** Contents and behaviors assessed by each scale in the MMSI-2 (scales 1–8).

| Scales | Content assessed | |
|---|---|---|
| K | Random answers<br>Psychopathological risks | Understanding of items<br>Degree of cooperation with the interview |
| L | Presence of lies<br>Defensive behaviors<br>Moralistic behaviors | Credulity<br>Unmotivated decisions |
| F | Psychological games<br>Deliberate lies<br>Manipulation<br>Frivolous behaviors | Machiavellianism<br>Be bad thought<br>Be a whistle |
| Si | Ambiguous answers<br>Confusing answers | Lack of responsibility<br>Barnum effect |
| Nt | Emotional instability<br>Intermittent tiredness<br>Anxiety | Lack of energy<br>Somatic behaviors |
| Cs | Toxic consumption<br>Drug intake | Self-medication<br>Attention disorders |
| Su | Emotional lability<br>Fearful behaviors<br>Emotional intensity | Difficulty understanding feelings<br>Sensitivity |
| Be | Tendency toward morbidity<br>Overstimulation<br>Sympathy for the exotic | Curiosity<br>Fantasy trend |

Note: *K= Inconsistencies; L= Lies; F= Fraud; Si= Simulation; Nt= Neurasthenia; Cs= Substance Use; Su= Suggestibility; Be= Thrill-Seeking.*

phenomena and indicators that evaluate the different psychological attributes that are presumably concomitant with these anomalous phenomena. In general, the factorial solutions and the reliability coefficients obtained suggest that the MMSI-2 is a valid and reliable instrument for the multiaxial evaluation of anomalous phenomena.

### 4.1. Analysis of results

First, it must be kept in mind that the MMSI-2 is a multiaxial instrument because it incorporates different evaluation constructs. The factorial solution offered by the first-order EFA (see Tables 1, 2, 3, 4, 5, 6, and 7) is compatible with the psychological variables previously observed in the published scientific literature. As can be observed in the conceptual framework, of the 15 psychological variables that were initially identified in the theoretical evidence (e.g., paranoia, narcissism, histrionism, schizotypy, substance abuse, exhaustion/anxiety, thrill-seeking, childhood trauma, simulation, fraud, creativity, intuition, extraversion, dissociative disorders and suggestibility), the first-order EFA allowed up to 10 to be identified. It should be recalled that of the 16 primary factors, four are anomalous phenomena (Pva, Pt, Po and Pc), and the K and L scales are included as prototypical variables of this type of psychometric inventory (e.g., Millon, 1994; Morey, 2011). As explained in the procedure section of this study, the remaining variables based on theory (childhood trauma, creativity, intuition, extraversion and dissociative disorders) had already been dismissed from the 174-item version. This compatibility is indicates that the items on the MMSI-2 were developed correctly and constitute valid empirical indicators for measuring the constructs included in the 16 factors/scales of the test. Similarly, regarding factorial loads, it can be observed that the reverse-scored items had negative saturations, a fact that also confirms the goodness of the measurement of each indicator/item.

As a second observation, it should be noted that the first-order EFA with factors that coincide with the constructs from the literature does not examine the relationship of the 10 psychological variables plus the K and L scales with the anomalous perceived phenomena. The results of the first-order EFA may prove the exploratory validity of the MMSI-2 measures and analyze the relationships between the items; however, they do not serve to examine the possible relationships among the extracted factors. If such an intercorrelation does exist between the scales, its effects should be observable in the second-order factor solution.

**Table 18.** Contents and behaviors assessed by each scale in the MMSI-2 (scales 9–16).

| Scales | Content assessed | |
|---|---|---|
| Pva | Hearing voices of deceased beings<br>Seeing deceased beings (ghosts)<br>Seeing supernatural beings | Seeing strange shadows<br>Hearing unidentified noises<br>Hearing music of unknown origin |
| Pt | Feeling unexplained chills<br>Feeling touch without anyone else present | Perceiving the presence of others who are not physically there<br>Feeling of pressure in different parts of the body |
| Po | Change in the quality of odors<br>Sensing unexplained odors | Perceiving the scent of a deceased being<br>Perceiving smells at impossible distances |
| Pc | *Déjà vu* experiences<br>Strange sensations in everyday places | Inability to recognize familiar places<br>Recognizing to unfamiliar places<br>Sudden changes in the size of body parts |
| Hi | Seductive behaviors<br>Eccentric behaviors<br>Affective conflicts | Tendency to exaggerate<br>Fear of feeling alone |
| Ez | Superstitious behaviors<br>Difficulties in socialization | Tendency to isolate<br>Tendency toward apathy<br>Magical thinking |
| Pa | Social mistrust<br>Persecutory anxieties<br>Irrational interpretations | Difficulties in making commitments<br>Feelings of betrayal |
| Na | Self-referral ideas<br>Difficulties in integrating criticism | Impatience<br>Need for differentiation<br>Search for ambitions |

Note: *Pva= Anomalous Visual/Auditory Phenomena; Pt= Anomalous Tactile Phenomena; Po= Anomalous Olfactory Phenomena; Pc= Anomalous Cenesthetic Phenomena; Hi= Histrionism; Ez= Schizotypy; Pa= Paranoia; Na= Narcissism.*

Specifically, it would be expected that the secondary APP would distribute the primary factors without isolating the perceptual scales from other factors. The fact that the solution yielded the secondary factor and that its variables showed no significant saturation in any other macrofactor suggests that the Pva, Pt, Po and Pc scales may present behavior that is independent of the other scales. Consequently, this fact calls into question the relationship of anomalous phenomena with the other psychological variables. It should be noted that this observation does not imply that the macrofactor APP is independent of the other higher-order factors given that the rotation used in the solution was oblique and influenced the loadings of the primary factors (and not the second-order factors). However, the independence of these four scales can also be checked by analyzing the correlation matrix in Tables 9 and 10. The correlations of the variables Pva, Pt, Po and Pc presented values close to 0 when they were related to other psychological variables. If these scales were related to the other variables, they should have had correlations other than 0. These nuances do not disprove the theoretical background that defends the relationship between anomalous phenomena and the highlighted psychological variables. However, they do call these theories into question and suggest, as indicated by French and Stone (2014), that anomalous behaviors related to 'psi' phenomena and parapsychology do not have an obvious psychological explanation if they go beyond the psychopathological. The question that arises from this observation confronts the following thought: depending on how anomalous phenomena are evaluated, their covariant behavior may be more or less independent with respect to the other variables. It should be kept in mind that the MMSI-2 examines anomalous phenomena by relating them to 'psi' phenomena and parapsychological experiences. By way of speculation, one might wonder what would happen with the second-order EFAs or the correlation matrix in Tables 9 and 10 if anomalous phenomena were evaluated exclusively as psychotic hallucinatory symptoms. It would then be possible for such intercorrelations to vary, yielding different results.

Along these same lines, the CPT scale includes the Pa, Na, Hi and Ez scales as subclinical features but also adds Su and Be, which had very high factorial loads. Specifically, the term "personality" was added to the CPT scale because it is understood that suggestibility and thrill-seeking are also stable psychological traits (e.g., Irwin et al., 2013). Therefore, according to the theoretical framework, the suggestibility that the MMSI examines should be related to secondary suggestibility (and not to altered states of consciousness) as it is concomitant with other subclinical personality traits (e.g., Smith et al., 2009). This observation is also supported by the content of the items pertaining to Su, which conceptually coincide with the understanding of suggestibility as a personality tendency (e.g., Eysenck, 2017; Hefferline et al., 1972). This differs from the macrofactor ASC, which probably does not measure traits, but rather measures dynamic psychological states (e.g., Groth-Marnat, 2009; Hambleton, 2008). According to the theory, both Nt and Cs are common characteristics that are observable during alterations of consciousness (e.g., Alvarado, 1998; Jinks, 2019). However, the latter secondary factor also suggests that the anxiety evaluated by MMSI-2 is not a stable psychological trait but a situational anxious state.

The macrofactor IMA demonstrated a grouping of variables consistent with what was expected based on the theory (e.g., Álvarez, 2007; French and Stone, 2014; Wilson and French, 2006). All the scales included in the IMA are variables that can be interpreted as manipulations of the answers based on deception. Unlike what was expected, while theoretically social desirability (L) is a common tendency observable in personality measures (e.g., Eysenck, 2017; Groth-Marnat, 2009), this test involves a scale that does not demonstrate high saturation in the CPT factor. The correlation matrix (see Tables 9 and 10) supports this idea and suggests that this scale also has independent behavior. In fact, Fernández-Ballesteros (2011) pointed out that social desirability is a factor that provides a very low explained variance in personality inventories, a statement that does not seem so inconsistent with the low correlations obtained in the MMSI-2. The same behavior can be extrapolated to the K, F, and Si scales. Additionally, taking into account the difficulties present in the analysis of fraudulent behavior (e.g., MacNeil and Soper, 2019), the macrofactor IMA invites us to think about the extent to which the MMSI-2 scales could be useful in lie detection, especially in forensic assessments. The EFA applied in this sample, and specifically its eigenvalues, indicates that this is a group of scales and items that provides more statistical information than other constructs (see Tables 1, 2, 3, 4, 5, 6, and 7; e.g., $\lambda_{Si} = 28.778 > \lambda_{Ez} = 0.961$). The reason why these scales have so much weight in the MMSI-2 (according to their eigenvalues and factorial charges) is unknown. However, this statistical evidence could be used and tested in other areas of evaluation where these variables have been evaluated with little reliability (e.g., Cardona, 2002; Vrij et al., 2019).

Third, it should be recalled that the MMSI-2 was created as a tool with which to compare psychological hypotheses that seek to explain anomalous phenomena and test the 'psi' hypothesis. To do this, it is appropriate to interpret the scales created and analyze the scope they offer in psychological evaluation. Direct scores may be useful in future statistical research; however, if the assessment or comparison of hypotheses is applied individually (e.g., through the development of psychological profiles), then it is necessary to determine the position the patient occupies within a normative group (see Kline, 1999; Muñiz, 2003). At the same time, following Martínez-Arias et al. (2006), in this context, the scales also make it possible to define the empirical thresholds that determine the extent to which an evaluated subject develops behaviors occurring at a frequency and intensity that is becoming clinically suspect. These cut-off points are normative and determined according to the transformation scale used. According to the psychometric contributions of other authors (e.g., Ben-Porath and Tellegen, 2019; Morey, 2011), in the case of the MMSI-2, the use of T scores instead of percentiles is recommended. Percentiles have been shown to facilitate statistical research but have shown less benefit for the analysis of the patient/client's psychometric profile. PT have an average value of 50 points, and their standard deviations have a value of 10 points (e.g., Abad et al., 2015). The following cut-off points are recommended for both men and women: $PT \geq 50$ and $PT \geq 60$. The significance of the scores is questionable when they exceed the average value ($PT = 50$) and clear when a $PT \geq 60$ is obtained. Due to the eigenvalues and asymmetric-positive distribution of scores in the K, F, Cs and IMA scales, the use of more restrictive cut-off points ($PT \geq 40$) is recommended. This suggestion is based on the fact that the behaviors described in the items of these scales are dysfunctional and are inconsistent with psychological normality. However, this proposal should be validated in subsequent studies, and hence, caution is recommended. The value of all of these cut-off scores and these scales is observed when a subject scores high on both the scales that examine abnormal phenomena and one of the other psychological variables. The possible debate raised by the MMSI-2 involves whether significant scores for psychological variables could explain significant values on the APP scale. This debate will probably be clarified when the factors are analyzed in subsequent confirmatory studies, as recommended by Gorsuch (1983).

To specify the behaviors assessed in each factor or scale, Tables 17 and 18 summarize and classify the attributes measured in each dimension.

EFAs are a good start and constitute a very useful empirical basis for assigning validity to a psychometric instrument (see Mulaik, 2018), however, the extracted factors must be subsequently replicated with a *confirmatory factor analysis* (henceforth CFA). While EFAs attribute validity to measures, CFAs also confirm and validate the structural model that justifies the conceptual bases of the instrument (e.g., Ruiz, 2000). Indeed, as with Houran et al. (2019), the main problem encountered in this research was the lack of previously validated theoretical models. As mentioned in the previous sections, although instruments exist that examine anomalous perceptions among nonclinical samples (e.g., Bell et al., 2006; Mason and Claridge, 2006; Stefanis et al., 2002), consistent statistical results are not provided when anomalous phenomena are related to other psychological variables outside the psychopathological framework (see Irwin, 2009; Parker, 2006). Thus, from an empirical perspective and taking into account sample size, EFA was chosen as the most suitable mathematical design for this type of scenario (see Kline, 1999; Mulaik, 2018). In fact, this limitation emphasizes that the MMSI-2 also requires a valid theoretical foundation that verifies the relationships among the constructs it evaluates. However, it is not possible to determine a theoretical model without consistent prior evidence, and this psychometric work based on EFAs is thought to be able to provide such evidence.

Another drawback is seen in the trait vs. state aspect of some of the scales in the MMSI-2. It is unclear whether the macrofactor CPT includes variables of a trait type and the ASC dimension includes factors of a state type. To verify the state vs. trait conditions in the respective scales, a *test-retest* design of repeated samples must be applied to simultaneously analyze the reliability of differences between the scores (e.g., Abad et al., 2015). These reliability indices would be complementary to internal consistency and would not alter the obtained *alpha* coefficients, which were excellent (e.g., George and Mallery, 2003).

A very obvious limitation also lies in the interpretation of scores using PTs. Scaling in this type of test is essential, but it seems necessary to validate the cut-off points using designs that analyze the sensitivity and specificity of the MMSI-2. These designs can be based on *ROC curves* and *logistic regression*, although an external classifier would need to be determined to allow comparison between the MMSI forecasts and classifications that were assumed as criteria. It is true that the scales offer T scores, which are useful in psychometric evaluation to facilitate decision-making in response to the degree of significance of the scores. However, individual T scores do not allow us to resolve the dilemma derived from research into 'psi' phenomena with significant results. If a subject obtained significant scores on the APP scales and high values for the other psychological variables, it would not be possible to confirm that the anomalous phenomena were produced by high scores on those psychological variables. However, this hypothetical profile would provide sufficient grounds to suspect that psychological scales are predictors of perceived anomalous phenomena. This limitation means that new research and contrasts are needed to examine the variation in PTs on the APP scales based on the possible effects of scores obtained for the other variables.

Given these limitations and the scientific literature cited, future lines of research should address three key points: (1) the conceptual understanding of observable differences between anomalous experiences understood as attenuated psychotic hallucinations and anomalous phenomena evaluated as anomalous experiences related to 'psi' phenomena; (2) the statistical analysis of new psychometric properties of the MMSI-2 that identify and confirm the factorial solution presented in this report; and (3) the goodness of cut-off points that would allow evaluative decisions (though not diagnostic ones) to be made (see also Jabbari et al., 2018; Lappalainen, 2019; Van Zeebroeck, 2019).

### 4.2. Conclusions

This study presents three main findings. First, the study obtained 12 empirical markers (the 12 scales of the MMSI-2) for identifying, examining, and measuring possible causes of perceived anomalous phenomena. Four specific markers were also obtained for evaluating abnormal experiences. Second, the study demonstrated that it is possible to define and establish an empirical-statistical model for evaluating anomalous phenomena. This model should allow for examination of perceptual anomalies to determine whether they are the result of hallucination, biases, deliberate fraud, or behaviors without a psychological-psychiatric explanation. Third, it is also concluded that it is necessary to review this factor model and validate it through a CFA and structural equation models.

Ultimately, the MMSI-2 is accepted as a valid and reliable psychometric instrument for evaluating anomalous phenomena and the theoretically concomitant psychological variables. The 174 items and the 20 psychometric scales of the MMSI-2 can be used in future studies aimed at psychological profile analysis and statistical research to confirm the predictive relationship between different psychological variables and anomalous phenomena.

## Declarations

### Author contribution statement

A. Escolà-Gascón: Conceived and designed the experiments; Performed the experiments; Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data; Wrote the paper.

*Funding statement*

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

*Competing interest statement*

The authors declare no conflict of interest.

*Additional information*

No additional information is available for this paper.

## Acknowledgements

The author of the MMSI-2 wishes to express his gratitude to the academic, professional and business groups or associations that participated in the collection of the sample. The collaborating groups were: *Sisters of Immaculate Conception* (Madrid, Spain) and *MAGIC International*® (Barcelona, Spain). The academic professionals who collaborated with data collection were (appearing in order of the date of collaboration): Esther Mosquera (*Researcher Assistant,* 2012–2014, Barcelona, Spain); Sister Bárbara Ávila (*Theologian* and *Clinical Psychologist*, 2013–2015, Madrid, Spain); Sister María Luz Martínez (*Theologian* and *Clinical Psychologist*, 2013–2015, Madrid, Spain); Isabel Miró (*Clinical Psychologist,* 2013–2019, Barcelona, Spain); Rosa María Gamboa (*Clinical Psychologist,* 2013–2019, Barcelona, Spain); Naia Cartañá (*Biostatistician,* 2013–2019, Barcelona, Spain); Yolanda Romero de Tejada (*Clinical Psychologist,* 2014–2018, Barcelona, Spain); Judith García (*Researcher Assistant,* 2014–2018, Barcelona, Spain); Manuel Lascasas (*Researcher Assistant,* 2015–2018, Barcelona, Spain); Víctor Fernández (*Researcher Assistant*, 2015–2018, Albacete, Spain).

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Anuario de Psicología
The UB Journal of Psychology | 50/3
Universitat de Barcelona

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*Anuario de Psicología*
N.º 50/3 | 2020 | págs. 115-126

Enviado: 3 de marzo de 2019
Aceptado: 27 de febrero de 2020

DOI: 10.1344/ANPSIC2020.50.11

ISSN: 0066-5126 | 

# Psychology of Anomalous Experiences: psychometric properties of the Multivariable Multiaxial Suggestibility Inventory-2 Reduced (MMSI-2-R)

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## Abstract

Anomalous experiences are perceptual alterations, which can be explained as possible hallucinatory symptoms (clinical model) or as a way of representing reality according to the beliefs of each individual (cognitive or phenomenological model). The aim of this study was to explore how these experiences are developed in the general population integrating both models. The statistical justification of the Multivariable Multiaxial Suggestibility Inventory-2 Reduced (MMSI-2-R) was completed in a non-probabilistic convenience sample of 1,773 participants. In the same way, subjects came from three different Spanish communities: Madrid, Albacete, and Barcelona. Factor analysis resulted in six factors, which offered high reliable indices. In order to integrate the cognitive model as a possible interpretative criterion, scores were scaled conforming different attitudes to anomalous experiences: believers in the paranormal (magical beliefs), agnostic attitudes, and non-believers. It was concluded that believers tend to develop these alterations in a more frequent way than non-believers.

## Keywords

Anomalous experiences, hallucinations, psychotic-like experiences, magical beliefs, paranormal beliefs.

## Psicología de las experiencias anómalas: propiedades psicométricas del Inventario Multiaxial de Sugestibilidad Multivariable -2 Reducido (MMSI-2-R)

## Resumen

Las experiencias anómalas representan alteraciones perceptivas que pueden ser explicadas como posibles síntomas alucinatorios (modelo clínico) o como una manera de representar la realidad acorde con las creencias de cada individuo (modelo fenomenológico). El objetivo de este estudio fue explorar cómo estas experiencias se desarrollan en la población general integrando ambos modelos. La justificación estadística del Inventario

Multiaxial de Sugestibilidad Multivariable -2 Reducido (MMSI-2-R) fue completada con una muestra de conveniencia no-probabilística formada por 1773 participantes. Del mismo modo, los sujetos seleccionados procedían de tres comunidades españolas distintas: Madrid, Albacete y Barcelona. El análisis factorial presentó seis factores principales, los cuales arrojaron índices elevados de fiabilidad. Con el objetivo de integrar el modelo cognitivo como un posible criterio interpretativo, las puntuaciones fueron baremadas en base a diferentes actitudes frente a las experiencias anómalas: creyentes en lo paranormal (creencias mágicas), actitud agnóstica y no creyentes. Se concluye que los creyentes tienden a desarrollar estas alteraciones de manera más frecuente que los no creyentes.

**Palabras clave**

Experiencias anómalas, alucinaciones, Psychotic-Like Experiences, creencias mágicas, creencias paranormales.

The term *anomalous experience* is used to describe a group of unusual phenomena that are in the boundaries of consciousness (e.g., Gallagher, Kumar, & Pekala, 1994; McClenon, 1994; Nadon & Kihlstrom, 1987; Palmer, 1979). These phenomena, although present in the general population, are hard to explain due to their complexity and are often classified as parapsychological, religious, or ufological experiences, among other denominations, depending on the phenomenological nature of the experience. Jaén-Moreno, Moreno-Díaz, Luque-Luque and Bell (2014) also used it to define a set of symptoms (hallucinatory and delirious) present in the subclinical psychotic states (see also Brenner et al., 2007). The concept of subclinical psychosis is a term which was listed by Capra, Kavanagh, Hides and Scott (2013) to explain experiences close to psychosis, also known as, psychotic-like experiences (PLEs). They are present in a phenotypic continuum, a period in which the degradation of a psychotic symptomatology can be identified.

Recent epidemiological studies show that anomalous experiences are indeed present in the general non-clinical population. On the one side, according to Peters, Joseph, Day and Garety (2004), the prevalence index is of 29.8% in the general adult population. On the other side, Horwood et al. (2008) defended that the prevalence index reaches up to 38.9% in the general adolescent population. Regardless, a more in-depth meta-analysis by van Os, Linscott, Myin-Germeys, Delespaul, and Krabbendam (2009) found a prevalence rate of 5% among the general adult population. Simultaneously, Fonseca-Pedrero et al. (2011a) conducted a study with the adolescent Spanish population which found a prevalence rate of 43% for experiences associated with magical thoughts and 8.9% for psychotic-like experiences. Therefore, there is a qualitative difference and a quantitative variation in the existence of anomalous experiences, including the meaning of the term anomalous experience, ranging from PLEs to more severe psychotic symptoms. Subsequently, anomalous experiences would be placed below the clinical threshold, despite not constituting any psychopathological symptoms by themselves (Johns & van Os, 2001; Verdoux & van Os, 2002). This conception belongs to the model of the psychotic continuum described by Stefanis et al. (2002) alongside other authors (e.g., Vollema, Sitskoorm, Appels, & Kahn, 2002; Yung et al., 2003).

The model of psychotic continuum comes from the hypothetical assumption that the symptoms observed in psychotic patients can also be found in the non-clinical population at different levels of intensity. The scientific validity of the model was analyzed by van Os et al. (2009), who arrived at the conclusion that the psychopathological, demographic, and epidemiological characteristics observed in schizophrenic patients are like those of subclinical psychosis. Similarly, Cantor-Grae and Selten (2005) discuss that certain risk factors, such as childhood trauma, belonging to marginalized ethnic groups, or having precarious education levels, present in schizophrenia are also found in PLEs (see also Krabbendam & van Os, 2005). However, some investigations question whether anomalous experiences make up experiences related to psychotic disorders (Escolà-Gascón, 2016; Font, 2016; Irwin, Dagnall, & Drinkwater, 2013; Parker, 2006). These studies proposed that anomalous experiences could exist in dimensions which are of a non-pathological type, such as magical ideation, causal illusions, and paranormal beliefs, that promote their development (see Yarritu, Matute, & Vadillo, 2013). In fact, Irwin (2009) suggests the presence of a loop between paranormal beliefs and anomalous experiences. This hypothetical model would describe anomalous experiences as a subjective validation of the subject's paranormal beliefs, where the believer intends to continue believing in the paranormal. Following this idea, the individual can expose him/herself to find new experiences which act as a guarantor for their belief

system (Gallagher et al., 1994; Iborra, 2016). In their clinical study, Capra et al. (2013) indirectly supported this proposal by excluding magical thoughts and beliefs from psychopathologically significant behaviors in the psychotic continuum.

Therefore, there are two models that can be identified within this conception. First, Model 1 contemplates that PLEs are not strictly associated with the presence of a disorder, but rather those experiences change in accordance with other variables, such as intrusiveness, belief systems, and other cultural factors (Johns & van Os, 2001; Lawrie, Hall, McIntosh, Owens, & Johnstone, 2010). Second, Model 2 postulates that PLEs represent a psychotic vulnerability factor for the development of future disorders, depending on three parameters: (1) tendency, (2) persistence, and (3) deterioration (David, 2010; Rus-Calafell & Lemos-Giráldez, 2014; van Os et al., 2009).

El-Mallakh and Walker (2010) argued that anomalous experiences can also be described as perceptive deformations or deceptions, including the concept of pseudohallucinations or pseudoperceptions. On the one hand, according to Belloch, Baños, and Perpiñá (1995) perceptive deformations appear when a stimulus present in the objective exterior space, also accessible to the sensory organs, is perceived in a different manner compared to its formal characteristics (see also Jaspers, 1993). Nevertheless, the distortion does not usually appear in the sensory organs themselves; instead, it lies in the interpretation that the subject elaborates from the perceived stimulus (Hamilton, 1985; Neisser, 1981). On the other hand, Ey, Bernard, and Brisset (1980) suggested that perceptive deceptions can be labeled as psychic hallucinations which provoke vivid hallucinatory activity within the imagination and thoughts of the individual. In agreement with this idea, Villagrán and Luque (1994) preferred to use the term pseudohallucination in order to differentiate this phenomenon from classical psycho-sensory hallucinations, since those lacked corporeality and objectivity in the exterior space.

Considering the examples presented, numerous investigations advise that hallucinations and pseudohallucinations can manifest themselves according to their sensory modalities (Asaad & Shapiro, 1986; Posey & Losch, 1983). On the one side, the most frequent anomalous experiences among the general population are constituted by those who are sensitive to the senses of taste, smell, and touch. On the other side, when anomalous experiences are conceived and evaluated as subclinical phenomena (continuum model), the alterations that predominate are of an olfactory, taste, cenesthetic, and auditory type. These conclusions contemplate whether pseudohallucinations and subclinical hallucinations share the same etiological base (Barrett, 1993; Barrett & Etheridge, 1994). According to Luque and Villagrán (2000), pseudohallucinations represent a non-pathological expression of the hallucinatory phenomenon, which only constitute the imaginary phenomena present in normal perceptions which initially seemed hallucinatory. Praveen, Walker, and El-Mallakh (2010) also supported this notion, with the addition that perceptive deceptions were frequent in the remission phases of psychosis. This suggestion was recently complemented by Telles-Correia, Lúcia, and Gonçalves (2015), who noted that pseudohallucinations could also develop regardless of hallucinatory psychotic symptoms. In fact, these discussions have not finished as yet. Some investigations still question the limits between hallucinations and pseudohallucinations (El-Mallakh & Walker, 2010).

Anomalous experiences can be measured and evaluated among the general population using multiple instruments (Irwin, 2009). On the one side, in congruence with the theoretical fundaments mentioned earlier, some have been elaborated with the intention of providing a representative and objective measure of the propensity to psychosis (e.g., Bentall & Slade, 1985; Mason & Claridge, 2006; Núñez, Arias, Vogel, & Gómez, 2015; Ros-Morente, Vilagrá-Ruiz, Rodríguez-Hassen, Wigman, & Barrantes-Vidal, 2011; Fonseca-Pedrero et al., 2011b). On the other side, several tests focus their attention on the evaluation of anomalous experiences as perceptive deformations or aberrant perceptions. Two examples to illustrate this could be the questionnaire of Chapman, Chapman, and Rawlin (1978), referred to as PAS (Perceptual Aberration Scale), and the CAPS scale (Cardiff Anomalous Perceptions Scale) designed by Bell, Halligan, and Ellis (2006). The main objective of the CAPS scale was to find out if there was a positive correlation between perceptive deformations and certain psychotic-type symptoms (Bell et al., 2006). Unlike other tests, the CAPS scale conceptualizes anomalous experiences as perceptions which are unilaterally independent of the clinical-psychiatry context (Jaén-Moreno et al., 2014).

While on the lookout for new questionnaires to evaluate anomalous experiences in the general adult population, it can be concluded that the majority of existing questionnaires focus on (i) the evaluation of psychotic phenotypes, and (ii) the distinction between pathological and non-pathological anomalous experiences (Peters, Joseph, & Garety, 1999). The main disadvantages are that many of them were theoretically elaborated and validated in other cultural and social contexts, consequently generating methodological difficulties during the adaptation process. Despite all of them presenting a rigorous statistical justification, many were adapted with non-representative samples of the general Spanish population. All the same, another drawback was that most instruments did not allow for discrimination between sensory characteristics and anomalous experiences – an important aspect to be taken into account during the psychological evaluation process (Barrett, 1993; Barrett & Etheridge, 1994). Finally, another difficulty was that the majority of instruments had not taken into consideration the problems contem-

plated by some authors, such as Gallagher et al. (1994) and Irwin (2009), regarding whether or not paranormal beliefs changed in the presence of anomalous experiences.

Therefore, the objective of the current study was, firstly, to develop an instrument that enabled the evaluation of anomalous experiences among the general Spanish population, while trying to integrate both theoretical models (the continuum model and the perceptive deformations/deceptions model), and secondly, to elaborate a test with the capacity to discriminate between the sensory characteristics and anomalous experiences among three groups of subjects, classified according to their predisposition to the paranormal (non-believers, agnostics, and believers), allowing for the further comprehension of this phenomenon.

## MATERIAL AND METHODS

### Participants

The final sample for the investigation was obtained from October 2013 until March 2016. It comprised 806 men and 967 women (N=1,773); from the three Spanish provinces of Barcelona (67.5%), Madrid (17%), and Albacete (15.6%). The ages of the participants ranged from 18 to 78 years (Mean=34.24; Standard Deviation=13.363). Regarding their level of education, 67.8% of participants had completed professional training cycles; 24% had attended college; 5.7% had finished secondary school (ESO); and 2% had only attended elementary school. As far as their belief systems were concerned, the majority (48.6%) declared themselves to be believers in the paranormal; 34.6% confirmed their agnostic attitude; while 16.8% declared being non-believers. From the same sample, 39.7% of subjects thought they had had a paranormal experience during their lifetime; 35% reported not knowing; while 23.7% declared they had not had any kind of anomalous experience. Finally, it must be noted that most of the participants did not present any psychiatric history, even though 8.2% chose not to speak on the topic. The subjects who did confirm having a clinical-psychiatric history were dismissed from the sample.

### Instruments

The Multivariable Multiaxial Suggestibility Inventory-2-Reduced (MMSI-2-R), which is used throughout this investigation, comprises 49 items. These items measure and explore not only hallucinatory-type experiences, but also perceptive deformations attenuated in the general adult Spanish population. The items were developed in the form of phrases or affirmations, the answers to which were encoded using the Likert five-point scale: 1 meaning *strongly disagree*, 2 *disagree*, 3 *neither agree nor disagree*, 4 *agree,* and 5 *strongly agree*. The MMSI-2-R has six factors or scales: *Visual and Auditory Perception* (Pva); *Cenesthetic Perception* (Pc); *Olfactory Perception* (Po); *Touch Perception* (Pt); *Taste Perception* (Pg); and *Paranoid Experience* (Et).

### Procedure

The design of this study was classified as a multivariant model, which corresponded to an Exploratory Factorial Analysis, with the purpose of examining the validity of the MMSI-2-R construct.

The elaboration of the questionnaire was carried out in five different phases. The first was developed over the span of four months, from September 2011 until January 2012. During this phase, the constructs to be evaluated were defined, following the views of Gallagher et al. (1994) and Jaspers (1980) for anomalous experiences. The classical suggestibility model was also referred to for the exploration of psychological mechanisms which stemmed from these experiences (see also Hefferline, Bruno, & Camp, 1972). In addition, a first draft of items composed by 159 sentences was written up. Afterwards, it was analyzed by a group of experts who only rejected six items. The questionnaire was then ready for experimental application.

The second stage was carried out between February 2012 and December 2012. During this period, the questionnaire was conducted on a preliminary sample of 254 students from Barcelona, whose ages ranged from 18 to 39 years. This first analysis (Exploratory Factorial Analysis) determined that the experimental MMSI presented ambiguous and inconclusive results. For this reason, the theoretical basis of the test was reformulated and its elements rewritten. Once we reached this point in the investigation, the third development stage of the MMSI-2-R was initiated between June and September 2013.

The questionnaire was improved because of the previous experience with the first version. Its theoretical framework was redefined. (1) Items did not contain ambiguous expressions such as “normally” or “frequently”. (2) Some polarized adverbs like “never” and “always”, which generated confusion among the participants, were eliminated from the formulation of sentences. In addition, sentences that presented excessively specific content were also eliminated because they made it more difficult to find an elevated variance. (3) Consequently, items were expressed in a more generic, subtle and attenuated way, since this would facilitate the heterogeneity of answers. During this period of the investigation the sentences were reformulated according to the theoretical framework, constituting a total of 49 elements which expressed behaviors associated with anomalous experiences.

The fourth phase was developed between October 2013 and March 2016. The aim of this phase was to apply the new sentences on a large sample.

Finally, during the fifth and final phase of the study, the validity and reliability of the MMSI-2-R were examined.

## Data analysis

The results of this study were analyzed using the statistical package *SPSS-PASW Statistics*-22 and *Jamovi* (see The Jamovi Project, 2019). The reliability of the questionnaire was calculated using *Cronbach's Alpha*, designed for ordinal values, and *McDonald's Omega*, as an alternative index. However, the analysis of construct validity was developed through the application of the Exploratory Factor Analysis (EFA), using the *Principal Axis* method. Likewise, given that items were ordinal variables, polychoric correlations were applied instead of the Pearson linear correlation. Moreover, to define the number of factors, a parallel analysis was used following the criteria of Reise, Waller, and Comrey (2000). For factorial explorations, *oblimin* rotation was used as an indirect solution. The pattern matrix was included to visualize the factorial solution. In the same way, facing the possibility that an item presented a factorial weight higher than .45 in two or more factors, it was dismissed from the matrix of definite items since it would not fulfill the discriminative properties of the EFA. As a complement, the following model fit indices were calculated: *Chi Square* with the *degrees of freedom* (*df*); normed $\chi^2$; root mean square error of approximation (RMSEA) (<0.08); comparative fit index (CFI); and Tucker-Lewis index (TLI). These indices were carried out using the mathematical software *MPLUS* 6.11 (see Muthén & Muthén, 2007). Afterwards, the extracted internal consistency of each factor was analyzed to confirm its reliability. Lastly, the scaling of the scores from the MMSI-2-R was encoded through Percentiles (Pc) and T-scores, using the belief systems to define the normative groups. A level of 95% confidence was used for all analyses.

# RESULTS

## Descriptive statistics

The averages, standard deviations, variances, asymmetry, and kurtosis were calculated in Table 1A (see Appendix). Items 2, 32, and 42 presented the highest averages ($M_{2,\ 32,\ 42}$=4.83; $SD_2$= .617; $SD_{32}$= .616; $SD_{42}$= .618), also observed in the corresponding table. However, items 40 (M=1.93; SD= 1.035) and 15 (M=2.01; SD= 1.114) displayed the lowest averages. At the same time, the variables showed a certain degree of asymmetry, most of them being negatively asymmetrical, except for items 5, 8, 15, 30, 31, 36, 40, 43, and 46, which presented a positive asymmetrical distribution. Finally, in relation to the kurtosis, the analyzed items mainly revealed platykurtic distributions, meaning that they did not adjust to a mesokurtic pattern typical of a normal distribution.

## Exploratory Factor Analysis

The Exploratory Factor Analysis started off with the examination of the correlation matrix between different items. If these items were not intercorrelated, the application of factor analysis would not be recommended due to the low probability of grouping them to a lower number of factors. In order to explore the quality of the sample, KMO (Kaiser-Meyer-Olkin) coefficients and the transformation of the Chi Square of the matrix's determinant, which allows for the corroboration of the hypothesis null sphericity, were used. On the one hand, the Kaiser-Meyer-Olkin test for sampling adequacy expressed a value of .952, which substantially exceeded the recommended value for these cases (.6). On the other hand, Bartlett's Sphericity Test displayed positive results ($\chi^2$=245,879.843; $p$=.001) too. This data indicated that the correlation matrix was not identical, being able to regroup the items into new variables, called factors, based on their shared variance.

The factor analysis of the 49 items extracted up to six factors according to the parallel analysis (see Figure 1). The trend of simulated eigenvalues supports the decision that assumes a factorial solution with six factors. As a whole, all found factors explained the 87.7% of variance. To further define the found factor structure, the *oblimin* oblique rotation was used. The factor weights and extracted factors are shown in Table 1.

Figure 1. Scree-plot of parallel analysis

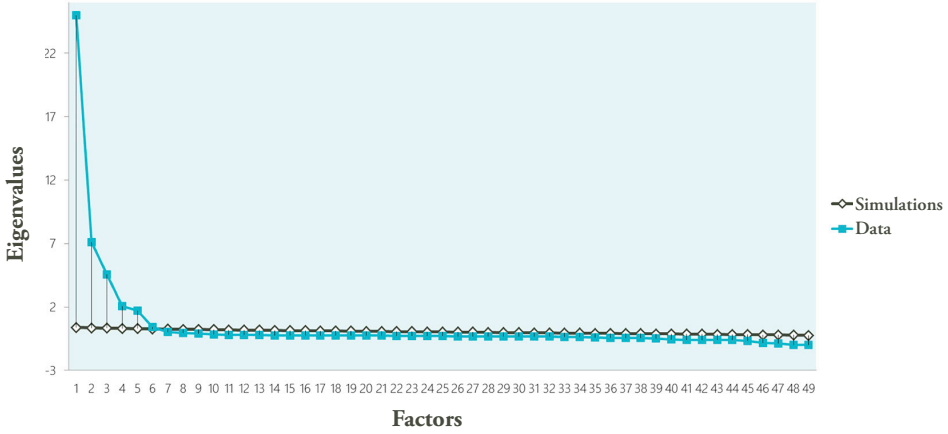

Table 1. Exploratory Factor Analysis (oblimin rotation, pattern matrix)

| | Factors | | | | | |
|---|---|---|---|---|---|---|
| | I | II | III | IV | V | VI |
| Pva 1 | .897 | | | | | |
| Pva 7 | .894 | | | | | |
| Pva 24 | .892 | | | | | |
| Pva 12 | .891 | | | | | |
| Pva 34 | .886 | | | | | |
| Pva 28 | .883 | | | | | |
| Pva 16 | .882 | | | | | |
| Pva 19 | .880 | | | | | |
| Pva 33 | .880 | | | | | |
| Pva 41 | .879 | | | | | |
| Pva 6 | .879 | | | | | |
| Pva 20 | .870 | | | | | |
| Pva 27 | .857 | | | | | |
| Pva 30 | .787 | | | | | |
| Pva 18 | .488 | | | | | |
| Po 47 | | .977 | | | | |
| Po 42 | | .969 | | | | |
| Po 13 | | .963 | | | | |
| Po 2 | | .946 | | | | |
| Po 32 | | .940 | | | | |
| Po 29 | | .930 | | | | |
| Po 10 | | .909 | | | | |
| Pc 26 | | | .917 | | | |
| Pc 17 | | | .914 | | | |
| Pc 44 | | | .909 | | | |
| Pc 49 | | | .903 | | | |
| Pc 39 | | | .903 | | | |
| Pc 4 | | | .897 | | | |
| Pc 48 | | | .895 | | | |
| Pc 9 | | | .881 | | | |
| Pc 45 | | | .877 | | | |
| Pc 35 | | | .869 | | | |
| Pc 22 | | | .827 | | | |
| Pc 43 | | | .686 | | | |
| Pg 46 | | | | .996 | | |
| Pg 8 | | | | .989 | | |
| Pg 36 | | | | .986 | | |
| Pg 31 | | | | .913 | | |
| Pt 38 | | | | | .979 | |
| Pt 14 | | | | | .968 | |
| Pt 3 | | | | | .962 | |
| Pt 11 | | | | | .960 | |
| Pt 25 | | | | | .956 | |
| Pt 21 | | | | | .955 | |
| Pt 37 | | | | | .953 | |
| Pt 23 | | | | | .944 | |
| Et 5 | | | | | | .960 |
| Et 40 | | | | | | .945 |
| Et 15 | | | | | | .902 |
| λ | 24.982 | 7.102 | 4.562 | 2.05 | 1.688 | 0.421 |

The first factor (M=50.622; SD=22.278) was called Visual and Auditory Perception (Pva) and comprised 15 items. The second factor (M=33.679; SD=4.354) was called Olfactory Perception (Po) and comprised seven items. The third factor (M=5.487; SD=12.333) was called Cenesthetic Perception (Pc) and comprised 12 items. The fourth (M=9.091; SD=5.208) was called Taste Perception (Pg) and comprised four items. The fifth factor (30.702; SD=10.982) was called Touch Perception (Pt) and comprised eight items. Lastly, the sixth factor (M=5.925; SD=3.011) was called Paranoid Experience (Et) and comprised three items.

Anomalous experiences would be more intense or less relevant as the punctuations scored higher or lower respectively. The minimum and maximum scores of each factor are displayed in Table 2, in addition to the descriptive statistics. Finally, the model fit indices were minimally acceptable considering the sample size (see Brown, 2015): $\chi^2$= 55,911, p<.001, *df*= 897; normed $\chi^2$= 62.331; RMSEA= .058; CFI= .912; TLI= .906.

## Reliability analysis

As shown in Table 3, Cronbach's Alpha coefficient generated positive results, all of them being higher than .6, as recommended by Muñiz (2003) for these kinds of tests. In the same way, none of these elements were dismissed, to promote Cronbach's Alpha, since significant results had already been obtained. The McDonald's Omega coefficient also showed satisfactory results that were similar to the Cronbach's Alpha indices.

Thus, the data revealed by the reliability coefficients indicates that the MMSI-2-R presents satisfactory internal consistency.

## Psychometric scaling

Considering that the statistical justification of the MMSI-2-R had to incorporate its metric properties in the Irwin et al. (2013) phenomenological hypothesis, three normative groups were defined according to the belief systems for paranormal phenomena, which were: believers, agnostics, and non-believers.

The direct scores were transformed into percentiles (Pc), the results of which allowed for the development of the parallel estimation of the standard derived scores, also called T-scores (M=50; SD=10). General scales were also created to facilitate a transformation of the scores.

# DISCUSSION

The aim of this study was to fulfill the statistical justification of the Multivariable Multiaxial Suggestibility Inventory-2-Reduced (MMSI-2-R) through factor validation, internal consistency, and validity of the construct. The

Table 2. Direct maximum and minimum scores and descriptive statistics of the factors

| | Direct scores (minimum and maximum) | Mean | SD | Asymmetry S.E. = .058 | Kurtosis S.E. = .116 |
|---|---|---|---|---|---|
| **Pva** | 15-75 | 50.622 | 22.278 | -.491 | -1.250 |
| **Pc** | 12-60 | 51.487 | 12.333 | -1.207 | .045 |
| **Pt** | 8-40 | 30.702 | 10.982 | -.992 | -.229 |
| **Po** | 7-35 | 33.679 | 4.354 | -4.624 | 23.847 |
| **Pg** | 4-20 | 9.091 | 5.208 | 1.071 | -.052 |
| **Et** | 3-15 | 5.925 | 3.011 | .191 | -1.660 |

results obtained put forth that the MMSI-2-R presents a hexadimensional internal structure with defined and satisfactory factor patterns, as well as excellent reliability for every factor (George & Mallery, 2003).

The theoretical analysis of the factors revealed a conceptual disposition based on the Barrett and Etheridge (1994) classifications, since, up to four sensory modalities were identified: Visual and Auditory Perception (Pva), Touch Perception (Pt), Olfactory Perception (Po), and Taste Perception (Pg).

The dispositional analysis of the factors also showed similarities with the factor structures of other instruments (Bell et al., 2006; Jaén-Moreno et al., 2014). In this case, factor patterns concomitant with the Exploratory Factor Analysis could be observed, which confirmed the Spanish adaptation of the CAPS and CAPE-42 scales. On the one side, the Cenesthetic Perceptions factor (Pc) described anomalous experiences related to depersonalization and derealization processes, aspects which seem to concur with the factors extracted by Jaén-Moreno et al. (2014). On the other side, the Paranoid Experiences (Et) factor revealed symptomatic contents associated to certain paranoid features, which coincided with the scales defined by Stefanis et al. (2002). Nevertheless, it is still important to indicate the similarities found between the Pva factor and the factor about experiences associated with the temporal lobe (III factor) on the CAPS scale, the nature of which is also sensorial.

Regarding the analysis of the scales, if the contrasting groups of believers, agnostics, and non-believers are considered, it can be observed that the believer subjects tended to present higher anomalous perceptions than those of the other belief systems. The T-scores for this normative group showed a normalized scale, all of them being inferior to the standard average (M=50; SD=10), with the exception of the Pg and Et scales, the scores of which were substantially weighted above the first standard deviation (T-scores ≥ 60). However, the non-believers group presented a transformed score antagonistically opposed to that of the believers' group (since their first subjects displayed a low direct score). Just as Irwin et al. (2013) verified, scaling of direct scores reflects the unusual val-

Table 3. Internal consistency analysis

| | Items | Item-factor correlations | Alpha if the item was eliminated |
|---|---|---|---|
| **Pva** Visual and Auditory Perceptions Alpha= .987 Omega= .987 | Pva 6 | .884 | .986 |
| | Pva 28 | .878 | .986 |
| | Pva 19 | .878 | .986 |
| | Pva 33 | .879 | .986 |
| | Pva 16 | .879 | .986 |
| | Pva 24 | .956 | .985 |
| | Pva 1 | .949 | .985 |
| | Pva 12 | .955 | .985 |
| | Pva 7 | .953 | .985 |
| | Pva 34 | .951 | .985 |
| | Pva 41 | .940 | .985 |
| | Pva 20 | .940 | .985 |
| | Pva 27 | .941 | .985 |
| | Pva 30 | .847 | .986 |
| | Pva 18 | .760 | .987 |
| **Pc** Cenesthetic Perceptions Alpha= .988 Omega= .990 | Pc 26 | .988 | .986 |
| | Pc 17 | .983 | .986 |
| | Pc 44 | .986 | .986 |
| | Pc 39 | .982 | .986 |
| | Pc 49 | .973 | .987 |
| | Pc 4 | .977 | .986 |
| | Pc 45 | .968 | .987 |
| | Pc 48 | .952 | .987 |
| | Pc 9 | .965 | .987 |
| | Pc 35 | .945 | .987 |
| | Pc 22 | .906 | .988 |
| | Pc 43 | .555 | .994 |
| **Pt** Touch Perceptions Alpha= .996 Omega=.996 | Pt 38 | .983 | .995 |
| | Pt 14 | .989 | .995 |
| | Pt 3 | .988 | .995 |
| | Pt 11 | .984 | .995 |
| | Pt 25 | .985 | .995 |
| | Pt 21 | .981 | .995 |
| | Pt 37 | .974 | .996 |
| | Pt 23 | .969 | .996 |
| **Po** Olfactory Perceptions Alpha= .984 Omega= .985 | Po 47 | .961 | .979 |
| | Po 42 | .967 | .979 |
| | Po 13 | .957 | .980 |
| | Po 2 | .955 | .980 |
| | Po 32 | .951 | .980 |
| | Po 29 | .909 | .983 |
| | Po 10 | .880 | .985 |
| **Pg** Taste Perceptions Alpha=.983 Omega= .984 | Pg 46 | .983 | .970 |
| | Pg 8 | .972 | .973 |
| | Pg 36 | .973 | .973 |
| | Pg 31 | .899 | .993 |
| **Et** Paranoid Experiences Alpha=.949 Omega= .949 | Et 5 | .895 | .925 |
| | Et 40 | .893 | .928 |
| | Et 15 | .896 | .925 |

Table 4. General scales of the Spanish population (men-women)

| Pc | MMSI-2-R Scales | | | | | | T |
|---|---|---|---|---|---|---|---|
| | Pva | Pc | Pt | Po | Pg | Et | |
| 99 | 75 | 60 | 40 | 35 | 20 | 11-15 | 73 |
| 98 | - | - | - | - | - | 9-10 | 71 |
| 97 | - | - | - | - | - | - | 69 |
| 96 | - | - | - | - | - | - | 68 |
| 95 | - | - | - | - | - | - | 66 |
| 90 | - | - | - | - | 19 | - | 63 |
| 85 | 74 | - | - | - | 16-18 | - | 60 |
| 80 | - | - | - | - | 12-15 | - | 58 |
| 75 | 70-73 | - | - | - | - | - | 57 |
| 70 | - | - | - | - | 8-11 | - | 56 |
| 65 | 62-69 | - | - | - | - | - | 54 |
| 60 | 60-61 | - | - | - | - | - | 53 |
| 55 | - | - | 32-39 | - | - | 6-8 | 51 |
| 50 | 59 | - | - | - | - | 3-5 | 50 |
| 45 | 52-58 | 59 | - | - | 6-7 | - | 49 |
| 40 | 43-51 | 55-58 | - | - | - | - | 47 |
| 35 | - | 49-54 | 26-31 | - | - | - | 46 |
| 30 | 36-42 | 47-48 | 34-25 | - | - | - | 44 |
| 25 | 26-35 | 39-46 | - | - | 4-5 | - | 43 |
| 20 | 16-25 | 38 | - | - | - | - | 42 |
| 15 | - | - | 9-23 | 32-34 | - | - | 40 |
| 10 | 15 | 25-37 | 8 | 28-31 | - | - | 37 |
| 5 | - | 23-24 | - | - | - | - | 34 |
| 4 | - | - | - | - | - | - | 32 |
| 3 | - | - | - | 25-27 | - | - | 31 |
| 2 | - | - | - | 7-24 | - | - | 29 |
| 1 | - | 12-22 | - | - | - | - | 27 |
| N | 1,773 | 1,773 | 1,773 | 1,773 | 1,773 | 1,762 | N |

Table 5. General scales of the Spanish population (non-believers)

| Pc | MMSI-2-R Scales | | | | | | T |
|---|---|---|---|---|---|---|---|
| | Pva | Pc | Pt | Po | Pg | Et | |
| 99 | 65-75 | 60 | 40 | 35 | 20 | 9-15 | 73 |
| 98 | 60-64 | - | - | - | 19 | - | 71 |
| 97 | - | - | - | - | - | - | 69 |
| 96 | - | - | - | - | - | 7-8 | 68 |
| 95 | 29-59 | - | - | - | - | 3-6 | 66 |
| 90 | 19-28 | - | 28-39 | - | 16-18 | - | 63 |
| 85 | 16-18 | - | 25-27 | - | 8-15 | - | 60 |
| 80 | - | - | 24 | - | 4-7 | - | 58 |
| 75 | - | - | 11-23 | - | - | - | 57 |
| 70 | 15 | - | 8-10 | - | - | - | 56 |
| 65 | - | - | - | - | - | - | 54 |
| 60 | - | - | - | 28-34 | - | - | 53 |
| 55 | - | - | - | - | - | - | 51 |
| 50 | - | 59 | - | - | - | - | 50 |
| 45 | - | - | - | - | - | - | 49 |
| 40 | - | 49-58 | - | - | - | - | 47 |
| 35 | - | 48 | - | - | - | - | 46 |
| 30 | - | - | - | - | - | - | 44 |
| 25 | - | 46-47 | - | - | - | - | 43 |
| 20 | - | 37-45 | - | - | - | - | 42 |
| 15 | - | - | - | 25-27 | - | - | 40 |
| 10 | - | 27-36 | - | 7-24 | - | - | 37 |
| 5 | - | 25-26 | - | - | - | - | 34 |
| 4 | - | 12-24 | - | - | - | - | 32 |
| 3 | - | - | - | - | - | - | 31 |
| 2 | - | - | - | - | - | - | 29 |
| 1 | - | - | - | - | - | - | 27 |
| N | 296 | 296 | 296 | 296 | 296 | 296 | N |
| Mean | 18.168 | 51.641 | 14.148 | 28.317 | 6.354 | 3.337 | Mean |
| SD | 9.884 | 11.667 | 11.205 | 7.883 | 5.087 | 1.315 | SD |

ue of these experiences for the subjects who identify as non-believers, unlike the believer subjects who perceive these experiences with a higher frequency, conceiving them as experiences related to their paranormal beliefs. As opposed to what was expected, the agnostic group presented similar T-scores to the believer group, although with certain deviations which were above average for the Pva and Pt scales. This fact emphasizes that the agnostic doubt of the existence of the paranormal promotes a psychometric behavior which intensifies the prevalence of anomalous experiences.

These observed contrasts between the different scales call into question the polarized debate between those clinical postulates, which differ from the correlation of the anomalous experiences with the presence of clinical disorders (type 1 model) and those which approve of their justification from psychopathology (type 2 model). On the one side, considering the contributions of the continuum model, experiencing anomalous perceptions below the clinical threshold would imply a risk or psychotic vulnerability. Understanding that believer subjects presented a wider spectrum of anomalous experiences than those who were non-believers, would form a population which is more possibly at risk on a clinical level. On the other side, according to Irwin's phenomenological model (2009), the development of paranormal beliefs would attenuate the psychopathological value of anomalous experiences, considering this class of beliefs to be present intrinsically, forming a recursive loop. Given that this model does not consider that anomalous experiences can be predicted and that disorders of the psychotic spectrum can be established, beliefs in the paranormal would grant the justification and normalization of such experiences, based on the meaning, interpretation, and sense they would provide to the experiences themselves. All these observations allow for the integration of the scores of the MMSI-2-R in both paradigms, thus generating an integrator dispositional model just like Yung et al. (2009) and Langer (2011) suggested.

On the one hand, researchers who need to use this instrument under the type 2 model will be able to use it from the direct scores or from the general scales. Taking into account the asymmetrical distributions represented in the scales, it is recommended that one uses the first

Table 6. General scales of the Spanish population (agnostics)

| Pc | MMSI-2-R Scales | | | | | | T |
|---|---|---|---|---|---|---|---|
| | Pva | Pc | Pt | Po | Pg | Et | |
| 99 | 69-70 | 60 | 39-40 | 35 | 20 | 14-15 | 73 |
| 98 | 67 | - | - | - | - | 11-13 | 71 |
| 97 | 61-66 | - | - | - | - | - | 69 |
| 96 | - | - | - | - | - | - | 68 |
| 95 | 60 | - | - | - | - | 9-10 | 66 |
| 90 | - | - | - | - | - | - | 63 |
| 85 | - | - | - | - | - | - | 60 |
| 80 | - | - | - | - | 16-19 | - | 58 |
| 75 | 59 | - | - | - | 12-15 | - | 57 |
| 70 | 44-58 | - | - | - | - | - | 56 |
| 65 | - | - | - | - | - | - | 54 |
| 60 | - | - | 32-38 | - | - | - | 53 |
| 55 | 43 | - | 27-31 | - | - | - | 51 |
| 50 | - | 59 | 24-26 | - | 8-11 | - | 50 |
| 45 | - | - | - | - | - | 7-8 | 49 |
| 40 | - | 55-58 | - | - | - | 5-6 | 47 |
| 35 | - | 47-54 | - | - | - | - | 46 |
| 30 | - | - | - | - | - | 3-4 | 44 |
| 25 | 35-42 | 38-46 | - | - | - | - | 43 |
| 20 | 28-34 | - | - | - | - | - | 42 |
| 15 | 22-27 | 33-37 | - | - | 7 | - | 40 |
| 10 | 16-21 | 26-32 | - | - | 4-6 | - | 37 |
| 5 | - | 23-24 | 16-23 | 34 | - | - | 34 |
| 4 | - | - | - | 33 | - | - | 32 |
| 3 | 15 | - | 11-15 | 26-32 | - | - | 31 |
| 2 | - | - | 8-10 | 16-25 | - | - | 29 |
| 1 | - | 12-22 | - | 7-15 | - | - | 27 |
| N | 611 | 611 | 611 | 611 | 611 | 600 | N |
| Mean | 43.492 | 51.114 | 30.347 | 34.577 | 11.455 | 6.780 | Mean |
| SD | 14.645 | 12.731 | 8.559 | 2.712 | 5.131 | 2.969 | SD |

Table 7. General scales of the Spanish population (believers)

| Pc | MMSI-2-R Scales | | | | | | T |
|---|---|---|---|---|---|---|---|
| | Pva | Pc | Pt | Po | Pg | Et | |
| 99 | 75 | 60 | 40 | 35 | 20 | 9-15 | 73 |
| 98 | - | - | - | - | - | 8 | 71 |
| 97 | - | - | - | - | - | - | 69 |
| 96 | - | - | - | - | - | - | 68 |
| 95 | - | - | - | - | - | - | 66 |
| 90 | - | - | - | - | 16-19 | - | 63 |
| 85 | - | - | - | - | 8-15 | - | 60 |
| 80 | - | - | - | - | - | - | 58 |
| 75 | - | - | - | - | - | - | 57 |
| 70 | 74 | - | - | - | - | - | 56 |
| 65 | - | - | - | - | - | - | 54 |
| 60 | - | - | - | - | - | - | 53 |
| 55 | - | - | - | - | 7 | - | 51 |
| 50 | 70-73 | - | - | - | - | - | 50 |
| 45 | - | 59 | - | - | - | 3-7 | 49 |
| 40 | - | 56-58 | 32-39 | - | - | - | 47 |
| 35 | - | 49-55 | - | - | - | - | 46 |
| 30 | 62-69 | 48 | - | - | - | - | 44 |
| 25 | 61 | 46-47 | - | - | - | - | 43 |
| 20 | 60 | 38-45 | - | - | 4-6 | - | 42 |
| 15 | - | - | - | - | - | - | 40 |
| 10 | 52-59 | 25-37 | - | - | - | - | 37 |
| 5 | 29-51 | 23-24 | - | - | - | - | 34 |
| 4 | - | - | - | - | - | - | 32 |
| 3 | 26-28 | - | 30-31 | 33-34 | - | - | 31 |
| 2 | 16-25 | - | 17-29 | 31-32 | - | - | 29 |
| 1 | 15 | 12-22 | 8-16 | 7-30 | - | - | 27 |
| N | 859 | 859 | 859 | 859 | 859 | 859 | N |
| Mean | 66.965 | 51.742 | 36.705 | 34.884 | 8.345 | 6.232 | Mean |
| SD | 12.901 | 12.339 | 4.716 | .750 | 4.593 | 2.983 | SD |

below-average standard deviation score (T-score= 40) as a critical cutting score for the Pva, Pc and Pt scales. At the same time, for the Po scale, it is recommended that one use the second below-average standard deviation score (T-score= 30), and for the Pg and Et scales, the first above average standard deviation score (T-score= 60). The T-scores located above the critical values would imply the presence of an intense manifestation of the contents in each scale as well as possible pathological risks of the psychotic spectrum.

On the other hand, professionals who apply the MMSI-2-R considering the belief systems represented here (type 1 model), will be able to do it using the scales based on the types of beliefs. The critical scores dependent on the standard deviations of the T-scores can be appreciated in Table 8.

The noteworthy limitations in relation to the factor model of the MMSI-2-R fall on four principal points. Firstly, given that the original objective of the test was to measure anomalous experiences, items which described negative symptoms of subclinical psychosis were not included in the reduced version of the MMSI-2. In relation to the detailing in the study of the concomitance between belief systems and anomalous experiences, it would be convenient to work with new groups of items and scales, which considered other psychological characteristics associated to the psychological phenotype. Secondly, it seems to be recommendable to suggest new psychometric analyses which allow exploration of the discriminative efficacy of possible psychopathological risks with higher precision, using a method of ROC curves. Thirdly, it would also be interesting to examine the subjective discomfort perceived by believer subjects regarding their anomalous experiences. This information would allow for the exploration of the degree of affectation felt

Table 8. Critical scores for the scales according to the belief systems regarding the paranormal

| | Pva | Pc | Pt | Po | Pg | Et |
|---|---|---|---|---|---|---|
| **Non-believers** | ≥60 | ≥40 | ≥60 | ≥40 | ≥60 | ≥70 |
| **Agnostics** | ≥60 | ≥40 | ≥40 | ≥30 | ≥60 | ≥60 |
| **Believers** | ≥40 | ≥40 | ≥30 | ≥30 | ≥60 | ≥60 |

by the subjects for these experiences, providing a new clinical hypothesis which goes into detail about the psychopathological limitations of these perceptions. Finally, although the EFA structured the first theoretical model in empirical and exploratory terms, the factorial solution should be validated later with confirmatory factor analyses (CFAs). Thus, in future research, it also seems essential to test the MMSI-2-R with new samples and CFAs. As a complementary limitation, it would have been ideal to include other constructs that are expected to be correlated with anomalous phenomena. This would improve the discriminant validity of the questionnaire, suggested as a proposal for future research.

To conclude, the evidence provided by the MMSI-2-R suggests the importance of paying attention to the belief system of each subject before estimating the possible underlying psychopathological risks for this class of experience. Moreover, the critical T-scores show and suggest new criteria that could be used in psychological assessment to explore and identify which types of anomalous experience could be classified as clinical symptoms or normalized experiences. All the same, the MMSI-2-R, which comprises 49 items and can be completed in under ten minutes, allows for exploration, in a reliable and valid manner, of the intensity and prevalence of anomalous experiences in relation to their sensory-perceptive categories.

# DECLARATIONS

## Funding statement

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

## Competing interest statement

The authors declare no conflict of interest.

## Human Ethics

Participants gave their written consent to use their anonymous data for statistical purposes. All of them were over 18 years of age and voluntarily collaborated without receiving any financial compensation. The procedures were carried out in compliance with the institutional regulations of the university and the Spanish Government Data Protection Law 15/1999. Similarly, all procedures adhere to the Helsinki Declaration of 1975, revised in 2013.

## Additional information

Professionals or researchers who wish to use the MMSI-2-R questionnaire, may contact the author: Álex Escolà-Gascón (alexeg@blanquerna.url.edu).

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## Appendix of extra tables

Table 1A. Descriptive statistics of the items (N=1,773)

| | Mean | Standard deviation | Variance | Asymmetry S.E. = .058 | Kurtosis S.E. = .116 |
|---|---|---|---|---|---|
| Item 1 | 3.24 | 1.722 | 2.966 | -.223 | -1.724 |
| Item 2 | 4.83 | .617 | .381 | -4.853 | 25.816 |
| Item 3 | 3.82 | 1.391 | 1.935 | -.954 | -.334 |
| Item 4 | 4.27 | 1.103 | 1.216 | -1.212 | .053 |
| Item 5 | 2.03 | 1.058 | 1.119 | .260 | -1.262 |
| Item 6 | 3.54 | 1.452 | 2.109 | -.848 | -.725 |
| Item 7 | 3.26 | 1.714 | 2.938 | -.253 | -1.704 |
| Item 8 | 2.32 | 1.316 | 1.731 | 1.051 | -.051 |
| Item 9 | 4.32 | 1.043 | 1.088 | -1.254 | .154 |
| Item 10 | 4.78 | .696 | .485 | -3.992 | 16.762 |
| Item 11 | 3.83 | 1.393 | 1.941 | -.951 | -.359 |
| Item 12 | 3.25 | 1.720 | 2.958 | -.236 | -1.715 |
| Item 13 | 4.82 | .637 | .406 | -4.751 | 24.371 |
| Item 14 | 3.85 | 1.385 | 1.919 | -.991 | -.259 |
| Item 15 | 2.01 | 1.114 | 1.240 | .512 | -.791 |
| Item 16 | 3.55 | 1.442 | 2.080 | -.875 | -.664 |
| Item 17 | 4.28 | 1.093 | 1.194 | -1.235 | .118 |
| Item 18 | 3.95 | 1.574 | 2.478 | -1.070 | -.623 |
| Item 19 | 3.55 | 1.447 | 2.094 | -.867 | -.683 |
| Item 20 | 3.23 | 1.720 | 2.957 | -.217 | -1.723 |
| Item 21 | 3.86 | 1.381 | 1.907 | -1.018 | -.198 |
| Item 22 | 4.22 | 1.148 | 1.319 | -1.195 | .075 |
| Item 23 | 3.82 | 1.402 | 1.965 | -.965 | -.335 |
| Item 24 | 3.25 | 1.719 | 2.956 | -.245 | -1.712 |
| Item 25 | 3.83 | 1.395 | 1.947 | -.966 | -.331 |
| Item 26 | 4.29 | 1.085 | 1.176 | -1.233 | .099 |
| Item 27 | 3.24 | 1.707 | 2.914 | -.219 | -1.712 |
| Item 28 | 3.55 | 1.445 | 2.088 | -.866 | -.680 |
| Item 29 | 4.79 | .708 | .502 | -4.384 | 19.807 |
| Item 30 | 2.98 | 1.682 | 2.829 | .093 | -1.632 |
| Item 31 | 2.11 | 1.380 | 1.905 | 1.133 | -.030 |
| Item 32 | 4.83 | .616 | .380 | -4.796 | 25.282 |
| Item 33 | 3.55 | 1.450 | 2.103 | -.860 | -.700 |
| Item 34 | 3.24 | 1.711 | 2.928 | -.232 | -1.706 |
| Item 35 | 4.30 | 1.068 | 1.141 | -1.283 | .308 |
| Item 36 | 2.33 | 1.320 | 1.743 | 1.021 | -.125 |
| Item 37 | 3.83 | 1.402 | 1.965 | -.986 | -.306 |
| Item 38 | 3.86 | 1.389 | 1.928 | -1.021 | -.211 |
| Item 39 | 4.28 | 1.079 | 1.163 | -1.204 | .018 |
| Item 40 | 1.93 | 1.035 | 1.072 | .356 | -1.391 |
| Item 41 | 3.25 | 1.709 | 2.919 | -.238 | -1.705 |
| Item 42 | 4.83 | .618 | .381 | -4.836 | 25.673 |
| Item 43 | 4.47 | 1.070 | 1.145 | 2.252 | 4.098 |
| Item 44 | 4.29 | 1.083 | 1.172 | -1.226 | .077 |
| Item 45 | 4.26 | 1.092 | 1.193 | -1.200 | .071 |
| Item 46 | 2.33 | 1.324 | 1.752 | 1.020 | -.134 |
| Item 47 | 4.81 | .664 | .441 | -4.381 | 20.273 |
| Item 48 | 4.25 | 1.123 | 1.262 | -1.221 | .112 |
| Item 49 | 4.27 | 1.106 | 1.224 | -1.233 | .135 |

Current Research in Behavioral Sciences 1 (2020) 100005

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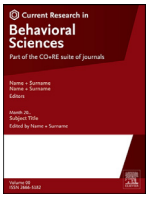

# Researching unexplained phenomena II: new evidences for anomalous experiences supported by the Multivariable Multiaxial Suggestibility Inventory-2 (MMSI-2)

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ARTICLE INFO

*Keywords:*
Parapsychology
Paranormal beliefs
Hallucinations
Anomalous experiences
Unexplained phenomena
Lie detection

ABSTRACT

*Anomalous phenomena* are human experiences that are characterized by challenging the foundations of current scientific ontology (i.e., psi phenomena). The problem lies in the fact that some studies have obtained significant results that support the existential validity of psi phenomena. This fact calls into question the role of psychology -and specifically that of psychological assessment- in scientifically justifying and objectively evaluating this type of behavior. This work examines the construct validity and reliability of the *Multivariable Multiaxial Suggestibility Inventory-2* (MMSI-2), a psychometric test that measures both anomalous phenomena and the main psychological predictive variables that could generate them. The study included 804 participants without psychiatric history. The participants were evenly distributed into two groups: participants who *believe* in the existence of the paranormal and participants who are *non-believers. Confirmatory factor analysis* was applied, *factorial invariance* between both groups was examined, and *Cronbach's alpha* and *Omega* reliability coefficients were calculated. The results allowed accepting the 'strong factorial invariance' for the internal structure of the MMSI-2. In parallel, *latent means* analysis indicated that believers had higher scores than non-believers in the 4 latent variables of the test. *Regression models* indicated that the *Clinical Personality Tendencies* (CPT), *Incoherent Manipulations* (IMA) and *Altered States of Consciousness* (ASC) scales predicted 51.2% of anomalous phenomena. It is concluded that the MMSI-2, with its 174 items and 20 scales, is a valid and reliable psychometric instrument. This research is a continuation of the Escolà-Gascón (2020) report, in which the first psychometric properties of the MMSI-2 were published.

## 1. Introduction

Certain types of behaviors that are scientifically difficult to explain are called *anomalous phenomena* (e.g., French and Stone, 2014), although they do not have to be inexplicable (see Lange et al., 2019). Research into these phenomena is complex because they challenge or might appear to contradict current scientific ontology (e.g., Parkinson, 2019). These phenomena can be very diverse and vary according to each scientific discipline (e.g., Bobrow, 1983, 2003). This report focuses on the psychometric study of *'psi' phenomena* and of anomalous experiences associated with parapsychology. The term 'psi' phenomena serves to classify the investigation of three objects of study (e.g., Irwin and Watt, 2007; Jinks, 2019): (1) *anomalous mind-to-mind communication* (also informally called "telepathy"); (2) *anomalous anticipation of information* (called "precognition"); and (3) *anomalous mind-matter interaction* (informally known as "psychokinesis") (see also Eysenck and Sargent, 1982). In some cases, other phenomena related to parapsychology are also included, such as *mediumship* or *out-of-body experiences* (hereinafter OBEs), which makes the classification of the 3 previous categories vary according to the criterion applied by professional researchers (e.g., Beischel and Zingrone, 2015). From psychiatry and clinical psychology, these behaviors are justified as hallucinatory symptoms (e.g., Kelly et al., 2020), perceptual alterations or bias (e.g., Wright et al., 2020) and as belief systems that allow the attribution of "paranormal" meanings to the daily experiences that each subject experiences (e.g., Irwin, 2009, 2003; Irwin et al., 2013; Jinks, 2019). For this reason, in place of informal terminology, the use of the expression "anomalous phenomena" or "anomalous behavior" is accepted. On the one hand, they are behaviors whose clinical or psychopathological value is unclear (e.g., David, 2010; Nordgaard et al., 2019) and, on the other hand, they also assume the hypothesis that some unknown psychological mechanism intervenes in the development of these behaviors (e.g., Utts, 2018). This hypothesis is called the *'psi' hypothesis* and differs from the paranormal model in that it does not assume the existence of supernatural forces or realities (e.g., Mayer, 2017). However, many researchers confused this hypothesis and understood it as one more expression of beliefs in the paranormal (see Carter, 2012).

In any case, anomalous phenomena are observable behaviors in psychiatric and psychological evaluations (e.g., Parker, 2006; Shapiro et al., 2019). Because of this, psychology and psychiatry play a role in how to

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https://doi.org/10.1016/j.crbeha.2020.100005
Received 5 October 2020; Received in revised form 27 October 2020; Accepted 10 November 2020

evaluate, quantify and identify the criteria that should be used to scientifically explain this type of behavioral anomaly (e.g., Lawrence, 2016). There is sufficient evidence that discredits or questions the scientific validity of 'psi' phenomena (see O'Keeffe and Wiseman, 2005; Reber and Alcock, 2019; Wagenmakers et al., 2011). However, this type of phenomenon is not incompatible with the scientific method, and numerous studies present significant results in favor of the 'psi' hypothesis (e.g., Beischel et al., 2015; Bem, 2011; Bem et al., 2016; Honorton, 1985; Kelly and Arcangel, 2011; Maher, 1999, 2000, 2015; Maher and Hansen, 1992, 1995; Mossbridge et al., 2012; Robertson and Roy, 2001, 2004; Roy and Robertson, 2001; Schwartz and Russek, 2001). Thus, it is no longer a debate exclusive to the "philosophy of science." The fact that there is scientific research with results that support the validity of the 'psi' hypothesis makes the scientific discussion of these objects of study also methodological (e.g., Jinks, 2019). According to Tressoldi and Utts (2015), this has three main implications: (1) the systems used in scientific research to measure and quantify the 'psi' phenomena must be examined; (2) the methodological designs and statistical analyses used should be reviewed; and (3), the procedures and results of the investigations should be replicated. Therefore, all this requires the application of the scientific method in the evaluation and examination of anomalous phenomena. It should be noted that the method used can be applied at different levels and ways (e.g., Bunge, 2013; Wright and Hallquist, 2020). One of these ways or levels is the psychometric approach, especially using self-reporting techniques (e.g., Abad et al., 2015).

One of the problems is how to evaluate the behavior of an individual in an objective and scientific manner (e.g., Groth-Marnat, 2009). Although the method of direct and systematic observation is applicable in clinical psychology, the technique most commonly used in evaluation is indirect observation through structured self-reporting tests (e.g., Miller and Lovler, 2020). These self-reporting tests have several classifications (see Weiner and Greene, 2017), but the two most commonly used are *structured interviews* and *self-report questionnaires*. The self-report questionnaires allow the psychometric profile to be traced with the scores associated with the psychological variables that could explain a certain type of behavior/discomfort (e.g., Kline, 2013). There are multiple questionnaires or psychometric instruments that serve to quantitatively measure anomalous phenomena (e.g., Bell et al., 2006; Mason and Claridge, 2006; Stefanis et al., 2002).

In the context of anomalous experiences, self-report questionnaires have been used for three main purposes: (1) as measures to quantify **hallucinatory behaviors** and to try to discriminate the most intense (pathological) symptomatology from the most attenuated symptomatology (not pathological) (e.g., Johns and van Os, 2001; Shapiro et al., 2019; van Os et al., 2009). This idea is based on the *psychosis continuum* model and is not only applied with hallucinatory symptoms but also includes other traits attributed to psychotic symptoms, which are summarized in the so-called *negative symptoms* (see Fekih-Romdhane et al., 2020). The purpose of evaluating hallucinations refers to identifying the *psychotic phenotype* that would allow estimating and preventing future psychotic crises (e.g., Oliver et al., 2019). (2) They have also been used to quantify **perceptual distortions or alterations** and **cognitive biases** (e.g., Barberia et al., 2013; Barberia et al., 2018; Groome et al., 2019; Khun et al., 2016). This use comes from the *semiotic model of perception* and from cognitive psychology, which determine a very clear difference with respect to hallucinations: in perceptual distortions, a provocative sensory object exists, but it is perceived in an altered way (e.g., Belloch et al., 1995). In contrast, the hallucination develops without provocative sensory stimuli, and it is the patient who infers new unreal perceived content (e.g., Upthegrove et al., 2015). The objective of these questionnaires is related to basic science applied to the psychology of perception and the exploration of illusory symptoms (which are not hallucinations) present in both psychotic symptoms (e.g., Chapman et al., 1978) as in other non-psychotic clinical conditions, such as *eating disorders* (e.g., Sirvent et al., 2019). (3) Another use is found in the **measurement of belief systems and mental representations** associated with the paranormal (e.g., Font, 2016; Heotis, 2019; Irwin, 1993, 2000, 2003, 2009; Jaspers, 1993). This is based on the *phenomenological model* and on the part of cognitive psychology that studies mental processes related to consciousness (e.g., French and Stone, 2014). This model postulates that certain scientifically impossible phenomena—for example, *hearing the thoughts of another person* (which would be an experience of mind-to-mind interaction)—are not explained by hallucinatory or perceptual errors (e.g., Irwin, 2009). According to Irwin et al. (2013) this type of experience is a subjective cognitive attribution that generates a magical interpretation of an ordinary and extraordinary situation. The concept of "extraordinary" describes uncommon but scientifically possible situations. An example is the phenomena of random coincidences (e.g., *having the feeling that something bad has happened to someone and that later is true*). It is possible that the presentiment is explained both by the hypothetical-deductive rational processes developed by the subject, as well as by processes of a more emotional or intuitive nature (e.g., Jinks, 2019; Parkinson, 2019). In any case, it is the individual who mentally represents this phenomenon under an attribution that can be inclusive within the framework of science or exclusive to the scientific world (which in this case would be the "paranormal" attribution) (e.g., Drinkwater et al., 2017). The importance of this model lies in the type of representation that the subject produces and not in whether the phenomenon occurred as described by the patient (e.g., Cameron, 2016; Font, 2016).

For the 'psi' phenomena, the following detail should be clarified: None of the three previous points accepts the ontological and scientific validity of 'psi' phenomena (e.g., Reber and Alcock, 2019). In reality, in the psychological evaluation, it is not necessary to check whether the anomalous phenomenon described by the patient has a direct empirical reference, but its irrational and divergent content with scientific discourse should not necessarily verify its hallucinatory condition (e.g., Bobrow, 2003). This is a clear example of the *Aristotelian fallacy of verifying a consequence from an uncertain cause* (e.g., Pardo and Román, 2013). Assuming that it is a "perceptual alteration" (consequence) because "the discourse seems incompatible with the rational principles of science" (antecedent) is equivalent to the following fallacious statement: "the ground is wet (consequence) because it has rained (antecedent)". The antecedent is uncertain because the ground may have gotten wet in many other ways. Confirmation that it had rained would also not exclude other possibilities; for example, someone might have previously been washing with water. The same happens with the 'psi' phenomena evaluated in psychiatric practice: it can be accepted that there are "perceptual alterations" (consequence), but not because their content is "scientifically impossible" (antecedent). Other possible hypothetical precedents may exist within the scientific framework, such as that the patient simulates or undertakes fraud (e.g., Leonard and Williams, 2019). Another possibility would be cognitive biases such as the *Barnum effect* (e.g., Shermer, 2011) or the systems of meaning themselves (see Irwin, 2009).

All this indicates that when faced with an anomalous experience, especially a supposed 'psi' phenomenon, the causes should not be judged from the "diagnostic impression" (e.g., Parker, 2006). Even in a clinical examination, the hypothetical causal antecedents must be scientifically contrasted using the tools provided for this purpose (e.g., Groth-Marnat, 2009). It is at this point that several problems arise.

First, in the scientific literature, there are no psychometric tools that assess anomalous phenomena, including the three applications described in the previous paragraphs (e.g., Houran et al., 2019). Psychometric scales can be found that separately and independently examine anomalous phenomena such as hallucinations, distortions or perceptual illusions and belief systems (e.g., Wahbeh et al., 2019). The main drawback is that they are analyzed as if they were independent psychiatric or psychological models, when in reality they are correlated with each other (e.g., French and Stone, 2014). Second, although these specific scales present satisfactory statistical validation, none of them explore other possible psychological antecedent variables that can correlate with

the anomalous experiences experienced. Knowing and analyzing these concomitant variables is something that could also contribute to psychological intervention, since they would give clues to the health professional about what dimensions should be modified to achieve a therapeutic change (e.g., Harary, 2006). Third, while it is true that clinical questionnaires are available to examine standardized psychiatric traits and symptoms (e.g., Butcher et al., 2019), it is also true that the items from these instruments were originally designed and validated with a medical-pathological population (e.g., Morey, 2011). This is another drawback because although the items and their scores are measured with non-clinical control groups, their content will remain pathological because it will not vary qualitatively (e.g., Butcher et al., 1995; Fernández-Ballesteros, 2011). This impairs the professional evaluation of anomalous phenomena in the general population because according to this logic, the experiences would be assumed to be exclusively pathological hallucinations (e.g., Parker, 2006). As Pasricha (2011) warns, classic clinical inventories are tools that in this study object provide biased information that does not help professional researchers make effective decisions. New tools are needed to explore the main hypothetical data and help the researcher or health professional make more accurate and objective clinical decisions (e.g., Waugh et al., 2017; Wright and Hallquist, 2020).

This report examines the confirmatory validity and reliability indices of the *Multivariable Multiaxial Suggestibility Inventory-2* (MMSI-2). Specifically, the factorial invariance of the MMSI-2 is analyzed in a group of subjects who believe in the paranormal and another group formed by non-believers. The purpose is to know if the believing subjects tend to score higher in the MMSI-2 than the non-believers, and should that be the case, if the reasons for these higher scores are related to the act of believing in the paranormal or to the MMSI-2. The MMSI is a psychometric instrument that quantifies anomalous phenomena by integrating them and relating them with 12 other psychological variables: *Inconsistencies* (K), *Lies* (L), *Fraud* (F), *Simulation* (Si), *Neurasthenia* (Nt), *Substance Use* (Cs), *Suggestibility* (Su), *Thrill-Seeking* (Be), *Histrionism* (Hi), *Schizotypy* (Ez), *Paranoia* (Pa) and *Narcissism* (Na). The test groups the anomalous phenomena into four dimensions: *Anomalous Visual/Auditory Phenomena* (Pva), *Anomalous Tactile Phenomena* (Pt), *Anomalous Olfactory Phenomena* (Po) and *Anomalous Cenesthetic Phenomena* (Pc). The objective of this report lies in contrasting the theoretical structure of MMSI-2, which is based on *exploratory factor analysis* (EFA) applied previously by Escolà-Gascón (2020) in a sample of more than 3,000 subjects. According to the results of the first validation phase, the 16 dimensions were distributed into 4 latent variables: *Clinical Personality Tendencies* (CPT), *Anomalous Perceived Phenomena* (APP), *Incoherent Manipulations* (IMA) and *Altered States of Consciousness* (ASC). Therefore, we intend to analyze the statistical relationship between the 4 latent variables and whether the CPT, IMA and ASC factors are correlated with perceptual alterations (APP).

## 2. Methods

### 2.1. Participants

The subjects who were part of this study came from the Spanish general population, specifically from Madrid (50%) and Barcelona (50%) ($N_{total}$=804). The participants signed an informed consent form, voluntarily collaborated with the study without receiving any financial compensation and reported no psychiatric history. The latter was the main inclusion criterion, since if the participants had a psychopathological history, the probability of suffering from a mental disorder would be higher and, therefore, also the probability of belonging to a medical population group. The sampling was not probabilistic.

The 804 subjects were classified according to two groups: (1) *believers in the existence of the paranormal* (N = 402) and (2) *nonbelievers in the existence of the paranormal* (N = 402). This classification was made from self-reported data that participants declared about their belief system. Each participant was asked the following question: *Do you believe that paranormal phenomena exist?* The subjects who answered 'yes' were part of the 'believing group' and those who answered 'no' formed the 'non-believers'. In each group, the number of subjects associated with the variables *sex* (men and women), *educational level* (classified according to the *National Statistics Institute of Spain*) and city of residence (Madrid or Barcelona) were equal to 50% except for 33.3% in the case of 'educational level'. This descriptive information is specified in Table 1.

For the analysis of the *age* variable, the *means* (M) and the *standard deviations* (SD) were calculated for each specific group of subjects. Again, Table 1 summarizes the information of these statistics. The age of the participants did not show significant differences in their means between the group of believers and non-believers. This ensured that the means associated with age were similar in each sample and that they their dispersion was homogeneous.

### 2.2. Procedure

This study is based on multivariate and *ex post facto* research designs, mainly using *structural equation models* and statistical analysis of *invariance*. The preparation of the research, data collection, statistical analysis and the report presented here are part of a university project that aims to measure statistics and psychological prediction of anomalous phenomena. This project began in 2013 and triggered the development of the *Multivariable Multiaxial Suggestibility Inventory-2* or MMSI-2, a new psychometric test that evaluates anomalous phenomena and the main psychological indicators that could justify them scientifically (see Escolà-Gascón and Gallifa, 2020). The construction of the MMSI-2 and part of its statistical justification are described in Escolà-Gascón (2020). This fact is relevant because it supports the beginnings of the research presented here.

To summarize, the wording of all the items of the MMSI was based on the scientific literature that related abnormal experiences with certain psychological attributes (e.g., Irwin, 2009). No initial or previous theoretical model was used. Decisions about which items should be written and what possible scales could be developed in the MMSI were determined by the empirical evidence published in the current scientific literature. The main psychological variables significantly correlated with anomalous phenomena were identified, and the MMSI items were written based on their characteristics or properties. Once the first inventory of items was developed (called the MMSI), each item was reviewed and analyzed using a content validity process. Of the 223 initial items, 49 were eliminated. The remaining 174 items were applied to a large sample of subjects belonging to the Spanish general population (N = 3,224). By not having a prior theoretical model, it was decided to contrast its empirical value and internal structure by applying various *exploratory factor analyses* (EFAs). The factorial solutions determined which groups of items would form the scales of the test. Then, using the direct scores of these scales, an initial scale and standardization of the MMSI with differentiated normative groups according to the variable 'sex' was performed. These first analyses concluded with the MMSI-2 version. The present research is based on these analyses and examines the construct validity of the MMSI-2 according to the empirical-statistical scales constructed from the initial EFAs (see Escolà-Gascón, 2020). Fig. 1 shows a diagram that summarizes the dimensions of the MMSI-2, its macrofactors and scales.

The hypothetical model aims to correlate the anomalous phenomena grouped in the latent variable APP with the other variables. Fig. 1 only represents the hypothesis of the model to contrast based on the initial EFAs.

After defining the structural model and the measurement model, in July 2018, the methodological preparation of the sampling and application materials began, and the collaborating professionals who would be responsible for the collection of the sample were contacted (see the acknowledgments section). At this point, the informed consents were also drafted, it was ensured that the recorded data of the participants was anonymous and the survey was designed to identify the previous so-

**Table 1**
Subject recounts and sample settings.

| | Groups | Initial sample (N= 946) | Removal process (Removed= 142) | Final sample (N=804) |
|---|---|---|---|---|
| Sex | | | | |
| *M* | Believers | 217 | 16 | 201 |
| | Non-believers | 266 | 65 | 201 |
| *W* | Believers | 217 | 16 | 201 |
| | Non-believers | 246 | 45 | 201 |
| Education level | | | | |
| *A* | Believers | 144 (M= 50; W= 94) | 10 (M= 4; W= 6) | 134 (M= 46; W= 88) |
| | Non-believers | 163 (M= 58; W= 105) | 29 (M= 23; W= 6) | 134 (M= 35; W= 99) |
| *B* | Believers | 138 (M= 67; W= 71) | 4 (M= 4; W= 0) | 134 (M= 63; W= 71) |
| | Non-believers | 175 (M= 66; W= 109) | 41 (M= 23; W= 18) | 134 (M= 43; W= 91) |
| *C* | Believers | 152 (M= 100; W= 52) | 18 (M= 8; W= 10) | 134 (M= 92; W= 42) |
| | Non-believers | 174 (M= 142; W= 32) | 40 (M= 19; W= 21) | 134 (M= 123; W= 11) |
| Spanish Cities | | | | |
| *BCN* | Believers | 219 (M= 148; W= 71) | 18 (M= 11; W= 7) | 201 (M= 137; W= 64) |
| | Non-believers | 262 (M= 185; W= 77) | 61 (M= 34; W= 27) | 201 (M= 151; W= 50) |
| *Mad.* | Believers | 215 (M= 69; W= 146) | 14 (M= 5; W= 9) | 201 (M= 64; W= 137) |
| | Non-believers | 250 (M= 81; W= 169) | 49 (M= 31; W= 18) | 201 (M= 50; W= 151) |
| Age | Believers | Mean= 27.72; SD= 12.454 | *t* test= -0.076; *df*= 802; *p*= 0.939<br>*U* test= 79,079.5; *p*= 0.599<br>*Z* test= -0.526; *p*= 0.599 | |
| | Non-believers | Mean= 27.65; SD= 12.482 | | |

Note: *A= Compulsory secondary education or basic vocational training; B= Baccalaureate or higher vocational training; C= university or higher education; M= Men; W= Women; BCN= Barcelona; Mad.= Madrid; df= Degrees of freedom; SD= Standard Deviation.*

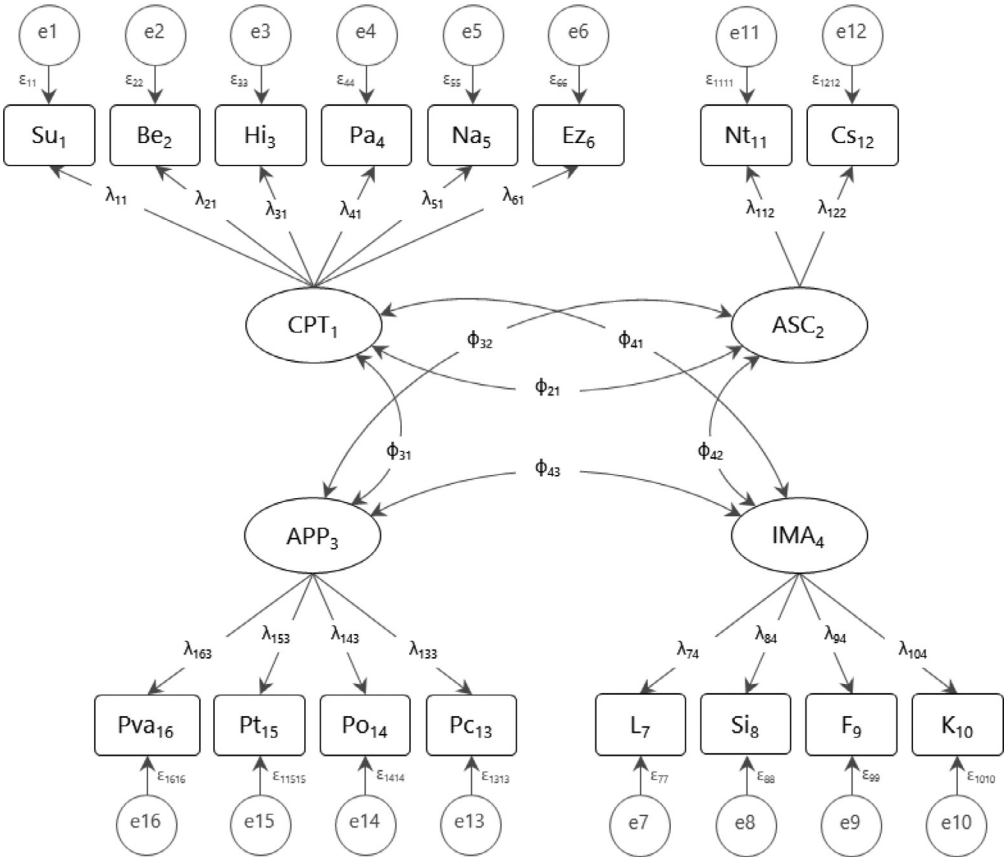


**Fig. 1.** Hypothetical model of the internal structure of the MMSI-2 using structural equations.

ciodemographic data. The direct scores obtained for each MMSI-2 scale were recorded in the data matrix. Although in the exploratory validation of the MMSI, psychometric scores were already made based on the T scores, the purpose of this research was statistical and was not intended to question or define individual interpretation criteria that require the study of the metric quality of the scales. Therefore, we chose to work statistically with the direct scores instead of using the T scores, which were still recently obtained and lacked subsequent statistical replications. In the same vein and following the example of Arribas (2011), the responses of the 174 items of the MMSI-2 were not recorded because each professional was provided with a system of correction templates that automatically allowed obtaining the direct scores for each factor. This was done to facilitate sample collection and computation of the data.

In September 2018, formal data collection began. Between January and March 2019, data entry began, and an initial sample sufficiently

large (N = 359) was collected to carry out a prior statistical check. Statistical normality tests were performed, the heterogeneity of the data was analyzed, and the correlation matrix was examined. These first analyses supported the idea of applying a CFA and continuing with expanding the sample. It was at this point when it was decided to continue collecting data to apply CFAs in different types of samples. This converted the research design into a *multiple-group model*. This design offers the possibility of performing a statistical analysis of *configural invariance, weak factorial invariance (metric), strong factorial invariance (scalar)* and *strict factorial invariance (residual)* (see Brown, 2015).

In December 2019, the data collection phase ended. In total, 946 subjects participated (42% men and 58% women). During that month, the statistical control technique of *equalizing* proportions over recorded sociodemographic variables was applied (see Fleiss et al., 2003). This information is summarized in Table 1. First, the number of subjects was matched according to the variable *beliefs in the existence of the paranormal*. Two groups were established, one consisting of subjects who claimed to be believers in the existence of the paranormal (N = 476) (believing subjects) and another with individuals who did not believe in the paranormal (N = 476) (unbelieving subjects). Second, the number of subjects was also balanced according to the variables *sex* (men and women); *educational level* (compulsory secondary education or modules of basic professional training, baccalaureate studies or higher professional training and university or higher education); and *place of residence* (Barcelona or Madrid). Taking into account the objective of the 'equalizing technique', a total of 142 subjects were eliminated using 4 steps: (1) First, counts for each subgroup were performed. (2) The decision of how many subjects should be excluded to match the counts was determined by the *minimum observed frequency of subjects* in the subgroups classified in Table 1. The smallest observed frequency was that belonging to the variable 'educational level' for category B and for the believers sub-group, which had a recount of 138 subjects. (3) The third step was related to *outliers*. At this point, it was observed that there were 4 subjects with atypical direct scores on the scales of the L (Lies), Pva (Anomalous Visual/Auditory Phenomena) and K (Inconsistencies) tests. These scores were below the minimum value that can be obtained in the respective scales. Therefore, these 4 subjects were eliminated from believers sub-group B, reducing its number to 134. As it was the smallest frequency within the variable 'educational level', the value 134 was the corrected minimum value ($MV$) that all subjects should have distributed in that variable, since:

$$MV_x = \left(MO_{ij} - AV_{ij}\right)$$

$$MV_{EL} = \left(MO_{BB} - AV_{BB}\right)$$

$$= (138 - 4) = 134 \cdot 6 = 804$$

where

$MV_x$ is the corrected minimum value of the *counts* of the *x* variable 'educational level' or *EL*;

$MO_{ij}$ is the minimum observed frequency in the *i* group and in the *j* subgroup of the selected variable, which in this case is educational level *B* and the subgroup is that of believers (now also *B*); and

$AV_{ij}$ is the number of cases with outliers observed in the *i* group and in the *j* subgroup of the selected variable, which in this case is educational level *B* and subgroup *B*.

The matching of these 6 subgroups to 134 subjects yields a total number of 804 subjects, which was also used to balance the groups of the other sociodemographic variables in parallel. (4) At this time, the fourth filter was applied simultaneously. Knowing that in the variables 'sex' and 'city of origin' the distinction was made between believing and non-believing subjects, in total, there should be 4 sub-groups in each of the two previous variables (see Table 1). If the final sample had 804 subjects in total, each of these 4 groups had 201 subjects. Thus:

$$O_{ij} - O'_{ij} = O_{1B} - O'_{1B} = 219 - 201 = 18$$

$$O_{1NB} - O'_{1NB} = 262 - 201 = 61$$

$$O_{2B} - O'_{2B} = 215 - 201 = 14$$

$$O_{2NB} - O'_{2NB} = 250 - 201 = 49$$

where

- $O_{1B}$ is the observed frequency belonging to BCN (1) and the subgroup of believers (B)
- $O_{1NB}$ is the observed frequency belonging to BCN (1) and the subgroup of non-believers (NB).
- $O_{2B}$ is the observed frequency belonging to Madrid (2) and sub-group B.
- $O_{2NB}$ is the observed frequency belonging to Madrid (2) and subgroup NB.
- $O'_{ij}$ are the relative frequencies of the assigned number of subjects (201).

(5) Finally, for each of the previous results (also applied to the variable 'educational level'), random quantities of men and women were eliminated. In total, 81 women and 61 men were eliminated. It was not possible to match the variable sex in the eliminations because the original counts did not allow it. It is important to highlight that eliminating the men and women from the cases was done randomly to eliminate the previously selected variables of city of residence and 'educational level'. The selection of these cases was not completely random since the presence of outliers (as indicated in step 3) was also taken into account. Thus, of the 18 subjects selected to be eliminated in the case of $O_{1B}$, 2 of them contained outliers. The remaining 16 subjects were randomly eliminated. This logic was applied in the rest of the eliminations. In total, the initial sample had 23 cases with outliers that were eliminated. In the remaining cases (of the 119 remaining subjects), the elimination of men and women was random. In any case, the final sample (N = 804) did not have cases with atypical scores. The variable 'age' was analyzed by comparison of means (*t-test*) and ranges (*Mann-Whitney U test*).

After the statistical cleansing of the original data matrix, data analysis and application of the structural equation models were developed, and the present research report was drafted.

### 2.3. Instruments

We used the *Multivariable Multiaxial Suggestibility Inventory-2* (MMSI-2), composed of 174 polytomous items distributed in the following scales: *Inconsistencies* (K), *Lies* (L), *Fraud* (F), *Simulation* (Si), *Neurasthenia* (Nt), *Substance Use* (Cs), *Suggestibility* (Su), *Thrill-Seeking* (Be), *Histrionism* (Hi), *Schizotypy* (Ez), *Paranoia* (Pa), *Narcissism* (Na), *Anomalous Visual/Auditory Phenomena* (Pva), *Anomalous Tactile Phenomena* (Pt), *Anomalous Olfactory Phenomena* (Po) and *Anomalous Cenesthetic Phenomena* (Pc). It also has scales elaborated empirically from different second-order factor analyses: *Clinical Personality Tendencies* (CPT), *Anomalous Perceived Phenomena* (APP), *Incoherent Manipulations* (IMA) and *Altered States of Consciousness* (ASC).

The participant must indicate up to what point he/she considers the contents of each item to be true using a 5-point *Likert* scale, which ranges between 1 (which means *completely disagree*) and 5 (which means *completely agree*). All questions must be answered. If the subject leaves items unanswered, this could lead to outliers in the dimension scores of the test (below the minimum direct score of each scale). If this occurs and cannot be resolved, the outliers should be invalidated or the entire profile should be excluded. In the Spanish version, the direct scores of each scale can be transformed to standardized scores (or T scores), which facilitate the individual analysis of scores and the preparation of psychological profiles.

The results of the test can be interpreted gradually; as the scores in each dimension increase, the greater the probability that the subject will present the respective attribute measured.

### 2.4. Data analysis

In relation to construct validity, *structural equation models* were used to contrast and analyze the theoretical structure of the MMSI-2 obtained empirically by statistical methods based on EFAs. More specifically, following the statistical recommendations of Brown (2015), the *confirmatory factor analysis* (CFA) technique was applied, and it was decided to develop a *cross-validation* psychometric design with the two samples of participants (group of believers and non-believers). We wanted to test whether the structural model of MMSI had acceptable and equivalent construct validity in both groups. When the variables are correctly measured and represented in the items of the inventory, the equality constraints imposed by the model (*configural invariance)*, the factor loadings (*weak factorial* (metric) *invariance*), the item intercepts (*strong factorial* (scalar) *invariance*) and residual variations (*strict factorial* (residual) *invariance*) should not impair the goodness of fit of the non-constrained model. According to Byrne (2014), one should test whether the changes that these constraints cause in the fit indices of the unconstrained model are significant. It is essential that the variations in the fit indices are not significant because in the contrary case, it would indicate the possibility that the contrasted models in each group would be different. This would imply questioning whether in both groups the same construct would actually be measured and, therefore, would also entail questioning the construct validity of the questionnaire. For the application of the *multiple-group* analysis based on 'strong factorial (scalar) invariance' and 'strict factorial (residual) invariance', the following steps were developed, specified by Brown (2015): (1) The hypothetical model of Fig. 1 was applied to each group separately using the CFA technique. The purpose was to ensure that the model in Fig. 1 fit satisfactorily in both groups. (2) Once the fit indices for each group of subjects were accepted, a CFA was again applied to the complete set including the two groups with and without invariance constraints. (3) Upon observing a minimal variation in the fit indices, we decided to contrast the null hypothesis of statistical significance. For this, the *Chi Square* statistic was used. Given that this statistic is highly sensitive to sample size, the criterion developed by Vandenberg and Lance (2000) was used, based on the cutoff point 0.01 in the comparative indices, specifically the *comparative fit index* (CFI). If the application of a determined invariance constraint caused this index to vary in an amount equal to or greater than 0.01, then the null hypothesis of equality would be rejected, and the result would suggest that the structural model is not the same in the groups. The equality between the empirical *covariance matrices* of the two groups was not analyzed because this statistical contrast can yield errors and results that would contradict the subsequent invariance analysis (e.g., Byrne, 2014; Byrne et al., 1989; Jaccard and Wan, 1996). As a preliminary exploration, it is worth noting that prior to the CFAs, EFAs were applied to ensure whether it was recommendable to proceed with the subsequent structural equations. All CFAs were based on the *maximum likelihood* method, and EFAs were calculated using the *unweighted least squares* method. Likewise, these analyses were carried out with the statistical program *SPSS.25* and its extension *AMOS*, specializing in structural equation models.

Reliability was analyzed based on the *Cronbach's alpha coefficient* ($\alpha$), taking into account that the MMSI scales are quantitative interval variables. This statistic examines the *internal consistency* of the scores from the *variance-covariance matrix* between the scales of the test. However, the *Cronbach's alpha* becomes unstable when the matrix dimension is $2 \times 2$ and penalizes the consistency when the values of the variables are excessively heterogeneous (see Abad et al., 2015). As an alternative and complementary analysis, the calculation of *Omega's reliability coefficient* ($\omega$) was applied. Although there are numerous estimates, all of them are based on the model factor loadings and on the *communality* of the items (see Trizano-Hermosilla and Alvarado, 2016). Mathematical expression (1) was chosen in this study, which is based on the contributions of McDonald (1999):

$$\omega_t = \frac{\left(\sum \lambda_j\right)^2}{\left[\left(\sum \lambda_j\right)^2 + \sum\left(1 - \lambda_j^2\right)\right]} = \frac{\left(\sum \lambda_j\right)^2}{\left[\left(\sum \lambda_j\right)^2 + \left(\sum \psi\right)\right]} \quad (1)$$

where $\lambda_j$ is the factor loading of item $j$,

$\lambda_j^2$ is the communality of item $j$, and
$\psi$ is the unique variance.

This equation is incorporated into the statistical program JAMOVI (see The Jamovi Project, 2019), which is open access and was the one used for this calculation. All reliability coefficients were calculated for each group (believers and non-believers) and for the total sample.

## 3. Results

### 3.1. Initial exploratory factor analysis

Before the application of the respective CFAs, a descriptive and factorial exploratory examination of the working groups included in this research proceeded. The first point to know was whether the two groups (believers and non-believers) had similar scores and trends in the first-order scales of the MMSI. To do this, various (parametric and non-parametric) statistical hypothesis tests were calculated. All of them are specified in Tables 2 and 3. The effect size of each contrast was also examined by the *Cohen's d* (see Cohen, 1988). Significant results were obtained in the 16 scales/dimensions that suggested rejecting the null hypothesis of equality of means. Believers tended to systematically score higher than non-believers in the existence of the paranormal. The scales that obtained the largest effect sizes were dimensions L, Nt, Hi, Ez, Na and Pva. The Be scale yielded the smallest effects. Measures of central tendency and dispersion support these results. One unusual result can be observed in the *Mann-Whitney U test* of the L scale, whose critical value tends to infinity and therefore is truncated to 0. This also indicates that the difference between the means (more specifically between *interquartile* ranges) exceeds the standard deviation of the group of non-believers six-fold.

The EFA applied in each of the groups shows a similar factorial solution between the two types of samples. Unlike CFAs, in EFAs, it is advisable to apply the *unweighted least squares* extraction method, since it is the most conservative and allows the previous calculation of the 'communalities' necessary to deduct the subsequent factor loadings (e.g., Mulaik, 2018). As seen in Table 4, in each group, 4 latent factors were extracted with eigenvalues greater than 1. The EFA applied to the group of believers explained 87.75% of the total variance. In contrast, the group of non-believers yielded a total explained variance of 81.91%. In this same group, it seems that the K, L, F and Si scales also have a high saturation in the first factor (CPT). However, the loads of these dimensions remain highest in the third factor (IMA). These preliminary results favor the use of CFAs through structural equations and indicate that it is recommended to contrast the internal structure of the MMSI in both groups.

### 3.2. Multiple-group structural equation models

For each group, the CFA technique was applied based on the structural model of Fig. 1. Figs. 2 and 3 show the regression coefficients and standardized covariances between the respective variables of the model. As can be observed, the factorial coefficients are similar between both groups. Regarding the goodness of fit, both models presented indices with satisfactory values (see Table 5). According to Abad et al., (2015) and Kline (2013) the following adjustment indices thresholds were used: root mean square error of approximation (RMSEA, threshold= <0.05); comparative fit index (CFI, threshold= >0.95);

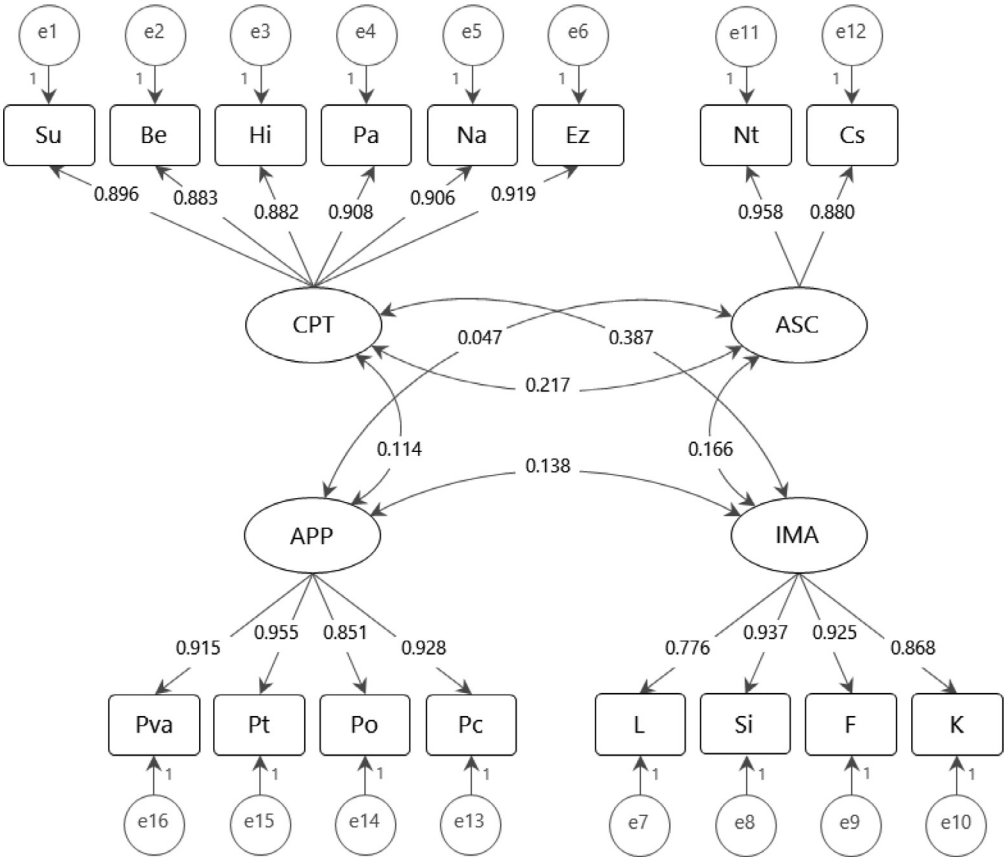


**Fig. 2.** Weighted regressions and standardized covariances between the variables of the MMSI-2 theoretical model (group of believers).

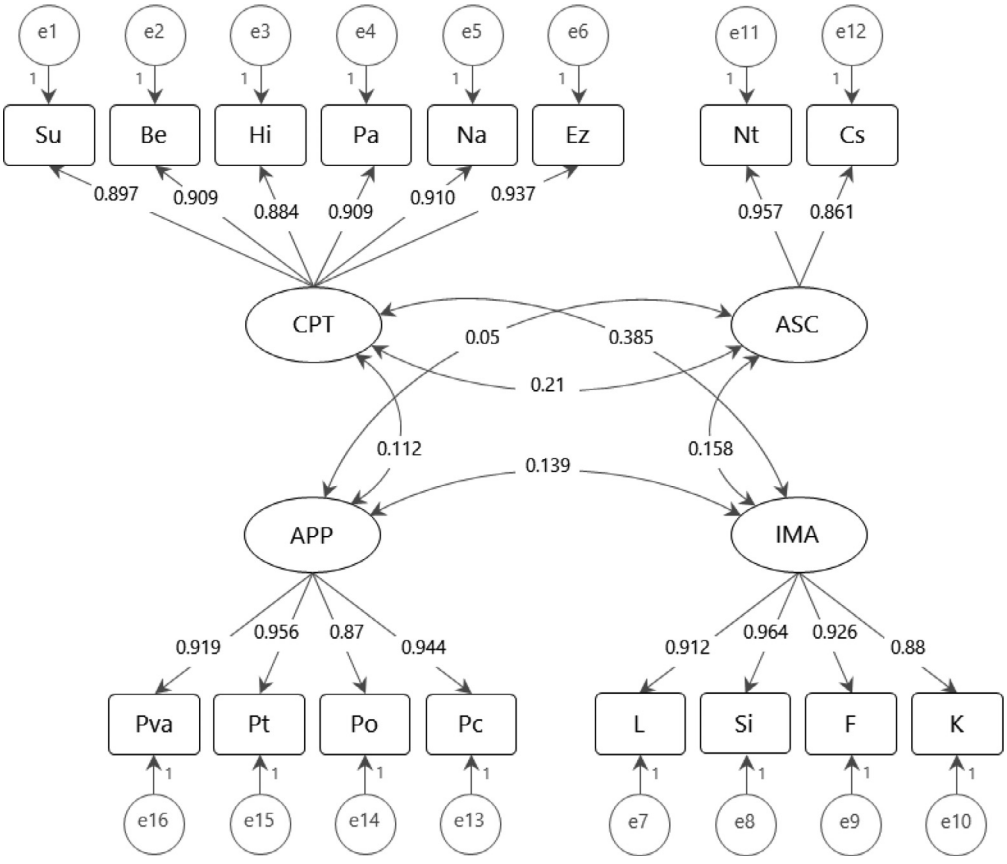


**Fig. 3.** Weighted regressions and standardized covariances between the variables of the MMSI-2 theoretical model (group of non-believers).

**Table 2**
Descriptive statistics of MMSI-2 scales.

| Scales | Believers | | Non-believers | | Complete sample | | *t test* | *Cohen's d* |
|---|---|---|---|---|---|---|---|---|
| | M | SD | M | SD | M | SD | *U test* | |
| | | | | | | | *Z test* | |
| K | 21.28 | 2.628 | 17.32 | 2.595 | 19.30 | 3.279 | −21.538 ($p$<0.001) | 1.516** |
| | | | | | | | 22,647 ($p$<0.001) | |
| | | | | | | | −17.736 | |
| L | 55 | 3.347 | 33.86 | 2.97 | 44.43 | 11.039 | −94.724 ($p$<0.001) | 6.681** |
| | | | | | | | ∞ ⇒ 0 (p<0.001) | |
| | | | | | | | −24.573 | |
| F | 42.53 | 2.862 | 31.56 | 2.853 | 37.05 | 6.186 | −54.414 ($p$<0.001) | 3.84** |
| | | | | | | | 583 ($p$<0.001) | |
| | | | | | | | −24.413 | |
| Si | 20.02 | 3.416 | 13.06 | 3.374 | 16.54 | 4.863 | −29.074 ($p$<0.001) | 2.05** |
| | | | | | | | 12,205 ($p$<0.001) | |
| | | | | | | | −20.875 | |
| Nt | 35.24 | 3.495 | 24.25 | 3.463 | 29.75 | 6.503 | −44.77 ($p$<0.001) | 3.158** |
| | | | | | | | 2008 ($p$<0.001) | |
| | | | | | | | −23.957 | |
| Cs | 14.82 | 3.086 | 11.95 | 3.047 | 13.39 | 3.385 | −13.296 ($p$<0.001) | 0.935* |
| | | | | | | | 37,248.5 ($p$<0.001) | |
| | | | | | | | −13.294 | |
| Su | 23.26 | 3.174 | 14.26 | 3.167 | 5.504 | 5.504 | −40.227 ($p$<0.001) | 2.838** |
| | | | | | | | 3466 ($p$<0.001) | |
| | | | | | | | −23.519 | |
| Be | 12.56 | 3.046 | 11.5 | 3.013 | 12.03 | 3.074 | −4.959 ($p$<0.001) | 0.35* |
| | | | | | | | 65,422 ($p$<0.001) | |
| | | | | | | | −4.694 | |

Note: K= Inconsistencies; L= Lies; F= Fraud; Si= Simulation; Nt= Neurasthenia; Cs= Substance Use; Su= Suggestibility; Be= Thrill-Seeking; M= Mean; SD= Standard Deviation; **= large effects; *= medium effects. Cohen's d was corrected using Hedge's g.

**Table 3**
Descriptive statistics of MMSI-2 scales. (Continuation Table 2).

| Scales | Believers | | Non-believers | | Complete sample | | *t test* | *Cohen's d* |
|---|---|---|---|---|---|---|---|---|
| | M | SD | M | SD | M | SD | *U test* | |
| | | | | | | | *Z test* | |
| Hi | 43.59 | 2.903 | 32.62 | 2.884 | 38.11 | 6.206 | −53.779 ($p$<0.001) | 3.791** |
| | | | | | | | 811.5 ($p$<0.001) | |
| | | | | | | | −24.339 | |
| Ez | 35.67 | 4.104 | 23.74 | 4.025 | 29.7 | 7.222 | −41.633 ($p$<0.001) | 2.935** |
| | | | | | | | 3279.5 ($p$<0.001) | |
| | | | | | | | −23.565 | |
| Pa | 28.35 | 3.203 | 19.37 | 3.165 | 23.86 | 5.504 | −39.962 ($p$<0.001) | 2.82** |
| | | | | | | | 4134 ($p$<0.001) | |
| | | | | | | | −23.328 | |
| Na | 34.36 | 3.415 | 24.4 | 3.371 | 29.38 | 6.027 | −41.62 ($p$<0.001) | 2.935** |
| | | | | | | | 3238.5 ($p$<0.001) | |
| | | | | | | | −23.591 | |
| Pva | 32.11 | 3.805 | 20.14 | 3.778 | 26.13 | 7.088 | −44.772 ($p$<0.001) | 3.157** |
| | | | | | | | 2040.5 ($p$<0.001) | |
| | | | | | | | −23.943 | |
| Pt | 25.49 | 4.007 | 16.5 | 3.997 | 20.99 | 6.019 | −31.848 ($p$<0.001) | 2.246** |
| | | | | | | | 9249.5 ($p$<0.001) | |
| | | | | | | | −21.757 | |
| Po | 24.07 | 3.921 | 16.14 | 3.845 | 20.11 | 5.547 | −28.925 ($p$<0.001) | 2.042** |
| | | | | | | | 12,327 ($p$<0.001) | |
| | | | | | | | −20.825 | |
| Pc | 20.03 | 3.903 | 16.08 | 3.86 | 18.06 | 4.354 | −14.428 ($p$<0.001) | 1.017** |
| | | | | | | | 38,352 ($p$<0.001) | |
| | | | | | | | −12.923 | |

Note: *Hi= Histrionism; Ez= Schizotypy; Pa= Paranoia; Na= Narcissism; Pva= Anomalous Visual/Auditory Phenomena; Pt= Anomalous Tactile Phenomena; Po= Anomalous Olfactory Phenomena; Pc= Anomalous Synesthetic Phenomena; M= Mean; SD= Standard Deviation; **= large effects.* Cohen's d was corrected using Hedge's *g*.

Tucker-Lewis coefficient (TLI, threshold= >0.95); incremental fit index (IFI, threshold= >0.95); Relative fit index (RFI, threshold= >0.95); Normed fit index (NFI, threshold=>0.95); adjusted goodness of fit index (AGFI, threshold= >0.9). It should be noted that the *Chi square* statistic is highly sensitive to the sample size, and the probability of significance could be altered by simply manipulating the size of the groups (e.g., Brown, 2015). Therefore, by itself, *Chi Square* could not be interpreted. These results suggested that invariance analysis could be a good option.

When fit indices were applied to the total set assuming the constraints of the different invariance models (see Table 5), their values were satisfactorily high, and the CFI had a variation lower than 0.01. The *chi-square* statistic also showed non-significant variations ($\Delta p$ *> 0.05). Unlike the analyses of a single group, in nested designs, this statis-

**Table 4**
Exploratory factor analysis.

| Scales | Believers (N= 402) | | | | Non-believers (N= 402) | | | | Ordinal alphas* |
|---|---|---|---|---|---|---|---|---|---|
| | CPT | APP | IMA | ASC | CPT | APP | IMA | ASC | |
| Ez | 0.845 | | | | 0.847 | | | | 0.997 |
| Su | 0.838 | | | | 0.829 | | | | 0.995 |
| Pa | 0.838 | | | | 0.829 | | | | 0.991 |
| Na | 0.832 | | | | 0.831 | | | | 0.997 |
| Be | 0.803 | | | | 0.820 | | | | 0.865 |
| Hi | 0.79 | | | | 0.782 | | | | 0.993 |
| Pt | | 0.897 | | | | 0.895 | | | 0.988 |
| Pva | | 0.867 | | | | 0.869 | | | 0.996 |
| Pc | | 0.864 | | | | 0.878 | | | 0.994 |
| Po | | 0.795 | | | | 0.813 | | | 0.996 |
| F | | | 0.684 | | 0.632 | | 0.670 | | 0.993 |
| Si | | | 0.668 | | 0.685 | | 0.673 | | 0.996 |
| K | | | 0.635 | | 0.624 | | 0.624 | | 0.973 |
| L | | | 0.609 | | 0.619 | | 0.669 | | 0.994 |
| Cs | | | | 0.933 | | | | 0.947 | 0.878 |
| Nt | | | | 0.831 | | | | 0.814 | 0.997 |
| % var. | 38.37 | 21.088 | 15.346 | 10.552 | 39.525 | 21.47 | 16.012 | 10.904 | - |

Note: *K= Inconsistencies; L= Lies; F= Fraud; Si= Simulation; Nt= Neurasthenia;*
Cs= Substance Use; Su= Suggestibility; Be= Thrill-Seeking; Hi= Histrionism;
Ez= Schizotypy; Pa= Paranoia; Na= Narcissism; Pva= Anomalous Visual/Auditory Phenomena; Pt= Anomalous Tactile Phenomena; Po= Anomalous Olfactory Phenomena; Pc= Anomalous Synesthetic Phenomena; CPT= Clinical Personality Tendencies; APP= Anomalous Perceived Phenomena; IMA= Incoherent Manipulations; ASC= Altered States of Consciousness; %var.= explained variance.
* Ordinal alphas came from Escolà-Gascón (2020) report.

**Table 5**
Model fit indices of the MMSI-2 internal structure and multi-group analysis.

| Indices | Initial models | | Multi-group models | | | |
|---|---|---|---|---|---|---|
| | B | NB | *Configural invariance* | *Weak factorial invariance* | *Strong factorial invariance* | *Strict Factorial invariance* |
| $\chi^2$ | 211.937 | 236.912 | 448.849 | 450.25 | 450.408 | 575.966 |
| $p$ | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 |
| $\Delta\chi^2$ | - | - | - | ↑1.401 | ↑0.158 | ↑125.558 |
| $\Delta p^{**}$ | - | - | - | N.S. | N.S. | <0.0001 |
| $X^2/df$ | 2.141 | 2.393 | 2.267 | 2.144 | 2.047 | 2.451 |
| RMSEA | 0.053 (0.043-0.063) | 0.059 (0.049-0.069) | 0.04 (0.035-0.045) | 0.038 (0.033-0.041) | 0.036 (0.031-0.041) | 0.043 (0.038-0.047) |
| CFI | 0.982 | 0.981 | 0.982 | 0.982 | 0.983 | 0.975 |
| ΔCFI | - | - | - | 0.000 | ↑0.001 | ↓0.008 |
| TLI | 0.979 | 0.977 | 0.978 | 0.98 | 0.982 | 0.974 |
| IFI | 0.983 | 0.981 | 0.982 | 0.982 | 0.983 | 0.975 |
| RFI | 0.961 | 0.961 | 0.961 | 0.963 | 0.965 | 0.958 |
| NFI | 0.968 | 0.968 | 0.968 | 0.968 | 0.968 | 0.958 |
| AGFI | 0.914 | 0.903 | 0.908 | 0.913 | 0.917 | 0.905 |

Note: B= Believers group; NB= Non-believers group; RMSEA= Root mean square error of approximation; CFI= Comparative fit index; TLI= Tucker-Lewis index; IFI= Incremental fit index; RFI= Relative fit index; NFI= Normed fit index; AGFI= Adjusted goodness of fit index; $\Delta\chi$2= Increase in the Chi Square coefficient; $\Delta p^{**}$ = Probability that the increase in Chi Square does not differ from the previous model; ΔCFI= Increase in the CFI index.

tic is also used to examine the probability that the progressive increase in the *Chi Square* itself did not differ from the initial *Chi Square* values (i.e., those belonging to the unconstrained model). If the increments present probabilities lower than 0.05 (and consequently were significant), then it would not be possible to assume factorial invariance. This would imply that the items and scales of the MMSI would not measure the same attribute in the two groups. Table 5 indicates that the increases in *Chi Square* did not yield significant probability values under the 'strong factorial (scalar) invariance' assumption. In contrast, probability did become significant under the 'strict factorial (residual) invariance' assumption. Although the ideal would have been to accept residual invariance, this situation is the most common in this type of psychometric model, and it is not necessary to assume the strictest invariance model to accept the construct validity of the test analyzed (e.g., Byrne, 2014; Little, 2013). Therefore, according to this idea, the theoretical model of the MMSI, the measurements and the content that evaluate its scales have the same meaning in both the group of believers and the group of non-believers, offering satisfactory construct validity and a good fit.

However, although the scales can have the same meaning, it does not mean that the scores of both groups are the same. Tables 2 and 3 show that the means between both groups were different. These results and the accepted invariance model allow us to examine whether the *latent means* (those belonging to the variables IMA, ASC, APP and CPT) are equal or differ from "0". This analysis can be done in several ways. The most accurate and appropriate for this type of design consists of *fixing the means of the reference group at zero*. The other means are estimated freely. In this case, the reference group is that of non-believers. In reality, the means freely estimated in the group of believers are not the empirical means of the second-order factors of the MMSI. They are average values that reflect the number of units the scores of the group of believers vary with respect to the reference group. This is the main difference with

**Table 6**
Latent means, descriptive statistics and reliability coefficients.

| G | LV | *Means* estimates (*p*) | S.E. | *OM* | *SD* | *Hypothesis Contrast Tests* | *ω* | *α* |
|---|---|---|---|---|---|---|---|---|
| Believers (N=402) | CPT | 9.09 *p*<0.0001 | 0.214 | 177.79 | 18.211 | - | 0.959 | 0.963 |
| | IMA | 7.932 *p*<0.0001 | 0.193 | 138.84 | 11.133 | - | 0.931 | 0.925 |
| | ASC | 10.867 *p*<0.0001 | 0.252 | 50.06 | 6.321 | - | 0.916 | 0.912 |
| | APP | 5.819 *p*<0.0001 | 0.209 | 101.7 | 14.617 | - | 0.952 | 0.952 |
| Non-believers (N=402) | CPT | 0 | - | 125.89 | 18.152 | - | 0.963 | 0.963 |
| | IMA | 0 | - | 95.8 | 11.118 | - | 0.957 | 0.955 |
| | ASC | 0 | - | 36.2 | 6.222 | - | 0.901 | 0.901 |
| | APP | 0 | - | 68.87 | 14.588 | - | 0.958 | 0.958 |
| Complete sample (N=804) | CPT | - | - | 151.84 | 31.693 | *t test*= -40.47* *U test*= 3552* *Z test*= -23.465* *Cohen's d*= 2.854** | 0.97 | 0.965 |
| | IMA | - | - | 117.32 | 24.233 | *t test*= -54.843* *U test*= 569* *Z test*= -24.377* *Cohen's d*= 3.868** | 0.963 | 0.892 |
| | ASC | - | - | 43.13 | 9.647 | *t test*= -31.335* *U test*= 9361.5* *Z test*= -21.716 *Cohen's d*= 2.209** | 0.866 | 0.770 |
| | APP | - | - | 85.29 | 21.974 | *t test*= -31.880* *U test*= 8915* *Z test*= -21.838* *Cohen's d*= 2.248** | 0.966 | 0.957 |

Note: *G= groups; CPT= Clinical Personality Tendencies; APP= Anomalous Perceived Phenomena; IMA= Incoherent Manipulations ASC= Altered States of Consciousness (ASC); OM= observed means; SD= standard deviation; **= large effects; ω= McDonald's Omega; α= Cronbach's Alpha.* Cohen's d was corrected using Hedge's *g*.

respect to comparison tests of groups based on the contrast of means or ranks (see Brown, 2015). Therefore, constraining the means associated with the latent variables of the non-believer group to "zero", the average dispersion values shown in Table 6 were obtained. The *p*-value of this table indicates the probability that the scores of the Believers group are distributed according to the distribution given by the scores of the reference group. All the mean estimates obtained significant probability values (<0.0001).

According to the results in Table 6, this means that the scores of the believing subjects are significantly higher than the scores of the group of non-believers. This result was confirmed through statistical hypothesis testing generated for the empirical means of each group. These data are also shown in Table 6.

### 3.3. Simultaneous regression models between latent variables

Figs. 2 and 3 show that the standardized covariances between the latent variables of the model were low. It was asked if this situation could change using the total sample (N = 804) and using the simultaneous regression models. This is justified by three main reasons: (1) in other studies, the macro-factors of the MMSI were extracted from oblique factorial solutions, allowing the possibility that the macro-factors were correlated (see Escolà-Gascón, 2020; Escolà-Gascón and Gallifa, 2020). (2) Taking into account the results of the factorial invariance, contrasting this possibility would also facilitate knowing if these belief systems modulate the covariances between the macro-factors. (3) In addition, according to Abad et al. (2015), in the behavioral sciences, orthogonal solutions are unusual, and it is most likely that there would be intercorrelations between the constructs. Therefore, to caution against possible intercorrelations between macro-factors and following the recommendations of Arribas (2011), it was decided to contrast the structural model through simultaneous regressions, as shown in Fig. 4. The 4 macro-factors defined in the previous Figs. were chosen, and their predictive value was examined, especially on the APP variable. To determine the fixing of the

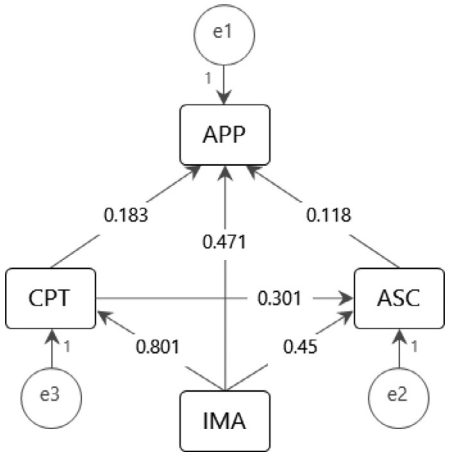


**Fig. 4.** Simultaneous regression model. Regression weights are provided.

effects, previous research that verified significant correlations between the latent variables was also taken into account.

As was suspected, when the two groups are merged, the linear correlations between the 4 factors increase significantly. Given that the regressions had been developed using the *maximum likelihood* method, the following fit indices were calculated: $\chi^2 = 8.424$ ($p = 0.004$); *normed* $\chi^2 = 8.424$; CFI = 0.996; TLI = 0.979; IFI = 0.996; RFI = 0.976; NFI = 0.996; AGFI = 0.948; and RMSEA = 0.09 (0.04-0.16).

The IMA, CPT and ASC variables explained a total of 51.2% of the variance of APP. IMA explained 64.2% of the variance of CPT. Both IMA and CPT explained 50.9% of the ASC variance. This contrast shows that IMA, CPT and ASC predict the anomalous phenomena evaluated by APP. Table 7 shows the matrix of linear correlations between macro-factors.

**Table 7**
Matrix correlations between latent variables.

| | IMA | CPT | ASC | APP |
|---|---|---|---|---|
| IMA | - | | | |
| CPT | 0.823* | - | | |
| ASC | 0.7* | 0.677* | - | |
| APP | 0.706* | 0.654* | 0.574* | - |

Note: CPT= Clinical Personality Tendencies; APP= Anomalous Perceived Phenomena; IMA= Incoherent Manipulations ASC= Altered States of Consciousness (ASC); *p<0.001.

These results suggest that the variable beliefs in existence in the paranormal could have moderating effects on the relationship between macro-factors. When this variable is isolated and recorded as a constant (establishing the two groups and imposing invariance constraints), the macro-factors lose predictive power, and the solution tends to be orthogonal.

### 3.4. Reliability analysis

*Cronbach's Alpha* and *McDonald's Omega* reliability coefficients also shown in Table 6. The values of these coefficients will be *acceptable* from 0.7 and *excellent* when they are greater than 0.9 (e.g., George and Mallery, 2003; Trizano-Hermosilla and Alvarado, 2016). Both the *omega* and *alpha* indices were calculated for each of the groups (believers and non-believers), as well as for the total set of the sample. All of them were acceptable and excellent in several cases, so it was not necessary to eliminate any scale to optimize these indices. Likewise, the lowest coefficients (especially that of the ASC dimension) can be associated with the small number of scales that are grouped. In general, the results of these indices allow us to satisfactorily accept the reliability of internal consistency in MMSI-2 scores.

## 4. Discussion

First, the validity and reliability of the MMSI-2 was tested using the statistical techniques of the structural equations, the analysis of the 'factorial invariance' and the reliability coefficients applied. The three designs showed results supporting the construct validity of the MMSI-2 and the reliability associated with its scores. Second, the initial objective of the study—based on the validation of a structural and measurement model with respect to anomalous phenomena—also had the purpose of contrasting the empirical relationship between the variables that, according to the published background, correlated with the anomalous phenomena. In this case, through the simultaneous regression models, it was possible to conclude that the 4 latent variables (CPT, ASC, APP and IMA) were positively correlated with each other when both groups were merged. Finally, the third objective was to examine the variability or change in scores between the group of believers and the group of non-believers. This was carried out through comparison of means tests and the 'latent means' analysis of the factorial model. All results supported the hypothesis that believers in the existence of the paranormal scored significantly and in most scales above those of non-believers. Each of these findings in the results raises questions and new hypotheses related to the problems formulated in the theoretical framework. Two questions of interest for clinical psychology and applied psychology in the forensic realm can be posed: (1) why do believing subjects score systematically higher than non-believing subjects? Moreover, are systems of meaning truly responsible for these differences? (2) What information or utility do the MMSI-2 scales—especially the CPT, ASC and IMA macro-factors—have in the evaluation of those behaviors that are "apparently" without scientific explanation or that are extremely uncertain and divergent with the clinical discourse?

One of the most important points was whether subjects who believe in the paranormal interpret and conceive anomalous phenomena in the same way as non-believers. The phenomenological model originally proposed by Jaspers (1993) and Irwin (2009) postulates that one can observe a change in 'systems of meanings' and 'causal attributions' between believing and non-believing subjects. According to this approach, believing subjects would be more vulnerable to experiencing anomalous phenomena because they possess cognitive systems capable of interpreting any situation under an attribution of paranormal cause (e.g., Irwin et al., 2013). This idea can be related to the results obtained in the comparison of means test (see Table 2). In all the contrasts, the means of the believing subjects were higher than the means of the non-believing subjects, especially in the scales grouped in APP. This convergence and compatibility with the postulates of Irwin et al. (2013) is also reflected in the analyses of 'latent means'. However, there is the question of whether these differences in the systems of meanings are truly responsible for one group to score higher than the other. These differences cannot be negated qualitatively since the contents and categories of each system of meanings are different in each group. However, it can be questioned where they come from. It would seem logical to expect the rejection of the 'strong factorial invariance' assumption if one starts from the basis that believers interpret anomalous phenomena differently than non-believers. However, the applied structural equation models present fit indices with satisfactory results and non-significant variations when imposing invariance constraints. The statistical interpretation derived from these results supports the possibility that, in effect, both groups understand and the contents of each scale in the same way. This calls into question the reasons why believing subjects systematically score higher than others. The qualitative and categorical differences between the cognitive systems of believers and non-believers are present and obvious (see French and Stone, 2014). However, these results indicate that these differences do not cause the scores to be higher in the group of believers. Even imposing these invariance constraints, the 'latent means' of the believers deviate between 5 and almost 11 units with respect to those of the group of non-believers.

This does not contradict the hypothesis of Irwin (2009), but it does warn that other psychological mechanisms could intervene and generate these differences. Taking into account the studies published by several professionals, it is possible that the variables responsible for these differences are related not only to beliefs but also to *cognitive* or *causal learning* mechanisms (e.g., Barberia et al., 2013; Barberia et al., 2018; Groome et al., 2019).

Regarding the psychological value provided by macro-factors in the psychometric evaluation of anomalous phenomena, two types of interpretations can be identified: on the one hand, the results observed in Figs. 2 and 3 and in the analysis of factorial invariance can be used. On the other hand, the simultaneous equations models that relate and allow predicting the APP variable with a total weight of 51.2% can also be used. While the first possibility offers an 'orthogonal' interpretation, the second is based on the relationship and prediction among the 4 factors, so it offers a more 'oblique' view. The CFAs applied to the two groups suggest that APP, ASC, IMA and CPT are not significantly related to each other. They present low correlations (the most relevant ones fluctuate between 0.1 and 0.3) and do not allow estimating the coefficient of determination ($R^2$). This does not preclude the interpretation of the anomalous phenomena evaluated by the MMSI, but it does make it difficult because it would not be possible to distinguish the psychological antecedents from the anomalous phenomena. However, this only occurs when subjects are differentiated according to whether they believe in the paranormal. When contrasting the null hypothesis of independence and the predictive value of macro-factors in the total sample of the study, the results are completely different. Fig. 4 clearly shows that the factors are interrelated. This antagonistic change between some models and others can be explained by two main reasons, but both are related to the criteria used for the distribution of the two groups.

First, as mentioned in the section on results 3.3., it is possible that the grouping variable (i.e., the belief in the existence of the paranormal) intervenes as *a moderating variable* (and not necessarily a *mediator*) in

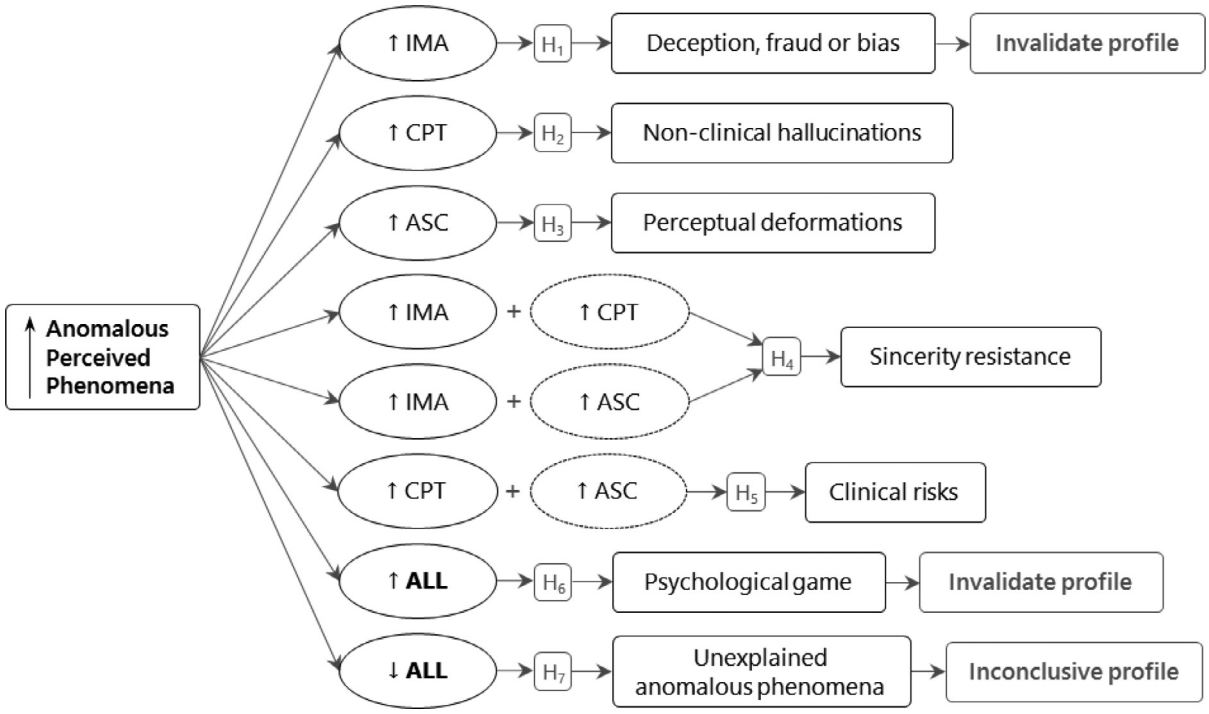


**Fig. 5.** Diagram of hypothetical formulations based on MMSI-2 scores.

the relationship of IMA, ASC and CPT with APP. This allows noting the possible interaction between this moderator variable and the IMA, ASC and CPT macro-factors. This is supported by the results in the 'latent means' analyses and the comparison of means.

Second, in addition to this first possibility, one must also take into account how both groups have been formed and with what characteristics. The most obvious is that the quantities for each of the values relating to the sociodemographic variables were matched. This may have favored homogeneity in the covariance between the scores of one group and the scores in the other, which optimizes the 'factorial invariance' analysis. However, it is possible that this has also penalized the covariability between the latent variables. Unless the factorial solution used is based on 'oblique' extraction criteria, which is not the case because the EFAs in this report have not been manipulated obliquely, this homogeneity in the covariances decreases as factors of a higher order are extracted (see Mulaik, 2018). In any of the cases, Abad et al. (2015) warn that completely 'orthogonal' solutions are not common in this type of analysis and, therefore, recommend replicating the intercorrelations and the predictive value among the latent variables of the model.

If the relationship of the four latent variables is based on Fig. 4, then one could *hypothesize* mechanisms or criteria to differentiate the explanation and classification of anomalous phenomena. The diagram in Fig. 5 was developed according to the contents grouped in each macro-factor. It summarizes the possible hypothetical interpretations that should be investigated and contrasted in future research.

Fig. 5 presents only hypothetical associations. The hypotheses in this diagram do not come directly from the results of this research. However, based on an evaluation without discriminating belief systems and taking into account the contents belonging to each scale, it is possible to deduce the hypotheses presented in Fig. 5.

Considering the dilemma generated by the investigation of the 'psi' phenomena and their impact on psychological evaluation, the MMSI-2 scales offer the possibility of formulating scientific hypotheses about the etiology and classification of anomalous phenomena. While conventional stereotypes tend to incur (though not always) in the 'Aristotelian fallacy of verification of the consequent', including statistical decisions (see Pardo and Román, 2013), MMSI-2 represents a resource to prevent this type of error. It attempts to substantiate the observations and suspicions of the professional-researcher working in the field of mental health. It is as erroneous to assert that 'psi' phenomena exist to deny their possible existence. It is erroneous to accept that anomalous phenomena have a "parapsychological" origin, as all of them are hallucinations related to psychosis (e.g., French and Stone, 2014). Academic research related to cognitive and perceptual processes should be based on the application of scientific methodology through the testing of empirical indicators (*scientific empiricism*) and should not be limited to the exclusive use of *scientific rationalism* (e.g., Carter, 2012). Precisely, one way to combat these argumentative and fallacious errors rests on the psychometric development of scientific evaluation protocols, such as the MMSI-2. It should be noted that the MMSI does not verify or confirm the causal antecedents of anomalous phenomena (APP). However, Figs. 4 and 5 at least empirically ground the explanatory psychological hypotheses and would help in the prevention of *type I* and *II errors*. Given that the criteria in Fig. 5 are designed to be applied both in the statistical study and at the individual level, new research is needed to test the predictive validity of Fig. 5 and the quality of the scales, especially with regard to cut-off scores. This is discussed again in the following paragraphs.

One of the most obvious limitations of this research is that the CFAs have not been directly applied to the 174 items of the MMSI-2. This entailed assuming the primary scales as the observable variables of the model and the macro-factors as the respective latent variables. This decision followed the statistical model applied by Arribas (2011) in the *TEA Personality Test* (TPT). The same idea has been used in multiple self-report questionnaires (see Butcher et al., 2019; Gorsuch, 1983; Morey, 2011). The advantage it offers with respect to the conventional CFA models based on the items is that in this class of models, the analysis of the structural model is optimized. However, a demonstrated disadvantage and limitation is that accuracy (but not information) is lost with respect to the study of the metric quality of the items. In any case, as indicated by Mulaik (2018), if the items presented problems of covariance or measurement, these errors would also affect the higher order factor

analysis. Given that the solutions and models presented seem acceptable in terms of goodness of fit, the metric of the items would not impair the results obtained.

As a second limitation, it can be noted that the interpretative hypotheses in Fig. 5 lack objectivity if cutoff points for each scale and latent factor of the MMSI-2 are not specified. This criticism is related to the scoring of the direct scores and the sensitivity and specificity of the test. Although Spanish scales are available to obtain guidance thresholds (see Escolà-Gascón and Gallifa, 2020) and thus make evaluative decisions, it would be advantageous to test the sensitivity and specificity of the MMSI with new samples and external evaluation criteria. This would also be related to the possibility of validating the MMSI-2 with a clinical population. The latter would allow examining cut-off points not only to discriminate what is elevated and what is not; it could also contrast the discriminative value of what is psychopathological and what is sub-clinical.

Finally, it should be noted that new psychometric research is needed to explore and replicate the relationship between primary scales, macrofactors and other variables of interest. Examples are those attributes related to the detection of lying, simulation and fraud. Although the MMSI-2 has a scale that is intended for the assessment of deliberate fraud (F scale), it would be necessary to conduct an experimental study between groups (one of simulant subjects and another of non-simulant subjects), which contrasts with the degree to which the F scale and the IMA factor are able to identify simulation behaviors. This same logic can be extrapolated with other clinical and educational variables.

It can be concluded that the MMSI-2, with its 20 total scales, represents a valid and reliable psychometric instrument for the examination of anomalous phenomena and other concomitant psychological variables. The test also shows that the psychological (and non-psychopathological) etiology of anomalous phenomena is conditioned and can be estimated hypothetically from the macro-factors 'Clinical Personality Tendencies' (CPT), 'Incoherent Manipulations' (IMA, related to fraud and lie detection) and 'Altered States of Consciousness' (ASC), all of which were examined by the MMSI-2. Therefore, the MMSI-2 can be a useful tool for evaluation and lie-detection in the subjects who report anomalous experiences. Likewise, the MMSI-2 can also be applied in the clinical scope with the purpose of discriminating if the anomalous experiences are unexplained experiences, perceptive deformations or hallucinations. In conclusion, the most relevant contribution of the MMSI-2 is being the only psychometric instrument designed in the field of psi research, that offers objective measurements to know if anomalous experiences have a psychological explanation or not.

## Author contributions

The author conceived and planned the study, drafted and designed the questionnaire, collected the sample, performed the statistical analyses and wrote the present report.

## Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

## Ethics statement

Participants gave their written consent to use their anonymous data for statistical purposes. All of them were over 18 years old and voluntarily collaborated without receiving any financial compensation. The procedures were carried out in compliance with the institutional regulations of the *Ramon Llull University* and the Spanish Government *Data Protection Law 15/1999*. Similarly, all procedures adhere to the *Helsinki Declaration of 1975*, revised in 2013.

## Datasets are available on request

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

## Declaration of Competing Interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

## Acknowledgments

The author wishes to express his gratitude to the assistants and organizations that collaborated with sample collection and data entry: to the congregation *Sisters of Immaculate Conception* (Madrid, Spain); and, the professionals *Judith García* (Barcelona, Spain), *Ramon Palau* (Barcelona, Spain), *Rosa María Gamboa* (Barcelona, Spain) and *Sister Bárbara Ávila* (Madrid, Spain).

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Explore 000 (2020) 1–9

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# Forced-choice experiment on Anomalous Information Reception and correlations with states of consciousness using the Multivariable Multiaxial Suggestibility Inventory-2 (MMSI-2)

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ARTICLE INFO

*Article History:*
Received 2 July 2020
Revised 16 November 2020
Accepted 21 November 2020
Available online xxx

*Keywords:*
Mediumship
Anomalous Information Reception
MMSI-2
"Psi" phenomena
Parapsychology
Anomalous cognition

ABSTRACT

*Context:* An Anomalous Information Reception (AIR) experiment was developed.
*Objective:* To statistically examine the occurrence of AIR in multiple experimental tests and explore their predictive psychological mechanisms.
*Design:* First, we investigated whether human beings could guess the positive or negative content from 30 randomly selected images that would be presented on a computer screen, one at a time. Ninety participants reported being mediums and another 90 claimed to be nonbelievers in the paranormal. The participants were randomly assigned to three experimental conditions: (1) positive-relaxing environments, (2) neutral environments, and (3) negative-stimulating environments. Second, the prediction of successes recorded in the AIR experiment was tested using five Multivariable Multiaxial Suggestibility Inventory-2 (MMSI-2) scales that measured the altered state of consciousness (ASC) and suggestibility.
*Results:* The successes did not exceed the estimated chance. The only significant results revealed that mediums obtained a greater number of correct answers than the non-believing participants. Bayesian estimation also confirmed these results. In the same way, the altered states of consciousness and suggestibility negatively predicted 25.8% of successes in the AIR experiment.
*Conclusions:* Insufficient statistical evidence was obtained for AIR. The results raise doubts about previous theories on AIR. Further research is required. Nevertheless, mediums obtained more success answers than nonbelievers did. This means that the anomalous sheep-goat effect is also present in mediums and supports results obtained in previous studies.


## Introduction

Anomalous Information Reception (hereinafter, AIR) is a neologism for clairvoyance that describes some phenomena that seem scientifically impossible: access to information or content through perceptual and sensory processes that are supposedly unknown to science.[6] An example of AIR occurs when an individual realizes some data or accurate information about the life of a deceased person without any source of information or prior knowledge about the person and without using rational logic or emotional intuition.[4,7]

In biological terms, the perception and causal relationship between the events that occur in objective reality—whether to make anticipatory decisions or to access information that has already passed—allow human beings to detect possible risks and survive in the face of environmental hazards.[10,45] Access to information, responses and decisions about past events are the result of two biological and rational procedures: on the one hand, the implementation of the sensory-perceptive channels known through the different functions of the central and peripheral nervous system; and on the other hand, the use of information sources and prior knowledge necessary to correctly establish the causal relationships between the different perceived inputs.[41] Decisions that do not meet these conditions should be erroneous or have a similar statistical behavior or can be extrapolated to mathematical chance, according to which coincidences between the divinatory decision and the events that have occurred are possible.[18] According to this idea, the hypothesis of Anomalous Information Reception postulates that humans can obtain information and make good decisions without using the conditioning procedures described by science (Roy & Robertson, 2001)[42]. It is called "anomalous reception" because the sources and psychological mechanisms that allow access to the respective information are unknown.[7]

There is a problem that certain scientific publications show statistical results in favor of the existence of AIR[6,4,26,43]; Schwartz &

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https://doi.org/10.1016/j.explore.2020.11.009

Russek,2001). This represents a problem because it challenges the ontological foundations of science (related to materialist reductionism) and questions the psychological theories of cognition[34,40]. However, the fact that there are scientific publications with significant results in favor of AIR with a correctly used methodology[3] requires testing the reproduction of the results obtained. The replicability of the results does represent an indispensable condition of scientific judgment and not academic opinion speculation about what is "possible" or what is "impossible" according to "science".[30,37] Although the AIR hypothesis may seem challenging, it can be analyzed using the scientific method.[2] Specifically, scientific judgments must be based on the use of the methodology that characterizes science and not on "conceptions" or "academic ideologies".[12]

In this area, self-report techniques evaluate AIR from 3 psychological-psychiatric models accepted by convention: (1) The first is the hallucination model of the psychosis continuum.[33,47,52] From this perspective, AIR is a hallucination produced by psychotic spectrum disorders.[29] Any subject who has an experience with hallucinatory characteristics similar to AIR would suffer from a psychotic disorder or would have a high risk of suffering it.[13] This perspective is also related to the theory of the "psychotic phenotype".[44] (2) There is also the semiotic model of perception, which explains AIR as illusions or perceptual distortions of a causal type that the individual fabricates to reduce the uncertainty of a past problem.[28,38] They are called illusions of control and are very common in believing subjects in the existence of the paranormal.[31] They differ from hallucinations in that they do not represent pathological behaviors in themselves.[10] (3), one can also observe the phenomenological model, which considers AIR as a subjective way of interpreting the phenomena that occur in objective reality.[20,22] These interpretations are based on the system of meanings that the subject uses to cognitively represent reality.[23]

The disadvantage of these models is very simple: all of them incur the Aristotelian fallacy of affirming the consequent.[35] This logical fallacy consists of the confirmation of a consequence from an uncertain cause. See the following example: - since the grass is wet, it is concluded that it has rained -. There is a causal conclusion or uncertain cause - it has rained - and the independent consequence - the grass is wet -. This consequence is not dependent on the cause - it has rained - because the grass may have been wet in many ways. The correct argument would be: - since it cannot be determined if it has rained, it is not known why the ground is wet -. With the AIR, the same error is made: - since AIRs are impossible or do not exist, it is concluded that they are hallucinations. This goes against the logic of the scientific method because although AIRs can be hallucinatory behaviors (just as the "grass can be wet"), what should be done is to contrast the scientific cause and not assume it from the "academic conventionalism" as a "hallucination".[25,46] One possibility to contrast the psychiatric history of this type of experience would be using self-report techniques.[9,27] The problem is that new evaluation instruments are necessary to avoid incurring the previous fallacy: the hallucinatory value of a supposed "hallucination" should not be contrasted, based on the apriorism that it is effectively a hallucination.

In this study, an experiment about AIR was conducted based on two objectives: (1) testing the hypothesis associated with AIR, which proposes that human beings can receive information about a hidden target; (2) examining whether the Multivariable Multiaxial Suggestibility Inventory-2 (hereafter, MMSI-2) scales (designed to assess belief in the paranormal in mediums and nonbelievers) predicts the successes quantified in the AIR experiment.

## Methods

### *Description of the sample*

A total of 180 people collaborated (47.8% women and 52.2% men), and all of them were adults over 18 years old (mean = 38.45; standard deviation = 9.929). On the one hand, 90 participants declared that they did not believe in the existence of the paranormal, whereas the other 90 claimed to be "mediums." The latter were convinced that they could communicate with deceased persons to obtain information about other people or places. More concretely, the mediums said that they used their clairvoyant talents through the messages that they received from the deceased. This detail is important because, although AIR and clairvoyance could be distinct "psi" phenomena, for these mediums, the events are interrelated and they use them together. Therefore, the label "mediums" refers to those participants who may believe in the paranormal, believe in the talent to communicate with deceased beings, and believe that they have the capacity to use this talent.

All participants signed an informed consent detailing the research procedure and declaring that they had no official psychiatric history. The participants could leave the experiment at any time and did not receive any financial compensation for their collaboration.

### *Procedures*

#### *General procedures*

This experiment aimed at testing the AIR hypothesis, which states that it is possible to receive information and guess content without using the physical-sensory channels recognized by science. In this case, the following procedure was also based on the meta-analysis of Storm and Tressoldi[49], who reviewed and analyzed the differences between "believers" and "nonbelievers" in extrasensory perception (ESP) forced-choice tasks.

The design used entailed a comparison of independent (between) groups. Two groups were defined according to the beliefs and attitudes of each participant. The participants who declared not believing in the existence of the paranormal formed the group of "skeptics or nonbelievers" ($n_0$= 90), and those who claimed to believe in the existence of the paranormal and practice mediumship constituted the group of "mediums" ($n_1$= 90). The participants of each of the two groups were randomly assigned to places characterized by one of the following three experimental conditions: (1) positive or relaxing inputs, (2) neutral inputs, and (3) negative or stimulating inputs.

On the one hand, the classification of the images of The Geneva Affective Picture Database (hereinafter, GAPED) was used to determine which places could induce relaxation and be neutral (that is, they had low average arousal or trigger values).[15] This classification system revealed that the stimuli that illustrated parks, gardens, meadows and flowers yielded low arousal values. On the other hand, those that showed workspaces such as an office were classified as neutral places. Therefore, taking into account this classification, the Cervantes Gardens of the city of Barcelona were chosen as the positive place, and rented offices in the Industria Street of Barcelona were used as a neutral work space. The choice of place that incited suggestibility was based on the research conducted by Wiseman et al.[54], in which the participants attended a supposedly "haunted" place, and the believers exhibited more anomalous perceptions than the nonbelievers. Hotel Colonia Puig was chosen as the haunted location because it was abandoned, it served as a hospital sanatorium during the Spanish civil war, and was in the Montserrat mountain range, which is also associated with mysteries and legends (Thomas & Schoonmaker, 2007). These features coincided with the recommendations of Dagnall et al.[14] regarding what places seem haunted.

To each of the three locations, 30 participants were randomly assigned. Therefore, there were two independent factors, namely the three experimental conditions and the classification of mediums and nonbelievers.

We aimed to evaluate whether the participants were able to guess the random content of 30 randomly selected images in each location. The images came from the GAPED photographic database and could be positive or negative. In addition, the images had to be previously

selected and had to have a different order sequence for each participant. From the total set of 750 photographs of the GAPED, 10 positive and 10 negative photographs were randomly selected. This photographic selection was the basis that was used in all the tests. The selected pictures are included in this article as supplementary material. From this point, the following was done:

(1) The program was instructed by a code syntax to choose a random number between 1 and 20 in each one of the 30 guesses (each number was a type of photograph).
(2) Both the sequence and the type of content selected were performed between 24 and 48 h before each test by a technician collaborator outside this research.
(3) The technical collaborators were only responsible for the random selection of the images, did not know the participants and could not access their data. They did not perform any other activity related to this research. Similarly, the collaborators did not know about the purpose of this experiment and they were volunteers from the Ramon Llull University.
(4) The data were stored in the computer and were sent to the author of this report once each experiment was completed.
(5) At no time was the sequence or data accessible to the participant, since both did not coincide at any time (either physically or digitally). The participants did not obtain any feedback about their performance.
(6) Both the researcher and the participant were unaware of the data of the selected images. Only the researcher knew the random selection once the respective experiments were completed.

These conditions were applied to guarantee the use of the double-blind technique (researcher and participants were unaware of the selection of the images). The procedures developed by Beischel et al.[4] were not used because the forced-choice procedure was preferred. In this way, the law of probability could be applied in the random selection of the stimulus images, the Barnum effect (both direct and indirect) could be neutralized[18]; Shermer, 2011), and the answers could be quantified according to the number of correct answers obtained in each trial (each trial consisted of 30 guesses). This design did not detract from the original hypothesis of the AIR because the selection of the images was made a priori and not a posteriori, as is usual in the designs of precognition.[8] It was about guessing or accessing information that had already occurred for which neither the researcher nor the participants had access before and during the experiment. Unlike precognition, this is called clairvoyance and it was the hypothetical phenomenon tested in this experiment.

The phases of each trial adhered to the following sequence: (1) Arrival at the place and preparation of the starting point. Each place had a different starting point. However, all participants assigned to the same group-place began the exercise from the same starting point of their respective place. (2) Prior check-up with the participants and verification of their willingness to start the activity. (3) Instructions were first read aloud by the researcher, then they were given to the participants to read again. When the participants turned the page, the countdown began. (4) Carrying out the activity. (5) When the participants finished and turned in their answer sheets, the activity was considered completed. If the exercise was not completed within 60 min, the activity was considered completed. (6) End of the trial and leaving the place of experimentation.

*Experimental instructions*

All experimental tests were conducted in the same way, both for mediums and for nonbelievers. Once arrived at the place (of which the participant had knowledge), precise instructions were given to each participant. Both groups received the same instructions:

- we have come to this place so that from a distance you try to "guess" the content of 30 randomly selected images. Each image can be "positive" (whose contents show pleasant and relaxing stimuli) or "negative" (whose contents offer aversive stimuli that are unpleasant). The images were previously selected and are not related to this location.

On the next page you will find 30 blank spaces arranged sequentially (from 1 to 30). Each section corresponds to an already selected image. In each section, you must choose between two response alternatives: (a) "positive image" or (b) "negative image". You can only choose one of the two options.

We ask you to use your own personal resources that you believe from your beliefs or convictions that can help you respond well to the test. Avoid answering randomly and focus on your answers. You can leave sections-questions blank or unanswered. Feel free and do what you need to do to enhance your psychic abilities. You can move freely around the place and take advantage of the sensations that the environment inspires, as long as you do not endanger your safety and health.

Although the order of the images is sequential, you can start with the section you want. If you think you have made a mistake in one of your answers, cross it out and indicate the alternative that you consider correct. The research team will accompany you throughout this exercise and will observe you while you perform the test. Keep in mind that the following are not allowed: (1) taking stimulant or relaxing substances before and during the exercise (including tobacco and natural herbs); (2) communicating digitally or electronically with other people you know; (3) eating and drinking during the exercise; (4) endangering your safety, your physical and mental health; and (5), carrying out any criminal action.

You have 1 h to complete this exercise, although if you wish you can finish earlier.

At the end of each trial, both the participant and the researcher left the site, and the experiment was considered finished. Each participant got one trial.

*Sampling and logistical procedures*

The phases that characterized the process of this research were developed over 3 years (2018–2020) and can be summarized as follows: **(Phase I) selection of participants**: during the MAGIC International esoteric fair in 2017 (for more information, contact Alfonso Trinidad, see acknowledgments), opinion surveys were conducted, and different psychometric questionnaires were applied (including the MMSI-2). An email was sent to the surveyed users who met the profile required for this experiment asking for their collaboration in the present investigation. Only 288 of the initial 748 participants who were contacted agreed to participate in the study. Of these 288, 157 considered themselves mediums, and 131 claimed not to believe in the paranormal. Three participants decided to drop out of the study at the last minute (157−1 = 156; 131−2 = 129). **(Phase II) Distribution.** The participants were randomly distributed by equal strata (at 33.33%) in the three working groups (52 mediums and 43 nonbelievers in each group). **(Phase III) previous interview and execution of the experimental sessions**. Each participant was contacted by email again to conduct a face-to-face interview. In this meeting, it was ensured that the participant continued to meet the main exclusion criteria; not suffering or having suffered a psychiatric disorder. If the participant accepted, it was organized when, how and where the experimental test would be. Eight participants did not want to continue with the research, and four participants did not show up on the day of the experiment (in which case the random sample of the previously selected images was discarded) (285−12= 273). This phase

lasted until March 2020. The interviews and sessions with the participants were homogeneous and gradual. That is, the experiments were not executed by blocks of groups; monthly, 12 participants were contacted (6 mediums and 6 nonbelieving participants; 4 participants for each type of place), and at least 6 of the 12 participants were tested during that month (3 of each type and 2 for each place). Given that the lowest number of participants was for the "abandoned place" group of the medium participants ($n_1$= 31), it was decided to limit the groups to 30 participants in each. Similarly, due to logistical challenges related to the health crisis and the social confinement caused by the SARS-CoV-2 in March 2020, it was decided not to collect more participants. Consequently, 93 participants out of the last total number (273) could not participate in the experiment (273−93=180 final participants). Therefore, the participants definitely remained at 30 for each group. In this way, the experimental design conceived in the year 2017−2018 could be respected. **(Phase IV) preparation and analysis of the data**. Although this task was progressively carried out during Phase III, it was not until April 2020 that it was decided to organize the raw data matrix. The raw matrix was reorganized in order to prepare the data properly according to the conditions of statistical software. Once the reorganization was completed, the statistical analyses were applied, the results of which are presented in this report.

*Procedures of post-hoc analysis*

The post-hoc tests consisted of the predictive analysis of the successes recorded during the AIR experiment using Anomalous Perceived Phenomena (APP), Clinical Personality Tendencies (CPT), Incoherent Manipulations (IMA), Neurasthenia (Nt), and Substance Use (Cs) scales of the MMSI-2 as predictor variables. According to Escolà-Gascón[16], it was decided to work directly with the Nt and Cs scales.

The 180 participants responded to the 174 items of the MMSI-2 after completing the experimental sessions (the participants had not responded to the MMSI-2 previously). Although the scores were included in the matrix practically simultaneously with the data from the AIR experiment, the analyses presented in this study could not be performed until the AIR experiment was complete.

*Instruments*

*The Geneva Affective Picture Database (GAPED)*

Dan-Glauser and Scherer[15] of the University of Geneva developed a new protocol with the same properties as the IAPS (International Affective Picture System) photo database but with free access, free distribution and open access. This new test is called The Geneva Affective Picture Database or GAPED and consists of 750 images validly classified and calibrated under the same parameters as the IAPS. The GAPED offers a typographic classification of images that is representative of Western European culture, which distinguishes between 130 positive images or stimuli (whose contents represent human babies or animal pups; both contents are socially attractive) and 257 images or negative stimuli (whose contents violate moral laws and ethical principles defined by human rights). Unlike the IAPS, negative stimuli do not contain repulsive scenes or gore, but both protocols do show violent and aggressive content for this type of image. In addition to the 498 images categorized as positive and negative, the GAPED also adds 111 classified as neutral stimuli, whose contents do not describe either positive or negative stimuli. It should be noted that the GAPED optionally offers 252 images whose positive, neutral or negative classification is not determined a priori. The contents of these images illustrate only spiders and snakes. However, Dan-Glauser and Scherer[15] suggest considering them as negative stimuli when participants are confronted with these contents who present some type of systematic phobia to spiders or snakes. Excluding this indication, these 252 images have no typographic validity.

*«Multivariable Multiaxial Suggestibility Inventory-2» (MMSI-2)*

This questionnaire developed by Escolà-Gascón[16], 2020b) consists of 174 polytomous items in the form of statements, whose responses are scored following the Likert scaling model between 1 and 5. The subject must indicate to what degree each statement is "true" or simply specify their degree of agreement with what each sentence says. It should be kept in mind that 1 means in total disagreement, 2 means in disagreement, 3 means somewhat in agreement, 4 means quite in agreement and 5 means completely in agreement. The MMSI consists of 16 first-order scales: Inconsistencies (K), Lies (L), Fraud (F), Simulation (Si), Neurasthenia (Nt), Substance Use (Cs), Suggestibility (Su), Thrill-Seeking (Be), Histrionism (Hi), Schizotypy (Ez), Paranoia (Pa), Narcissism (Na), Anomalous Visual/Auditory Phenomena (Pva), Anomalous Tactile Phenomena (Pt), Anomalous Olfactory Phenomena (Po) and Anomalous Cenesthetic Phenomena (Pc). It also has 4 higher-order factors: Clinical Personality Tendencies (CPT), Anomalous Perceived Phenomena (APP), Incoherent Manipulations (IMA), and Altered States of Consciousness (ASC). The factors or scales of the MMSI-2 should allow the prediction of APP (it is the macrofactor that brings together the scales related to anomalous experiences).

*Data analysis*

The data were analyzed with the JASP program[50] and the R code.[39] A univariate analysis of variance (or 2 × 3 ANOVA) was applied. One of the factors (group of mediums and group of nonbelievers) was fixed effects, and the other (positive place, neutral place and negative place) was random effects. As a complement, a Bayesian statistical analysis was also performed using the Bayes factor (hereafter $BF_{10}$) in favor of the alternative hypothesis. It should be remembered that $BF_{10}$ can be estimated in multiple ways, but the most common and used in this research was:

$$BF_{10} = \frac{\int_{\Theta_{H_1}} P(D|\theta_{H_1}, H_1) \cdot \pi(\theta_{H_1}|H_1) d\theta_{H_1}}{\int_{\Theta_{H_0}} P(D|\theta_{H_0}, H_0) \cdot \pi(\theta_{H_0}|H_0) d\theta_{H_0}} = \frac{P(D|H_1)}{P(D|H_0)} \quad (1)$$

where $P(D|H_1)$ is the probability that the data are distributed according to the distribution given by the alternative hypothesis and $P(D|H_0)$ corresponds to the probability distribution of the null model. Equation [1] is still an interpretable mathematical ratio from the odds metric,[24] so it can be transformed to the probability scale as follows:

$$P(H_1|D) = \frac{BF_{10}}{BF_{10} + 1} \quad (2)$$

Then, what is obtained is the estimated probability that the alternative hypothesis fits the empirical data, represented as $P(H_1|D)$. The probability of the a priori distributions was adjusted to 50% for the null and alternative hypotheses. Given that the Bayesian approximation was applied for the contrasts of the main effects, the variance explained by the coefficient of determination ($R^2$) derived from the *BFs* for all the variable factors was also estimated.

It was also checked whether the successes of the participants exceeded the statistical chance. This possibility was made by applying Student's *t*-test and the binomial distribution. The mathematical expectation that the participants guess correctly is 30/2 = 15 (then 15/30 = 0.5 on the probability scale). We wanted to contrast whether the successes could significantly exceed this cut-off point. Therefore, it is a right unilateral statistical contrast, which can be represented as follows:

$$H_0 = \mu_e \leq \widehat{\mu}_t$$

$$H_1 = \mu_e > \widehat{\mu}_t$$

where $\mu_e$ is the observed empirical mean and $\hat{\mu}_t$ is the theoretical estimated mean. For all analyses, including the latter, a risk of error of 1% was applied.

Finally, a multiple regression model was applied stepwise forward for the group of mediums. The scores of the predictor variables of the group of nonbelieving participants did not meet the precondition of being linearly related to the criterial variable (success count). Therefore, nonbelieving participants were discarded from this analysis. The elimination of the 90 non-believing participants did not affect the quality of the sample. On the contrary, according to the methodological indications of Pardo and Ruiz[36], in this type of categorical variables, eliminating non-believing participants allows the neutralization of the effects of the belief variable (mediums and nonbelievers). Specifically, including only the mediums made this variable a "constant." Including the scores of nonbelievers would generate influential outliers because they did not meet the previous assumptions and this would impair the reliability of the prediction. The rest of the previous conditions were assumed.

## Results of the AIR experiment

Given that a priori, there were no mathematical or empirical reasons to expect the AIR to yield significant results, the null hypotheses that were tested were as follows: (1) The means related to the successes do not differ between the different types of places. (2) The means relative to the successes do not differ between the medium participants and the nonbelievers. (3) The successes do not exceed the estimated statistical chance for all groups and participants.

To contrast the first two hypotheses, Table 1 was prepared. It is a table with the means and standard deviations of each variable and group. It should be taken into account that the main effects (including the main effect of the interaction between both variables) are derived from the marginal means. On the other hand, the simple effects and the simple interaction effects establish the comparisons between the different means of each of the cells.

Table 2 shows the results related to the analysis of variance for the main effects. Given that the variable that designates the experimental conditions has random effects, instead of Fisher's F, the Wald Z test was used, which performs the contrasts on the covariance parameters of the model.

The results indicate that only null hypothesis 2 can be rejected, which assumes the equality of means for the beliefs variable (between medium and nonbelieving groups). The mediums group tended to obtain more success answers than nonbelievers. This result is related to the sheep-goat theory effects that will be discussed under Discussion.

The means of the experimental conditions and those related to the interaction between both factors do not yield significant results; therefore, null hypothesis 1 should be maintained. The *BFs* support the rejection of the null hypothesis of the beliefs variable and the maintenance of the rest of the null hypotheses. In reality, the $BF_{10}$ of the beliefs variable is very high, which indicates that the alternative hypothesis for this variable fits the observed empirical data. However, the explained variance provided by ($R^2$) is very low. This coefficient was obtained based on the instructions of Gelman and Pardoe,[19] who suggested formula [3] for full-factorial models. The expression "E" represents the posterior mean.

$$R^2 = 1 - \frac{E\left(V^K_{K=1^{\epsilon_k}}\right)}{E\left(V^K_{K=1^{\theta_k}}\right)} \quad (3)$$

Taking into account that for the variable "beliefs" the results are significant, it is not necessary to apply post hoc comparisons - and it is not possible either because there are only 2 groups - but the simple effects must be analyzed. These effects are analyzed in Tables 3.

The simple effects contrast the difference between the means of the group of mediums and nonbelievers in each of the levels of the factor that establishes the experimental conditions. The other simple effects were not contrasted because the other factor did not yield significant results (see Table 2). Significant differences between mediums and nonbelievers can be seen only when the participants attend Cervantes Gardens (positive place) and the supposedly haunted Hotel (haunted place). In the offices (neutral places), no significant differences were observed.

The fact that mediums score higher than nonbelieving participants does not mean that the number of correct answers of the participants exceeds the estimated chance from the classical model. Table 4 shows the contrast on whether the counts of the successes of each participant (distributed by variables and groups) are above the estimated mathematical expectation ($\pi = 0.5$).

In no variable and in any group were the successes higher than expected by chance (15 successes or 0.5 on the probability scale). This means that successes can be explained by the action of chance and not by the intervention of "anomalous" mechanisms related to AIR. The Bayesian approach also supports the maintenance of the null hypothesis in these contrasts. However, it must be taken into account that maintaining null hypothesis 3 does not require denying the existence of AIR. In more rigorous terms, it could be said that AIR is not observed in the sample used in this study, but this does not mean that it cannot be statistically recorded in other different samples. Despite this nuance, it should be noted that the results in Table 5 do not support the hypotheses related to AIR.

### *Results of post-hoc analysis: do states of consciousness predict correct answers in the AIR experiment?*

Table 5 shows the descriptive statistics for the predictor variables (MMSI-2 scales). The linear correlations between these variables and the criterion variable were also calculated. The criterion variable was the correct answers in the AIR experiment.

The results of Table 5 indicate that the predictors IMA, APP and Cs are not significantly correlated with the criterion, which excludes them from the multiple regression model. Therefore, the regression model analyzed in Table 6 consisted of two steps, which included two models: the one formed by the CPT predictor (model 1) and the one comprised by both CPT and Nt.

The results indicate that the AIR, measured from the count of correct answers for each subject, is predictable at most by 25.8% by the

**Table 1**
Descriptive statistics.

| Variable | Groups | Experimental conditions | | | Main effects |
|---|---|---|---|---|---|
| | | Positive | Neutral | Haunted | |
| Beliefs | Mediums | 14.4 (7.147) | 9.567 (6.468) | 14.764 (9.276) | 12.911 (0.715) |
| | Nonbelievers | 7.933 (5.239) | 8.4 (5.654) | 8.267 (6.125) | 8.2 (0.715) |
| | Main effects | 11.167 (0.875) | 8.983 (0.875) | 11.517 (0.875) | |

Note: In each cell are means. Standard deviations are in brackets.

**Table 2**
Analysis of variance, main effects of variables and Bayesian approach.

| IV | F | Wald Z | p | $BF_{10}$ (% estimated error) | $P(H_1\|D)$ | $R^2$ |
|---|---|---|---|---|---|---|
| Beliefs | 21.721 | | <0.001 | 1829.846 (14.467%) | ~1 | 0.01 |
| Experimental conditions | – | 0.583 | 0.56 | 0.365 (0.007%) | 0.267 | ~0 |
| Interaction | – | 0.902 | 0.367 | 1.256 (7.080%) | 0.557 | 0.167 |

Note: IV= Independent variables; *F*= Fisher's tests;.
$BF_{10}$= Bayes Factors in favor to alternative hypothesis;.
$R^2$= explained variance corrected according *BFs*.

**Table 3**
Simple main effects analysis between mediums and nonbelievers in each level of the experimental conditions.

| Levels of the experimental conditions | Means Comparison (see Table 1) | t-test* | p values (Tuckey) | p values (Bonferroni) | d |
|---|---|---|---|---|---|
| Positive | 14.4 vs. 7.933 | −3.693 | 0.004 | 0.004 | −1.032 |
| Neutral | 9.567 vs. 8.4 | −0.666 | 0.985 | ~1 | 0.192 |
| Haunted | 14.764 vs. 8.267 | −3.712 | 0.004 | 0.004 | −0.826 |

Note: *d*= Cohen's d corrected using Hedges' g.
*t-test was corrected for multiple comparisons.

**Table 4**
Do means exceed the estimated chance?

| G | LEC | Means | t-test (p values) | W test (p values) | Z test (p values) | Binomial test (p values) | $BF_{10}$ (error%) |
|---|---|---|---|---|---|---|---|
| M | Positive | 14.4 | −0.46 (0.675) | 177 (0.618) | −3.286 (~1) | $n_{>15}$= 0.467 (0.708) | 0.142 (~0.031) |
| | Neutral | 9.567 | −4.601 (~1) | 52.5 (~1) | −29.76 (~1) | $n_{>15}$= 0.2 (~1) | 0.044 (~0.005) |
| | Haunted | 14.764 | −0.138 (0.554) | 193.5 (0.59) | −1.278 (0.899) | $n_{>15}$= 0.533 (0.428) | 0.176 (~0.023) |
| NB | Positive | 7.933 | −7.388 (~1) | 6 (~1) | −38.706 (~1) | $n_{>15}$= 0.067 (~1) | 0.014 (~0) |
| | Neutral | 8.4 | −6.393 (~1) | 17.5 (~1) | −36.15 (~1) | $n_{>15}$= 0.1 (~1) | 0.017 (~0) |
| | Haunted | 8.267 | −6.021 (~1) | 33 (~1) | −36.880 (~1) | $n_{>15}$= 0.233 (~1) | 0.018 (~0) |

Note: *G*= groups; *M*= mediums group; NB= Non-believers group; LEC= Levels of experimental conditions; *W*= Wilcoxon test; and $BF_{10}$= Bayes Factors in favor to alternative hypothesis.

CPT and Nt variables of the MMSI-2 (regression model 2). If the regression coefficients ($\beta$) are taken into account, it can be observed that for each unit that both predictors increase, the criterion variable decreases –at an average level– by 0.104 and 0.267, respectively (see Table 6). This means that increases in correct answers can only be predicted when the CPT and Nt scores are low or decrease correlatively.

## Discussion

Different hypotheses related to the possible occurrence of AIR were tested. In the experimental trials, participants had to guess the content (positive or aversive) of 30 selected images, which were presented in random order for each participant. Taking into account that spontaneous psychic effects or anomalous experiences are frequent in haunted places,[14,21] we wanted to check whether the environment could condition participants' responses in each of the places where the experiment was conducted. The success count of each participant was analyzed to examine whether it exceeded the expected chance. Significant differences were observed between mediums and non-believing participants for positive and haunted places. The average success counts did not exceed the expected chance in any group. The post-hoc analysis examined whether the APP, CPT, IMA, Nt, and Cs scales of the MMSI-2 correlated with the counts of the correct answers in the AIR experiment and if they could predict them. The results indicated that only the CPT and Nt variables negatively correlated with the correct answers, whose prediction with both variables was quantified with a weight of 25.8%.

### *Interpretation and implications of the results*

The results of the AIR experiment address the most important question: what psychological and cognitive value can AIR have in human behavior? In numerous studies that analyzed the AIR, significant results were obtained[6,26]; Schwartz & Russek). Other studies were able to explain these significant results through the Barnum effect (O'Keeffe & Wiseman, 2005). Other more recent studies showed significant results in favor of AIR, neutralizing the Barnum

**Table 5**
Descriptive statistics for MMSI-2 scales included in the post-hoc analysis ($n_{mediums}$= 90).

| Variables | Means | Standard deviations | Correlation coefficients with criterion variable | |
|---|---|---|---|---|
| IMA | 182.97 | 25.574 | 0.167 | $p$ = 0.057 |
| CPT* | 183.31 | 31.409 | −0.37* | $p$<0.0001* |
| APP | 93.22 | 27.427 | −0.021 | $p$ = 0.423 |
| Nt* | 41.69 | 11.161 | −0.332* | $p$ = 0.001* |
| Cs | 13.69 | 3.584 | −0.028 | $p$ = 0.397 |

Note: *variables included in the multiple regression model; IMA= Incoherent Manipulations; CPT= Clinical Personality Tendencies; APP= Anomalous Perceived Phenomena; Nt= Neurasthenia; and Cs= Substance Use.

**Table 6**
Multiple forward stepwise regression (dependent variable= correct answers).

| Model | Variables | $\beta$ | Error | $\beta_z$ | \|r\| | $R^2$ | $\Delta R^2$ | F | p |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Constant | 30.18 | 4.691 | – | \|0.37\| | 0.127 | 0.137 | 13.949 | <0.0001 |
| | CPT | −0.094 | 0.025 | −0.37* | | | | | |
| 2 | Constant | 43.054 | 5.361 | – | \|0.524\| | 0.258 | 0.138 | 16.509 | <0.0001 |
| | CPT | −0.104 | 0.023 | −0.407* | | | | | |
| | Nt | −0.267 | 0.066 | −0.373* | | | | | |

Note: *$p<0.01$; $\beta$= regression coefficients; $\beta_z$= standardized regression coefficients; $r$= multiple correlation coefficients.
Excluded variables: APP, IMA and Cs. They did not fulfill the preconditions (see Table 5).

effect.[4] In all these investigations (including those that did not obtain significant results), the AIR was tested based on the "readings" or "clairvoyance" about the life and past experiences of different groups of randomly assigned subjects. With this research, the following idea is questioned: why is AIR understood as a "supposed" phenomenon that only seems to happen when an individual – without prior knowledge – tries to guess what another deceased subject has experienced? There is no scientific evidence that should limit the supposed AIR to the "clairvoyance" practiced by the mediums.[18] Therefore, in this study, the two groups were defined: the "mediums" and the "nonbelievers". However, in addition to the latter, there is no evidence that the AIR should be limited to the idea of "readings" or supposed "clairvoyance" about the lives of other people. If the AIR were a cognitive-perceptive attribute of the human being, it should be possible to record statistically more easily in those "readings" that were correct about simpler contents (e.g., the positive or negative contents of the images) compared to other contents more complex (e.g., trying to guess what experiences an unknown person has had). To express it more clearly, in university exams and psychometric aptitude tests, the following is met: as the degree of complexity of the tasks or questions decreases, successes increase.[1] If AIR were an attribute of human cognition-perception, the same logic found psychometrically in aptitude tests should be met. The results of Table 4 are clear in this regard: the observed successes fit a pattern of successes extrapolated to mathematical randomization. This means that the trend and the distribution of the successes observed can be obtained by randomly answering the 30 sections or questions posed. It should be noted that this argument is not in line with the scientific literature on parapsychology. Actually, the designs and theories that address the AIR hypothesis support the free-response designs.[49] This point is crucial because, if forced-choice designs have less power effect than free response designs, why did the mediums get more hits than the nonbelieving participants? In other words, why were the sheep-goat effects significant? However, as already mentioned, one should not incur the "Aristotelian fallacy of affirming the consequent"[35]; the fact that the results do not support the alternative hypothesis of the AIR does not mean that the AIR itself cannot be significantly recorded in other experiments. As a first conclusion, it is highlighted that based on the design and the sample used, no reasons were found to support the supposed existence of AIR as a cognitive attribute of a human being. Nevertheless, according to the significant differences between mediums and nonbelievers, the results also suggest the following conclusion: the group of mediums tends to obtain more hits, as has been repeatedly observed with "sheep" (believers) in other studies.[48]

Starting from the theoretical basis provided by numerous investigations that positively related the altered states of consciousness and suggestion with the successes in this type of test,[5,11] there would be reasons to infer that the levels of suggestion associated with sites of this research could modulate the successes of the participants. The greater the suggestion, the greater the probability of generating altered states of consciousness through which the subjects would be more easily successful. Given that the successes increase when the place turns out to be positive or negative, could these two places have elements that would suggest enough to the medium participants to obtain a greater number of successes than the nonbelieving subjects? This should be contrasted in future research as it is a hypothetical speculation. It is clarified that this possible interpretation would only make sense if the results of previous research that supports the "psi" phenomena were accepted as valid. No unanimous scientific conclusion has been reached on this issue; some professionals are in favor[8,32,51] and others are against.[40,53] However, we might point out that the former scholars present empirical evidence, while the latter argue based on theoretical grounds. Empirical data must be preferred over theoretical arguments; otherwise, science collapses into dogmatic religion. This argument means that we can question the studies that are against.

At this point, it seems appropriate to analyze the results of the post-hoc analysis. Given that in this analysis, the existence of the AIR is neither denied nor affirmed a priori, it was decided to check whether the MMSI-2 variables predicted the successes observed in the sample of the AIR experiment. Table 6 shows results that are significant, as can be observed for the CPT and Nt variables. This means that the lower the score on these two scales, the higher the correct answers. More specifically, this increase in the correct answers is quantified at 25.8%. The clinical personality traits assessed by CPT are Suggestibility (Su), Thrill-Seeking (Be), Histrionism (Hi), Schizotypy (Ez), Paranoia (Pa), and Narcissism (Na). Neurasthenia (Nt) is related to symptoms that fluctuate between ordinary states of consciousness and trance states. Therefore, as a fourth conclusion, it can be highlighted that people who develop AIR do not tend to present psychopathological traits. This also coincides with the results of other research that disprove the relationship between mediumnity and psychopathology.[11] Further research is required to examine the role of altered states of consciousness in AIR.

*Limitations*

Regarding the criticisms and limitations of this research, it is true that some professionals and specialists in the "psi" phenomena could question whether the concept of Anomalous Information Reception defined in this research is in line with the theoretical proposals that these authors defend in their research areas or if it is an approach that harms the AIR hypothesis. For example, for Beischel,[2] the AIR applied in the framework of mediumship also implies the intervention of the belief or conviction of the medium-subject, that he can communicate with deceased beings and, precisely, it is these beings that provide him with the correct response to "clairvoyance" or "readings " performed. This condition was not taken into account in this research since, at least at present, it is a nonverifiable condition through the scientific method: How can one experimentally control that a person can communicate with deceased beings? Given that there are results both in favor and against AIR (and even of the "psi" phenomena), it cannot be accepted that the successes recorded in this type of experimental session can represent indirect empirical markers of a possible anomalous cognition of human behavior.

Therefore, the AIR is understood in this research as a presumed phenomenon unexplained in statistical terms (because it is recorded through statistical and not directly empirical procedures). The expression "directly empirical procedures" refers to the following: we do not have material manifestations or physical indicators (the current indicators are only statistics) to measure AIR. What are the empirical guarantees that the "correct answers" certainly represent clairvoyance (and not AIR only)?

In this manuscript, we started from the original basis that raises whether this class of supposed behaviors evaluated statistically can - apart from any theoretical speculation, whether believing or nonbelieving in the existence of "psi" phenomena - be replicated by the scientific method. Therefore, there were no apriorisms based on the academic beliefs defended in the cited scientific literature.[12] Said in a more explicit way: what was intended was to apply the scientific method in the AIR in the most neutral way possible and not to make "philosophy" of the hypothetical conceptions that defend or discredit anomalous phenomena.

In short, the definition given to AIR in this study differs conceptually from the other definitions observed in previous studies that use the same denominator, but its meaning does not change in functional and pragmatic terms. In this research and in previous studies that use the AIR concept, the task that the subject must solve is the same: individuals must guess a content that happened in the past. The only difference is that in the present investigation, the objects that must be "guessed" are simpler at the cognitive level because the response options are reduced to two alternatives: either they are negative or they are positive, but the experimental slogan that characterizes the AIR is the same for this type of research. This fact could generate conceptual debates about the hypotheses underlying the AIR, but it does not harm the internal validity of the results obtained.

## Conclusions

The contributions of this research can be summarized with the following conclusions: (1) there is no statistical evidence in favor of AIR, neither in the subjects considered "mediums" nor in the "nonbelievers". The successes did not exceed the estimated mathematical expectation. (2) Mediums tend to obtain more successes than nonbelievers in places with positive-relaxing stimuli and in places with negative-triggering stimuli. This observed statistical trend could not be explained rationally and, therefore, represents a statistical result that should be replicated in future studies. Indeed, Bayesian results support these differences, which indicate the presence of sheep-goat effects in the AIR phenomena. (3) Altered states of consciousness (evaluated using the Nt scale) and suggestibility, together with other subclinical personality traits (CPT), negatively predict the successes of mediums by 25.8%. This result is contradictory to the proposals of other studies that concluded the positive relationship between altered states of consciousness and perceived anomalous phenomena (including AIR). These results are not due to methodological failures related to the Multivariable Multiaxial Suggestibility Inventory-2 or MMSI-2 because the psychometric properties of this questionnaire were successfully replicated in Escolà-Gascón.[17] New research is required to test the AIR hypothesis again from neutrality and without assuming any previous ideology a priori that systematically denies or affirms the scientific existence of AIR.

## Declarations of ethical guarantees

This research is part of the university project *"Predictor variables of precognition and haunting phenomena: an approach from Bayesian models and structural equations"* approved by the Committee of Ethical Guarantees of Ramon Llull University. Likewise, all the procedures of this study complied with the principles of the *Declaration of Helsinki* of 1975, which was also revised in 2013.

## Acknowledgments

The author wishes to express his gratitude to the academic, professional and business groups or associations that participated in the collection of the sample. The academic professionals who collaborated with data collection were: Alonso Trinidad (*Managing Director,* MAGIC International, Inc.,), Isabel Miró (*Clinical Psychologist,* AVANZA, Psychiatric Clinic), Naia Cartañá (*Researcher Assistant*, Ramon Llull University).

## Statements in relation to the places of experimentation

All the sites where the experimental tests were carried out had free access and are open to the public.

## Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.explore.2020.11.009.

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Escolà-Gascón et al. Globalization and Health (2020) 16:72
https://doi.org/10.1186/s12992-020-00603-1

Globalization and Health

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# Pseudoscientific beliefs and psychopathological risks increase after COVID-19 social quarantine

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## Abstract

**Background:** The health crisis caused by COVID-19 has led many countries to opt for *social quarantine* of the population. During this quarantine, communication systems have been characterized by *disintermediation*, the *acceleration of digitization* and an *infodemic* (excess and saturation of information). The following debate arises: Do the levels related to *the psychotic phenotype* and *pseudoscientific beliefs* related to the interpretation of information vary before and after social quarantine?

**Objectives:** This research aims to examine the psychological effects of social quarantine on the psychotic phenotype and pseudoscientific beliefs-experiences of the general nonclinical population. The following hypothesis was posed: social quarantine alters the levels of magical thinking, pseudoscientific beliefs and anomalous perceptions due to quarantine.

**Methods:** A *pre- and posttest* analysis design was applied based on the difference in means, and complementary *Bayesian* estimation was performed. A total of 174 Spanish subjects responded to different questionnaires that evaluated psychopathological risks based on psychotic phenotypes, pseudoscientific beliefs and experiences before and after quarantine.

**Results:** Significant differences were obtained for the variables *positive psychotic symptoms, depressive symptoms,* and certain *perceptual alterations* (e.g., *cenesthetic perceptions*), and a significant increase in pseudoscientific beliefs was also observed. The perceptual disturbances that increased the most after quarantine were those related to *derealization* and *depersonalization*. However, *paranoid perceptions* showed the highest increase, doubling the initial standard deviation. These high increases could be related to the delimitation of physical space during social quarantine and distrust towards information communicated by the government to the population. Is it possible that social alarmism generated by the excess of information and pseudoscientific information has increased paranoid perceptual alterations?

**Conclusions:** Measures taken after quarantine indicate that perceptual disturbances, subclinical psychotic symptoms and beliefs in the pseudoscience have increased. We discuss which elements of quarantine coincide with the social marginality theory and its clinical repercussions.

**Keywords:** COVID-19, SARS-CoV-2, Psychotic phenotype, Pseudoscientific beliefs, Psychotic disorders

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## Introduction

Tolerance to uncertainty regarding the future is conditioned and moderated by the degree of control that the subject perceives over what happens in the environment [1]. One of the psychological mechanisms that is activated with the aim of seeking and increasing the feeling of control is magical thinking [2]. Among the most frequent expressions of magical thinking are beliefs that contradict the laws and bases of the current scientific knowledge. These beliefs are usually called pseudoscientific beliefs [3]. In this case, the *Scientific Unexplained Beliefs Model* (hereafter SUB) justifies the social and psychological functionality of pseudoscientific beliefs as a way to feel safe and find an explanation or meaning to the uncertain circumstances that occur throughout life [4]. However, pseudoscientific beliefs - as in most belief systems - also allow the subject to make decisions and take actions that generate behavioral responses whose consequences can affect the mental health of people [5].

### Social, health and theoretical background

In recent months, many countries have been severely affected by the pandemic caused by the SARS-CoV-2 virus [6]. One of the most frequent legislative measures was the social quarantine of the population in their homes and the cessation of economic activities considered non-essential [7, 8]. In this line, the media reported that during the first week of quarantine, some products related to personal hygiene were exhausted in the respective establishments [9]. Although *sanitary masks* and *hydroalcoholic gels* were the first products to disappear, it was reported that toilet paper had also run out [10, 11]. This is the case in most European countries but also includes the United States and Australia, in which some people also bought this product en masse [12]. This type of behavior is classified into *compulsive behaviors* related to fear, anxiety and magical thinking [13, 14]. Similarly, some studies also suggest that they are responses to the need to seek control [15]. Other studies indicate that this extraordinary social situation produced by COVID-19 has generated an increase in magical beliefs and *herd behavior*, which is correlated with the increase in perceived stress during quarantine [16, 17].

The consequences of pseudoscientific beliefs on the health of people were analyzed and investigated from multiple perspectives [4, 18]. These perspectives can be summarized in two models: the first model is based on the psychopathological and symptomatic effects that pseudoscientific beliefs produce in patients [19–23]. Most studies conclude that pseudoscientific beliefs represent an attribute of *the psychotic phenotype*, which is included within the *psychosis continuum* model [24, 25]. At the statistical and epidemiological level, its effects can be synthesized in two points: on the one hand, in an increased probabilistic risk of contracting or developing a future psychotic picture (e.g., paranoid pictures) [26] and, on the other hand, in the clinical or subclinical development of the *attenuated psychotic symptoms syndrome* [27, 28]. This is a relatively new classification included in the DSM-5 that is being studied [29]. In any case, according to this perspective, pseudoscientific beliefs would not represent adaptive models of thought or systems of meanings for the patient and, therefore, would constitute behaviors preferably to be extinguished during the therapeutic course of treatment [30]. It is important to note that the medical conception of mental health has been widely criticized by some research [31]. The problem of the psychopathological perspective is that clinical judgment is often confused with *moral judgment* on the patient's own beliefs, which determines what is "correct" (functional) versus "incorrect" (dysfunctional) [4, 32]. The mixture of moral and clinical judgment incurs in the *Naturalistic Fallacy* [33, 34]: - *Pseudoscientific beliefs are dysfunctional* (imperative argument); then, – *it is not correct that a person or patient can have pseudoscientific beliefs because they are dysfunctional* (fallacious argument). The separation between decisions involving clinical judgment and moral assessments is essential if the respect and freedom of the patient is to be guaranteed [31].

The second model is outside the psychopathological framework, but within this conception, pseudoscientific beliefs are also understood as cognitive errors or perception biases [5, 35]. This perspective includes perceptual distortion and cognitive styles [36]. In fact, some studies concluded that subjects that believe in *pseudosciences* develop causal illusions more frequently and more heightened than nonbelieving subjects [37]. The psychobiological function of perceptual distortion is based on survival: if the cause of a phenomenon is known, the cause itself and the respective phenomenon could be prevented; this would allow anticipating environmental threats and finding answers that would guarantee the survival of the species [5, 37, 38]. In this area, the most studied perceptual distortions are causal illusions and *pareidolia* [39], which is also very common in believers in pseudoscience [40].

The *social marginality theory* explains the production of pseudoscientific beliefs as a consequence of the personal and geographic isolation of some communities [41]. According to some studies, the greater the social isolation, the higher the levels of magical thinking that individuals in the respective communities who would remain on the "margin" of society can develop [41–43]. Likewise, it was observed that marginality was also positively correlated with an increase in anomalous perceptions [4]. Anomalous perceptions are apparently hallucinatory experiences, and those who live them usually experience

them as a phenomenon without scientific explanation [44]. Believers tend to interpret anomalous perceptions as the justification that "they have experienced a supernatural phenomenon" [45]. The hypothetical model of social marginality requires analyzing communication systems, access and the quality of information consumption.

Precisely, during the social quarantine, the consumption of information could be characterized by (1) the *disintermediation* between the original information sources and the people-recipients of the respective information [46], 2) the *acceleration of digitalization,* which has facilitated mass access to information and has changed the way of informing oneself about what is happening in reality [47]; and (3), the two previous characteristics contribute to what Innerarity and Colomina (2020) call an *infodemic* or population saturation in the face of so much amount and type of information [48]. At the same time, these three characteristics and the lack of trust in conventional media suggest that the population could have more difficulties in differentiating objective and credible information from pseudoscientific information based on false news [46, 48].

In reality, *social marginality* - originally understood as the personal and geographic isolation of the population - during the quarantine, it has been limited to only *physical* isolation between people, since the acceleration of digitization has allowed individuals with access to technologies, to remain communicated. In other words, the population could suffer various types of "marginalities", not limited exclusively to the initial idea of "social marginality". In this line, the quarantine derived from COVID-19 would be related to a "physical-affective" marginality, whose lack of physical contact would have an impact on the management, expression and use of *emotions* [13, 14]. Thus, this type of marginality could be understood as a *physical-affective marginality* that would be different from the social marginality theory".

Therefore, all the aforementioned involve understanding the social quarantine from three perspectives: (1) should address the psychopathological risks that the social marginality theory warns. According to the social marginality theory, the concept of psychopathological risks should be understood or defined as the tendency to develop attenuated symptoms related to schizoaffective disorders in the general non-clinical population [49]. This expression should not be extrapolated to other mental disorders. (2) The characteristics related to the use and interpretation of the information during quarantine should be taken into account. (3) Finally, the perception of lack of control (related to tolerance to uncertainty) should also be included, which according to the SUB model [4] would explain the development of magical and pseudoscientific beliefs. As determined by the SUB model, pseudoscientific beliefs can be defined as the irrational acceptance (based on magical thinking) of the existence of phenomena that are impossible according to the epistemology of current scientific knowledge [50].

These three points allow characterizing the social quarantine and propose the objectives of this research. Likewise, the definitions of psychopathological risks and pseudoscientific beliefs also represent an operative way of defining variables that are also found in the objectives.

### Objectives

This study aims to analyze the impact of social quarantine during the COVID-19 crisis on magical thinking, pseudoscientific beliefs, anomalous perceptions and psychotic phenotype in subjects from the Spanish general population. The discussion and debates derived from this study are as follows:

1) If one of the characteristics of quarantine is based on social marginality, then the debate raised by this research is based on the following question: How would *physical-affective* marginality affect the levels of magical thinking and pseudoscientific beliefs?
2) If *disintermediation*, the *acceleration of digitization* and the *infodemic* are implicit attributes present in the quarantine, the following debate also arises: Could the probable changes observed in the scores of pseudoscientific beliefs be explained by the three previous characteristics?
3) If the perception of lack of control is one of the causal factors that would justify why pseudoscientific beliefs are developed, then the following question could be discussed: Could *disintermediation*, the *acceleration of digitalization* and the *infodemic* increase the lack of perceived control generating a consecutive increase in pseudoscientific beliefs? For this question, the results should be obtained with significant increases in pseudoscientific beliefs, anomalous perceptions and the psychotic phenotype.

Finally, the study contrasted the following hypothesis: *the levels of pseudoscientific beliefs and anomalous perceptions vary significantly before (pretests) and after (posttests) quarantine due to the effects of "physical-affective marginality".*

## Materials and methods

### Participants

A total of 99 women and 75 men (174 subjects in total) of legal age (mean = 28.82; standard deviation = 7.943) participated. A total of 41.4% of the participants resided in Madrid, and 58.6% lived in Barcelona. All of them signed a consent form authorizing their voluntary

participation. Likewise, they also stated that they had no psychiatric history.

## Instruments

### *Multivariable multiaxial suggestibility inventory – 2 reduced (MMSI-2-R)*

It is a self-report questionnaire composed of 49 polytomous items distributed in 6 dimensions or scales: *Visual and Auditory Perception* (Pva); *Cenesthetic Perception* (Pc); *Olfactory Perception* (Po); *Touch Perception* (Pt); *Taste Perception* (Pg); and *Paranoid Experience* (Et). The answers are coded using a Likert scale that fluctuates between 1 and 5. 1 means "strongly disagree" and 5 "strongly agree". Both versions offer guarantees on their validity and reliability, whose internal consistency indices are greater than 0.8 in all scales [51]. Table 1 reports the description of each dimension and the reliability coefficients.

### *Australian sheep-goat scale (ASGS)*

It is a brief scale formed by 18 items that examine pseudoscientific beliefs and experiences. Originally, this scale was developed and validated in Australia [52], but A. Escolà-Gascón and L. Storm developed the Spanish adaptation (which has not yet been published), which also shows adequate validity and reliability of the test (Guttman's *lambda* = 0.93). The responses to the 18 items can be coded in two ways, either complying with the original protocol or the following coding can be applied: 0 = "false", 1 = "I doubt my answer" and 2 = "true". This coding was used in the Spanish adaptation and has also been shown to be reliable (McDonald's *omega* = 0.92) [53]. Given that the Spanish adaptation of the ASGS is not published, the ASGS scale translated into Spanish used in this study is attached to this report (see Supplementary Materials).

### *Community assessment of psychic experiences-42 (CAPE-42)*

It is a psychometric scale widely used to evaluate the psychotic phenotype in subjects from the general population [25]. It consists of 3 main dimensions: *Positive Dimension* (hereafter PD) (composed of 20 items), (2) *Negative Dimension* (hereafter ND) (consisting of 14 items), and (3), *Depressive Dimension* (hereafter DD) (contains 8 items). In total, there are 42 items whose responses are quantified following the Likert model with 5 response options. The 1 means "almost never" and the 5 "almost always". The CAPE-42 was translated and adapted with the Spanish population [54]. This adaptation presents satisfactory reliability indices and construct validity according to the original version of the test. This version was the one used in this study. Table 2 presents a description of each scale and reliability coefficients.

The subscale that measured the psychopathological impact of psychotic symptoms was not applied because the scales of the CAPE-42 were analyzed as dependent variables (and not as independent variables). The aim was to analyze the impact of the social quarantine derived from COVID-19 on subclinical psychotic symptoms and not vice versa.

## Procedures

In this study, hypothesis contrast tests were applied by comparing means between two repeated samples. The aim was to verify whether social quarantine could alter perceptual processes and magical belief systems.

Initially, the purpose of this research was to replicate the psychometric properties of the MMSI-2-R by

**Table 1** Description of MMSI-2-R dimensions and reliability coefficients

| AB | Complete denomination | What do the MMSI-2-R scales assess? | Cronbach's *alpha* | McDonald's *omega* |
|---|---|---|---|---|
| Pva | *Visual and Auditory Perception* | Perceptual disturbances whose sensory object is captured visually and auditorily (e.g., seeing ghosts, inexplicable shadows, and hearing voices of deceased beings). | 0.987** | 0.987** |
| Pc | *Cenesthetic Perception* | Perceptual disturbances related to depersonalization and derealization (e.g., not recognizing places that are habitual for the patient and experiencing the sensation of leaving one's own body as an external observer). | 0.988** | 0.99** |
| Po | *Olfactory Perception* | Perceptual disturbances whose sensory object is captured through smell (e.g., perceiving odors that other people do not perceive or perceiving odors far from the place where the patient is). | 0.984** | 0.985** |
| Pt | *Touch Perception* | Perceptual disturbances whose sensory object is captured using touch or supposed physical contact (e.g., believing that a deceased being has touched you or feeling that something unknown has paralyzed your body). | 0.996** | 0.996** |
| Pg | *Taste Perception* | Perceptual changes related to the taste of food (e.g., perceiving more intense flavors than usual or feeling an unpleasant or "rotten" taste in food that is actually in a good condition). | 0.983** | 0.984** |
| Et | *Paranoid Experience* | Perceptual disturbances related to the belief that supernatural forces seek to control us (e.g., feel the presence of energies or spirits that want to harm you). | 0.949** | 0.949** |

*AB* abbreviation of the scales' denomination. Abbreviations do not coincide with the complete denominations as they come from the Spanish version of the MMSI-2-R. ** > 0.8 (reliability coefficients are excellent)

**Table 2** Description of CAPE-42 dimensions and reliability coefficients

| AB | Complete denomination | What do the CAPE-42 scales assess? | Cronbach's *alpha* |
|---|---|---|---|
| PD | *Positive Dimension* | Analyzes perceptual disturbances and hallucinations expressed in an attenuated and subclinical way (e.g., reading other people's thoughts). | 0.84** |
| ND | *Negative Dimension* | Analyze clinical symptoms related to difficulties in social and affective relationships (e.g., having the feeling that people do not understand you or difficulties expressing and sharing emotions with others). | 0.78* |
| DD | *Depressive Dimension* | Analyze clinical symptoms related to sudden feelings of sadness and loneliness (this means, without apparent explanation) (e.g., feelings of hopelessness or lack of energy to carry out daily activities). | 0.79* |

*AB* abbreviation of the scales' denomination
** > 0.8 (reliability coefficients are excellent), * > 0.7 (reliability coefficients are good)

examining its convergent validity with respect to the ASGS and CAPE-42 scales. During December 2019 and January, February and March 2020, 346 subjects responded to the questionnaires. When in Spain, the *state of alarm* was decreed on March 14 due to the health crisis caused by COVID-19 [55], the research had to be interrupted to meet other more urgent needs related to this crisis. However, with the state of alarm in Spain, the total social quarantine of the population was also decreed during the following 2 weeks of March. Subsequently, the quarantine lasted until May 10. This fact caused the research team to make a decision regarding how to take advantage of the research sample. Understanding the importance of the scientific and statistical analysis of the social, health and economic impact of the SARS-CoV-2 virus, the research team decided to reorganize the priorities of the original study and made the quick decision to contact the participants again by email to return to answer telematically to the MMSI-2-R, CAPE-42 and ASGS questionnaires. The contact with the participants began on May 11 (also the day in which the first phase began to resolve the quarantine and return to normal social relations). The deadline for receiving the responses was May 21. This decision was made with the aim of adapting the collection of posttests to the circumstances of each participant, since it was not possible for all participants to respond to the questionnaires on the last day of quarantine. Of the 346 subjects, only 174 subjects answered the tests again. In the following week, the data were analyzed, and the present report was written.

### Data analysis

The data were processed in the JASP and JAMOVI programs, both of which are open access and were created by the same research group [56]. *Student's t*-tests were applied for repeated samples, their nonparametric version (*Wilcoxon* test) and a *Bayesian* estimation were also performed from the *Bayes factor* in favor of the alternative hypothesis (hereafter $BF_{10}$). The a priori probabilities were adjusted to 50% such that the null hypothesis ($H_0$) and alternative hypothesis were *equiprobable*. The *Cauchy scale* was also adjusted for convenience to 0.707. From the *BFs*, the probability ($P$) that the alternative hypothesis ($H_1$) reproduces the observed data ($D$) could be obtained. The following transformation formula was used:

$$BF_{10} = \frac{P(D|H_1)}{P(D|H_0)} \asymp P(H_1|D) = \frac{BF_{10}}{BF_{10}+1}$$

This is possible because the $BF_{10}$ are *likelihood ratios*, but they differ from the *likelihood quotient* in that the parameters of the previous equation are obtained by integration and not by maximizing. As a complement, measures of effect size were also estimated using *Cohen's d*. The risk of error was adjusted to 1% in all contrasts and to 5% for the credibility intervals of the Bayesian estimates.

## Results

Table 3 presents the descriptive statistics for the dependent variables used and for each application of the tests (pre- and posttest applications).

Increases in the average values can be observed in all dependent variables (except for the *Negative Dimension* scale). To compare whether these increases are significant, different means comparison tests were applied for each variable. This information is shown in Table 4.

Table 4 brings together parametric and nonparametric contrast statistics. In most variables, both the *t*-test and the *Wilcoxon* test offer consistent results and indicate that the average increases are significant, with the exception of the *visual and auditory perception* scales (scale belonging to the MMSI-2-R). and *Negative Dimension* (belonging to the CAPE-42 test), whose critical levels are greater than 0.01. Precisely in the results of Table 4, according to *Cohen's d* indices, the effects that have a larger or larger size are found for the variables *Cenesthetic Perception*, *Paranoid Experience*, *Positive dimensions* and *Depressive Dimension*. However, the *Pseudoscientific Beliefs* and *Taste Perception* variables also show *Cohen's d* indices greater than 1 (taken as absolute values).

**Table 3** Descriptive statistics for each variable

| Scales | Measures | Means | Standard deviation | 95% Credible interval[a] | |
|---|---|---|---|---|---|
| | | | | Lower | Upper |
| *Pseudoscientific beliefs* | Pre-test | 12.805 | 8.529 | 11.528 | 14.081 |
| | Post test | 17.557 | 6.668 | 16.560 | 18.555 |
| *Visual and auditory perception* | Pre-test | 35.368 | 11.398 | 33.662 | 37.073 |
| | Post test | 36.356 | 12.253 | 34.523 | 38.190 |
| *Touch perception* | Pre-test | 17.345 | 5.291 | 16.553 | 18.137 |
| | Post test | 21.034 | 6.582 | 20.050 | 22.019 |
| *Olfactory perception* | Pre-test | 16.925 | 4.683 | 16.225 | 17.626 |
| | Post test | 19.632 | 5.453 | 18.816 | 20.448 |
| *Taste perception* | Pre-test | 8.879 | 2.610 | 8.489 | 9.270 |
| | Post test | 10.615 | 3.475 | 10.095 | 11.135 |
| *Cenesthetic perception* | Pre-test | 25.856 | 6.978 | 24.812 | 26.900 |
| | Post test | 31.310 | 7.564 | 30.178 | 32.442 |
| *Paranoid experience* | Pre-test | 5.805 | 1.874 | 5.524 | 6.085 |
| | Post test | 9.201 | 2.964 | 8.758 | 9.645 |
| *Positive dimension* | Pre-test | 28.448 | 5.006 | 27.699 | 29.197 |
| | Post test | 31.885 | 5.758 | 31.023 | 32.747 |
| *Negative dimension* | Pre-test | 24.862 | 6.839 | 23.839 | 25.885 |
| | Post test | 24.460 | 6.623 | 23.469 | 25.451 |
| *Depressive dimension* | Pre-test | 14.879 | 5.003 | 14.131 | 15.628 |
| | Post test | 24.408 | 3.983 | 23.812 | 25.004 |

[a]Credible interval was taken from the Bayesian analyses

**Table 4** Means compassion using t test, Wilcoxon test and Bayes factors

| Scales | *t test* (*p* values) | *Wilcoxon* (*p* values) | $BF^{a}_{10}$ (% error) | $P(H_1 \mid D)$ | *Cohen's d*[b] |
|---|---|---|---|---|---|
| *Pseudoscientific beliefs* | − 14.172<br>$p < 0.001$ | 345.5<br>$p < 0.001$ | 3.357e+ 27 ≈ 36.125<br>(~0) | 0.97306* | − 1.074 |
| *Visual and auditory perception* | −3.014<br>$p = 0.003$ | 4503.5<br>$p = 0.118$ | 6.603<br>(2.524%) | 0.86847 | −0.228 |
| *Touch perception* | −14.382<br>$p < 0.001$ | 360.5<br>$p < 0.001$ | 1.324e+ 28 ≈ 31.6<br>(~0) | 0.96933* | −1.090 |
| *Olfactory perception* | −17.382<br>$p < 0.001$ | 85.7<br>$p < 0.001$ | 2.865e+ 36 ≈ 43.788<br>(~0) | 0.97767* | −0.986 |
| *Taste perception* | −13.982<br>$p < 0.001$ | 157.5<br>$p < 0.001$ | 9.861e+ 26 ≈ 52.805<br>(~0) | 0.98141* | −1.060 |
| *Cenesthetic perception* | −16.596<br>$p < 0.001$ | 67<br>$p < 0.001$ | 2.006e+ 34 ≈ 39.453<br>(~0) | 0.97528* | −1.258 |
| *Paranoid experience* | −24.435<br>$p < 0.001$ | 179.5<br>$p < 0.001$ | 2.867e+ 54 ≈ 61.793<br>(~0) | 0.98407* | −1.852 |
| *Positive dimension* | −23.022<br>$p < 0.001$ | ~0<br>$p < 0.001$ | 1.152e+ 51 ≈ 54.131<br>(~0) | 0.98186* | −1.745 |
| *Negative dimension* | 0.666<br>$p = 0.507$ | 6438.5<br>$p = 0.678$ | 0.105<br>(~0) | 0.09502 | 0.05 |
| *Depressive dimension* | −22.736<br>$p < 0.001$ | 50<br>$p < 0.001$ | 2.289e+ 50 ≈ 56.222<br>(~0) | 0.98252* | −1.724 |

[a]$BF_{10}$ is Bayes Factor
[b]*Cohen's d* was applied according t tests
*Evidence in favor of the alternative hypothesis (*BFs* > 10)

Attending the *BFs* and the $P(H_1|D)$, the results also support the statistical decisions specified so far. More specifically, the *BFs* indicate that the alternative hypothesis fits the empirical data between 53 and 61 times more than the null hypothesis for the variables *Taste Perception, Paranoid Experience, Positive Dimension* and *Depressive Dimension*. For the variables whose *BFs* were greater than 10, the distributions were characterized as "a posteriori" based on the Bayesian estimation performed. These distributions allow us to know the *credibility intervals* estimated at 95%. Within the limits of these intervals, the mediated and estimated *Cohen's d* effect sizes can be located.

The pre- and postscores of each scale were also examined using *Pearson linear correlations*. Table 5 presents the results of this analysis.

The weight of the correlations increases as the size of the effects is larger. This seems to coincide with previous results. The only value of the matrix trace in Table 5 that yields an incoherent weight with the effect size obtained in Table 4 is that belonging to the *Depressive Dimension* scale. This suggests that the changes observed in this variable and specifically in the posttest tend to independence in relation to the measures applied before quarantine.

As a joint decision, given the results obtained, the null hypothesis can be rejected and the alternative maintained, which supports the relationship between social quarantine and significant increases for all scales (except for the Pva and ND dimensions).

## Discussion

In this study, we wanted to verify the effects of the social and health consequences of social quarantine on the variables pseudoscientific beliefs, anomalous perceptions and the traits that describe the psychotic phenotype. The contrast tests applied reveal that the scores in these variables increase after 57 days of social quarantine.

### Interpretation of the results

The hypothetical social marginality theory related to pseudoscientific beliefs has rarely been investigated outside the experimental framework [41, 42]. In reality, social marginality was studied from a sociocultural perspective limited to geographically isolated regions, whose living conditions differed from the normative lifestyle of large Western cities (e.g., towns with few inhabitants or villages located in climatologically aversive environments) [42]. Unlike the geographically isolated areas, the social quarantine during the COVID-19 crisis was only physical since technologies allowed us to maintain communications and digitize human relations.

Taking as a reference the results obtained, it can be concluded that social quarantine increases levels of magical thinking, pseudoscientific beliefs and anomalous perceptions. However, knowing that this research is not purely experimental, if one were to consider why these increases occur, hypothetical inferences should be made related to the sociosanitary characteristics implicit in the quarantine. As already mentioned, these characteristics may be related to psychological and psychopathological variables as well as to other variables associated with communication and access to information. From here, the following is proposed: is it possible that the *disintermediation*, the *acceleration of digitization* and the *infodemic* - especially the latter - can alter the way of interpreting information by the population generating generalized *fatigue* and a *saturation of* stimuli? Is it possible that fatigue and saturation are the mediating variables responsible for this increase? If the results of this research indicate that magical thinking has increased, so can *false news*, disinformation and *pseudoscientific*

**Table 5** Correlation matrix between variables pre and post-tests

| | | *Pre-tests* | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | PB | Pva | Pt | Po | Pg | Pc | Et | PD | ND | DD |
| *Post-tests* | PB | **0.858*** | 0.526* | 0.432* | 0.227* | 0.333* | 0.318* | 0.547* | 0.587* | 0.179* | 0.213* |
| | Pva | 0.591* | **0.936*** | 0.551* | 0.467* | 0.613* | 0.465* | 0.704* | 0.4* | 0.166 | 0.216* |
| | Pt | 0.482* | 0.579* | **0.186*** | 0.426* | 0.543* | 0.486* | 0.476* | 0.38* | 0.123 | 0.25* |
| | Po | 0.374* | 0.391* | 0.406* | **0.929*** | 0.487* | 0.21* | 0.392* | 0.183* | 0.01 | 0.191* |
| | Pg | 0.299* | 0.469* | 0.421* | 0.563* | **0.893*** | 0.222* | 0.412* | 0.029 | 0.105 | 0.094 |
| | Pc | 0.524* | 0.677* | 0.539* | 0.205* | 0.404* | **0.825*** | 0.594* | 0.496* | 0.154 | 0.263* |
| | Et | 0.606* | 0.652* | 0.485* | 0.381* | 0.51* | 0.414* | **0.804*** | 0.509* | −0.022 | 0.054 |
| | PD | 0.722* | 0.581* | 0.45* | 0.225* | 0.291* | 0.38* | 0.676* | **0.943*** | 0.081 | 0.291* |
| | ND | 0.172 | 0.252* | 0.214* | 0.171 | 0.19* | 0.107 | 0.133 | 0.211* | **0.299*** | 0.354* |
| | DD | 0.254* | 0.286* | 0.3* | −0.031 | 0.031 | 0.155 | 0.298* | 0.358* | 0.236* | **0.259*** |

*PB* Pseudoscientific beliefs, *Pva* Visual and Auditory Perception, *Pt* Touch Perception, *Po* Olfactory Perception, *Pg* Taste Perception, *Pc* Cenesthetic Perception, *Et* Paranoid Experiences, *PD* Positive Dimension, *ND* Negative Dimension, *DD* Depressive Dimension
*$p < 0.01$

information. Then, as some international studies point out, it is possible that disinformation may be another of the causal variables of these increases [57, 58]. It is noted that the previous questions would not be justified if the scores on the *Paranoid Experiences* scale had not obtained the highest effect size. It is important to stop at this point because this scale warns that the levels of distrust and paranoia are those that have increased the most (with respect to the other psychological indicators evaluated). To the team's surprise, this increase coincides with the results published by the CAC (*Consell de l'Audiovisual de Catalunya*) on the increase in disinformation and false news during the quarantine derived from COVID-19 (whose rates reach 80%) [59].

As seen, these issues are merely speculative and invite future research to correlate the data related to false news publications with the recorded increases in magical thinking and pseudoscientific beliefs in this research. For this reason, the raw data of the project are available in the file Raw_data_1; thus, other investigations could also be used.

Returning to the characteristics or psychopathological risks related to quarantine, another relevant interpretation falls on the following question: Why in some variables are the sizes of the increase in scores higher than in others? On the one hand, in the case of the Pc scale of the MMSI-2-R, it should be taken into account that kinesthetic perceptions describe alterations related to *depersonalization* and *derealization* processes. Another of the characteristics of quarantine is that the subject had to remain locked up a number of hours higher than usual in limited and non-variable spaces. That is, in addition to being confined, another characteristic of the quarantine space is that in most cases, it is the same and does not change, although the subject does change activities and tasks throughout the day. The fusion of these two implicit characteristics during periods of quarantine could generate states of confusion in the subject that would trigger kinesthesia as the main perceptual alteration. On the other hand, the psychotic phenotype is still a subclinical marker relative to the risks of suffering future psychotic symptoms. The fact that PD and DD (belonging to the CAPE-42 scale) have also shown significant increases indicates that quarantine could increase risk levels in suffering from future psychotic behaviors. The PD scale examines psychotic hallucinations, and its effects are the second highest (see *Cohen's d* in Table 4). These data - integrating it with the results of the Pc scale of the MMSI-2-R - warns that the hallucinatory pictures could increase after the subjects experience prolonged states of quarantine and, specifically, that the increase is observed in the kinesthetic-type hallucinatory contents.

If scientific research should have professional applicability and social influence, then the questions that have been posed should help the respective media and interested agencies to consider what control should be exercised over information traffic and disinformation in the crisis stages. It is precisely in these periods when people have greater psychopathological risks (see the results in Table 4) and are more vulnerable to suffering the negative consequences of disinformation and false news (see data published by the CAC), associated with effects of the state of social quarantine itself. In addition, taking into account what has been discussed, magical beliefs could also be altered by the way in which information is consumed, accessed and interpreted. The sense of control that they can transmit to the believing subject (see the SUB model proposed by Irwin) [4] could justify its implementation and activation, but its increase is also conditioned on the dissemination and manipulation of information. How to analyze the consumption of information and ensure its credibility is one of the challenges that can be posed based on the results obtained and based on the COVID-19 crisis.

### Criticisms and limitations

The limitations of this study can be summarized in six key points:

1) The applied design was not experimental. This means that the impact of quarantine cannot be interpreted in absolute causal terms. It is for this reason that "conditional" arguments have been used in the analysis and speculation with the results obtained. The findings of this study support that there may be a causal relationship between the state of quarantine and changes in the behaviors examined, but this causality has not been contrasted. Therefore, this should be replicated in the future to optimize both internal and external validity.
2) The pretests were performed by the subjects on excessively heterogeneous dates before starting quarantine (between the first subject who responded to the pretests and the last subject before the onset of the state of alarm, 46 days passed). How this variability associated with pretest dates could have affected is something that could not be controlled in this study and will not be controlled, since it is not possible to know the factors that intervened in the lives of the subjects of the sample during those 46 days. One possible solution that was considered was the exclusion of subjects who had answered the pretests before February 29 (15 days before the state of alarm); in this way, the effect of the variability relative to the dates could have been reduced. The problem with this methodological decision is that it would

excessively damage the external validity of the results, since the sample would be reduced to less than 30 subjects (a critical number for hypothesis testing). Therefore, a design was chosen that would benefit external validity (facilitating the increase in sample size and the replicability of the results). Likewise, in Spain, the COVID-19 health crisis was reported by the media almost suddenly and with no time frame to act, prevent and make quick decisions that would allow for the implementation of a necessary and complex study such as the one presented here.

3) The fact that pseudoscientific beliefs have increased after quarantine does not mean that this increase is psychopathological in itself. Nor does it mean that the increase is explained by the "psychotic phenotype" (unlike the PD scale of the CAPE-42). Taking into account the *Scientific Unexplained Beliefs Model* [4], pseudoscientific beliefs may have increased due to uncertainty and the feeling of lack of control and not so much due to the presence of subclinical psychotic mechanisms in the individual. The increase in the risk indices evaluated by the CAPE-42 and the increase in pseudoscientific beliefs may be correlative in the sample used but does not imply that one group of variables causally justifies the increase in the others. This is important to note, since the fact of having divergent beliefs should not be confused with the ontological principles of science (e.g., beliefs in the "supernatural") and the possibility of suffering a dissociative-psychotic picture.
4) In this research, no indicators were recorded in the posttests that would allow knowing the compliance and management of the state of quarantine of each subject. All participants declared having met quarantine (which was the basic condition and sufficient to perform the posttests). In addition, the control or record of the behavioral indicators on how the participant complied with the quarantine represents an object outside this research: the impact of the quarantine was limited to the specified dependent variables. However, it is true that such information would have made possible the inclusion of new independent variables that would interact with the main variable pre- and posttests. To what extent the latter would improve and optimize the already made contrasts is something that is unknown.
5) Some limitations related to the lack of representativeness of the sample should be discussed. First, sample selection was not probabilistic and could not be weighted according to stratification or cluster selection techniques. This makes it difficult to generalize the findings to the population as a whole. Therefore, it is proposed to interpret the results of this research as a warning and not as a confirmation in statistical terms of the effects of social quarantine on the non-cynical population. Second, although the extrapolation of the results is not completely generalizable, the data and interpretations can be used to rationally and empirically support future research that contrasts similar variables. Specifically, it is recommended to consider sociodemographic markers that provide information on which social groups are most vulnerable to COVID-19. For example, the following question should be addressed: do the elderly (as the most vulnerable social group according to age) tend to develop more or less irrational behaviors than the young people?
6) Finally, the results of the investigation were interpreted in relation to the consumption of information and digital media. However, although data from Spanish public entities were used [59], explicit measurements of these variables were not included in the investigation. Taking into account that the dissemination of pseudoscientific information can lead the population to make bad decisions [60–62], it seems necessary for future studies to relate the degree to which decisions based on pseudoscience increase psychopathological risks. To carry out this analysis, the consumption of pseudoscientific information must be measured. Despite this limitation, the results of this report warn that the effects of pseudoscientific information were involved during the social quarantine, as pseudoscientific beliefs increased in post-tests.

## Conclusions

This research and its results allow us to reach the following conclusions:

1) Understanding that in large cities, the quarantine of the population in their homes has so far represented one of the circumstances closest to the idea of "social marginality", the results of this research support the extrapolation of the hypothesis of social marginality to a physical-affective level, applied specifically to subjects residing in large cities.
2) The increases in pseudoscientific beliefs, anomalous experiences and even the psychotic phenotype were observable and significant after 57 days of state of alarm and social quarantine. It is concluded that depressive symptoms, psychotic hallucinations, kinesthetic alterations and paranoid experiences were the variables with the largest effect sizes. The Bayesian estimation indicated that the perceptual

visual-auditory anomalies (Pva scale of the MMSI-2-R) did not present significant changes; therefore, it does not seem to be a perceptual alteration that is affected by social quarantine. The same happened with the negative symptoms of the ND scale (present in certain psychotic pictures); quarantine had no effect on this variable.

3) It is concluded that the risk of suffering from paranoid, psychotic or dissociative states can easily increase after these days of physical-social isolation. This would also put at risk the mental health of people and would emphasize the urgency of the psychiatric and psychological measures that the legislation and the government should take to protect the most vulnerable medical-psychological profiles in terms of the development of psychotic pictures.
4) As a final conclusion, knowing that the states of paranoia were the experiences that increased the most after the social quarantine, it is worth considering the possibility that an excess of information and disinformation in digital media is one of the variables causing the increases observed for generating confusion and preventing the general population from effectively discriminating between credible information sources and pseudoscientific information sources.

## Supplementary information

**Supplementary information** accompanies this paper at https://doi.org/10.1186/s12992-020-00603-1.

**Additional file 1.**

**Additional file 2.**

### Acknowledgements
Not applicable' for that section.

### Concerning preregistration
This study was not preregistered.

### Authors' contributions
AEG conceived and planned the study, collected the sample, performed the statistical analyses and wrote the manuscript in consultation with FXM and JR. JG supervised the project. The authors read and approved the final manuscript.

### Funding
The authors confirm there has been no significant financial support for this work that could have influenced its outcome.

### Availability of data and materials
All data generated or analyzed during this study are included in this published article (see Raw_data_1) [and its supplementary information files].

### Ethics approval and consent to participate
*Dr. Sacra Morejon Torné*, Vice Dean of Research of the Faculty of Psychology of *Ramon Llull University*, representing the Committee of Ethical Guarantees of *Ramon Llull University*, Barcelona, Spain (number of certificate references: 1920009P), reviewed, favorably evaluated and approved this research. Likewise, the procedures of this study adhere to the Spanish Government Data Protection Act 15/1999 and the *Declaration of Helsinki of 1975*, revised in 2013.

### Consent for publication
Not applicable' for that section.

### Competing interests
The authors confirm that there are no known conflicts of interest associated with this publication.

Received: 17 June 2020 Accepted: 23 July 2020
Published online: 30 July 2020

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## Publisher's Note

frontiers in Psychology

ORIGINAL RESEARCH
published: 19 November 2020
doi: 10.3389/fpsyg.2020.607064

# Measuring Psychosocial Reactions to COVID-19: The *COVID Reaction Scales* (COVID-RS) as a New Assessment Tool

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Knowing and measuring the psychosocial reactions of people to the coronavirus crisis could be useful for predicting citizen responsibility and psychological well-being in the general population. In this research, we present the *COVID Reaction Scales* (COVID-RS), a new tool that can measure and quantify the psychopathological reactions of the population to the COVID-19 crisis. The sample consisted of 667 subjects. Explorative and confirmative factor analyses were applied to examine the validity and reliability of the COVID-RS. Five dimensions were extracted that predicted 35.08% of the variance of the psychopathological reactions: (1) *disorganized behaviors*, (2) *avoidant behaviors*, (3) *maladaptive information consumption*, (4) *herd behaviors* and (5) *loneliness*. The results indicated that social quarantine induces and increases psychopathological reactions. However, emotional loneliness is reduced for each person with whom the respective subject lives during the quarantine. Finally, we can conclude that the COVID-RS has satisfactory validity and reliability. Measuring dysfunctional reactions to COVID-19 can enable the prediction of citizen responsibility.

**Keywords: COVID-19, SARS-CoV-2, coronavirus, post-pandemic, coping styles**

OPEN ACCESS

***Edited by:***
*Sai-Fu Fung,*
*City University of Hong Kong,*
*Hong Kong*

***Reviewed by:***
*Francesco Giancamilli,*
*Sapienza University of Rome, Italy*
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***Specialty section:***
*This article was submitted to Quantitative Psychology and Measurement, a section of the journal Frontiers in Psychology*

***Received:*** *17 September 2020*
***Accepted:*** *30 October 2020*
***Published:*** *19 November 2020*

***Citation:***
*Escolà-Gascón Á, Marín F-X, Rusiñol J and Gallifa J (2020) Measuring Psychosocial Reactions to COVID-19: The COVID Reaction Scales (COVID-RS) as a New Assessment Tool. Front. Psychol. 11:607064. doi: 10.3389/fpsyg.2020.607064*

## INTRODUCTION

Most of the studies that related the coronavirus crisis to mental health focused on determining the psychopathological impact of the social quarantines enacted in Western and Asian countries (see Parmet and Sinha, 2020; Venkatesh and Edirappuli, 2020). In general, during the early phases of the pandemic, numerous publications noted significant increases in levels of anxiety and depression, as well as a growing trend of irrational behaviors in the general population (e.g., Ahorsu et al., 2020; Brooks et al., 2020; Lee, 2020; López and Rodó, 2020; Shanafelt et al., 2020). Once the international social quarantining measures were lifted (i.e., reopening of borders between the countries of the European Union), the social and psychiatric consequences of this crisis became more complex to analyze (e.g., Escolà-Gascón et al., 2020; Frías et al., 2020). The main reason is that there are still no behavioral and psychosocial markers that allow effective decisions to be made to prevent the spread of the coronavirus and safeguard the quality of life of the population. As a demonstration of this problem, many scientific articles that gave solutions regarding how to solve this crisis were retracted (see Yeo-Teh and Tang, 2020).

The results of this study offer new statistically valid and consistent psychometric measures to examine the processes of psychosocial adaptation and dysfunctional management of the general

population in the face of this international crisis. Specifically, we offer the development of a new scale that aims to characterize and quantify the psychopathological reactions of the general population in response to the coronavirus crisis. This new scale is called the *COVID Reaction Scales* (COVID-RS).

The consequences of the COVID-19 crisis can be summarized hypothetically in three dimensions (in addition to the medical-health dimension): (1) Changes in social behavior (e.g., Armitage and Nellums, 2020; Bavel et al., 2020); (2) Changes in consumption of information (e.g., Innerarity and Colomina, 2020a,b; Masip et al., 2020); and (3) Socioeconomic changes (e.g., Bonaccorsi et al., 2020; Nicola et al., 2020). All these characteristics can be defined in many ways, but in this research, they will be examined from a psychological and clinical perspective (see De Sousa et al., 2020).

The first dimension refers to the various beliefs or conceptions about lifestyle, socialization behaviors and the quality of mental health of people (see Lau et al., 2005; Chan et al., 2020). For example, Zhang and Ma (2020) reported that more than 50% of the Chinese population felt *panic* and *horror* at the possibility of contracting COVID-19 (included also generalized anxiety). Likewise, symptoms related to *posttraumatic stress* were identified (e.g., Boyraz and Legros, 2020; Horesh and Brown, 2020; Liang et al., 2020). *Irrational behaviors* were also observed, associated with stocking up on food and with dietary changes that many people made during confinement, most notably eating high-calorie foods (see Mattioli et al., 2020). Likewise, a sharp increase in *compulsive buying* of hygienic products (especially toilet paper, which was sold out in most supermarkets) was reported (see Pagano et al., 2020; Zhou et al., 2020). This type of behavior is related to *herd behavior* and the pseudoscientific beliefs that the general population have developed in response to the uncertainty surrounding the COVID-19 pandemic (see Escolà-Gascón et al., 2020). Some authors ask whether these behaviors can be explained by the generalized panic and collective fear that the population has perceived in the face of the coronavirus crisis (see Khan et al., 2020).

The second, referring to changes in information consumption, can be characterized during the first months of the pandemic as (1) *accelerated digitization*. This concept means that communication and social interaction were massively digitized (see Innerarity and Colomina, 2020a). (2) *Disintermediation*. This concept refers to the disappearance of media outlets that facilitated the understanding of technical information (see García-Morales, 2020). (3) *Infodemic*, which is an overabundance of COVID-19-related information (see Innerarity and Colomina, 2020b). According to Andreu-Sánchez and Martín-Pascual (2020), one of the consequences of disintermediation is the indiscriminate appearance of *hoaxes* or *"fake news"* about the coronavirus since many local media acted as filters that prevented *disinformation*. Currently, it is the direct consumer of the information who must filter and screen which news he or she decides to believe and which not (see Aleixandre-Benavent et al., 2020). The problem is that not everyone has sufficient skill and knowledge to effectively screen information (see Pulido et al., 2020a). In fact, Pulido et al. (2020b) observed that fake news is "tweeted" or disseminated more on social networks than scientifically-based information. This can have very negative effects on how the population reacts to the pandemic, which could lead to failed preventive health measures against the advancing virus. For example, Escolà-Gascón et al. (2020) found that pseudoscientific beliefs and positive psychotic symptoms had increased significantly after a social quarantine of 57 days (the study was conducted with a Spanish population; bear in mind that the duration of the quarantine varies according to the legislation and the situation of each country). Determining the social consequences of collective psychosis related to the consumption of information is something that is still in the process of analysis, and more results based on scientific evidence are required to reach a conclusive conclusion (see Van Rheenen et al., 2020).

Third, socioeconomic changes represent the most difficult factor to operationalize in psychological terms. This dimension may be best characterized by the records of the regularization of labor promoted by some governments, such as border closures and the suspension of certain social and leisure activities (i.e., restaurants, hotels, sports centers, etc.), the granting of economic in the United States and deferring tax payments or offering tax relief in the United Kingdom and Spain (see Boletín Oficial del Estado, 2020; Deloitte Insights, 2020; Government UK, 2020; Nicola et al., 2020). Actually, a few years ago, Barbisch et al. (2015) had already reflected on the viability of social quarantine by comparing previous mutations of the SARS virus with *ebolavirus* and pointed out that it could have economic consequences that in the medium or long term would not be sustainable for governments. Regarding people who kept their jobs by teleworking, scientific evidence suggests that *fatigue* and *mental exhaustion* are the main psychological consequences of increased perceived *work stress* (e.g., Tavares et al., 2020).

These three factors are directly related to the psychological well-being of the population and the decisions that each person makes regarding how to react to this crisis (e.g., Escolà-Gascón et al., 2020). In reality, psychological decisions and psychopathological reactions were not variables taken into account in the mathematical models that were developed to predict the epidemiological behavior of coronavirus transmission (see Ivorra et al., 2020). The lack of experimental and valid data concerning the psychopathological impact of this crisis questions the effectiveness of these mathematical models to predict the medical and psychosocial consequences derived from the COVID-19 (see Yeo-Teh and Tang, 2020).

The definition of psychopathological reactions in this study are based on the *attachment theory* developed by Ainsworth and Bowlby (1991). This theory argues that humans face the daily problems of adult life based on learning and the affective bond developed from childhood. Thus, the concept of "reaction" should be understood in this study as the predominant coping style in each subject, determined by their prior relationships and learning. These styles can be psychopathological when affective relationships are learned and developed in a dysfunctional way. Ainsworth and Bowlby (1991) call this dysfunctional quality *insecure attachment*. Subjects who have an insecure attachment tend to have

a negative view of themselves, self-describe and remain in a state of defensive anxiety on a regular basis (read Camps-Pons et al., 2014). Likewise, insecure attachment can be classified into three coping styles: *avoidant, dependent-ambivalent*, and *disorganized*. In this research, we will focus on the avoidant (with anxious and paranoid characteristics) and disorganized (with schizoid and schizotypal characteristics) styles. Avoidant attachment is characterized by the presence of social anxiety, attitudes of distrust in social relationships, and feelings of vulnerability. In contrast, disorganized attachment is characterized by the presence of irrational beliefs, impersonal or cold social relationships, and relentless negative thinking. Therefore, the term "psychopathological reactions" refers to coping styles that meet the characteristics of *avoidant* and *disorganized* profiles (e.g., Wang et al., 2020). These coping styles acquire much emphasis when international crises or natural catastrophes occur, so they represent an essential object of study (see Sung et al., 2020; Tian et al., 2020).

Finally, the concept of loneliness or levels of loneliness is defined in this investigation as established by de Jong-Gierveld and Kamphuis (1985). This conception is characterized by understanding loneliness based on two main psychological parameters: the lack of emotional support and the subjective suffering that each individual perceives when they are psychologically alone (see also Trejnowska et al., 2020). More concretely, in a pandemic context, loneliness is also defined as the fear of losing social supports or being physically alone, as well as increased anxiety due to the uncertainty regarding what the individual must personally endure (see Hwang et al., 2020).

# MATERIALS AND METHODS

## Description of the Sample

A total of 667 participants from the general population participated (30.9% were men and 69.1% were women). All of them were of legal age (mean = 32.46; standard deviation = 10.373). A total of 34.5% resided in the community of Catalonia, 28% in Madrid, 19.8% in Castilla-La Mancha and 17.7% resided in Andalusia. All participants were asked the number of people they had lived with during the 57 days of confinement (mean = 2.07; standard deviation = 1.486). Given

**TABLE 1 |** Percentages and counts of the subjects according to each Spanish community.

| Social variables | Categories | CAT | Madrid | CLM | Andalusia | Total sample |
|---|---|---|---|---|---|---|
| Education level | High school | 18.7% | 15% | 27.3% | 28% | 21% |
| | | (43) | (28) | (36) | (33) | (140) |
| | Basic vocational training | 19.6% | 20.3% | 22.7% | 28.8% | 22% |
| | | (45) | (38) | (30) | (34) | (147) |
| | Advanced vocational training | 13.5% | 18.7% | 23.5% | 22.9% | 18.6% |
| | | (31) | (35) | (31) | (27) | (124) |
| | University studies | 48.3% | 46% | 26.5% | 20.3% | 38.4% |
| | | (111) | (86) | (35) | (24) | (256) |
| Psychiatric antecedents | Not | 59.1% | 56.7% | 55.3% | 58.5% | 57.6% |
| | | (136) | (106) | (73) | (69) | (384) |
| | Yes | 29.1% | 29.9% | 28% | 28% | 28.9% |
| | | (67) | (56) | (37) | (33) | (193) |
| | Prefer not to answer. | 11.7% | 13.4% | 16.7% | 13.6% | 13.5% |
| | | (27) | (25) | (22) | (16) | (90) |
| Did you get sick of coronavirus? | Yes, with diagnostic tests. | 8.3% | 18.2% | – | – | 7.9% |
| | | (19) | (34) | | | (53) |
| | Yes, without diagnostic tests. | 22.6% | 13.9% | 9.8% | 5.1% | 14.5% |
| | | (52) | (26) | (13) | (6) | (97) |
| | No, but I have had COVID-19 symptoms. | 18.7% | 22.5% | 9.8% | 9.3% | 16.3% |
| | | (43) | (42) | (13) | (11) | (109) |
| | No and I did not have COVID-19 symptoms. | 50.4% | 45.5% | 80.3% | 85.6% | 61.2% |
| | | (116) | (85) | (106) | (101) | (408) |
| Do you believe that social confinement was and is a necessary measure to prevent the spread of the virus? | Totally yes | 32.2% | 45.5% | 17.4% | 18.6% | 30.6% |
| | | (74) | (85) | (23) | (22) | (204) |
| | In the beginning not, but currently yes. | 20% | 12.8% | 10.6% | 5.9% | 13.6% |
| | | (46) | (24) | (14) | (7) | (91) |
| | In the beginning yes, but currently not. | 28.7% | 28.9% | 40.9% | 33.9% | 32.1% |
| | | (66) | (54) | (54) | (40) | (214) |
| | Absolutely not | 19.1% | 12.8% | 31.1% | 41.5% | 23.7% |
| | | (44) | (24) | (41) | (49) | (158) |

*In brackets are the observed recounts. CLM, Castilla-La Mancha; CAT, Catalonia.*

that the coronavirus had impacted differently in each of the regions, sociodemographic data were collected concerning the educational level, the presence of psychiatric history, and the economy vs. health dilemma. They were also asked if they had contracted the coronavirus disease. **Table 1** classifies the four previous variables according to the autonomous community in which each subject resides.

The sociodemographic information was obtained in a self-reported manner, and the subjects signed written informed consent as voluntary authorization to participate in this research.

## Instruments Used

### De Jong-Gierveld Loneliness Scale (DJGLS)

The DJGLS is a questionnaire consisting of 11 items that examine the perceived loneliness of the subject according to the *social deprivation* theoretical model developed by Peplau and Perlman (1982). The items are statements that express different situations and desires for social contact with other people. All of them were written by de Jong-Gierveld and Kamphuis (1985). The answers are coded as follows: "yes" = 2 points, "more or less" = 1 point and "No" = 0 points. It should be noted that items 1, 2, 4, 7, 8, and 11 must be scored inversely, so that "yes" = 0 points, "more or less" = 1 point and "No" = 2 points. All the answers are added together, and the total result will be the direct score of the perceived levels of loneliness. In this study, the Spanish adaptation was developed by Buz et al. (2014). The validity and reliability of the scores of this scale were excellent in their original version, but the Spanish version showed a better internal consistency index than the initial scale (*Cronbach's alpha* = 0.91).

### COVID Reaction Scales (COVID-RS)

This scale was developed by Álex Escolà-Gascón and aimed to measure the psychopathological reactions and the way each subject copes with the coronavirus crisis. It consists of 31 items expressed in the form of statements. The responses are scored according to the *Likert* model, which ranges from 0 (which means "completely disagree") to 4 (which means "totally agree"). The items are grouped into five dimensions contrasted and validated in this report: (1) *avoidant behaviors* (AB); (2) *disorganized behaviors* (DB); (3) *Maladaptive information consumption* (MI); (4) *Loneliness* (LO); and (5) *Herd behavior* (HB). The development process of the items and the clinical contents that each scale evaluates are described in the procedures section (see **Table 2**). The reliability and validity of the COVID-RS were analyzed in this study.

## Procedures

This research follows an *ex post facto* or correlational methodological design. The procedure can be classified into two large blocks: the procedure related to the development of the COVID-RS questionnaire and the procedure related to sampling.

**TABLE 2 |** Description of the theoretical framework related to the coping styles and COVID-RS questionnaire development.

| Theories used in the COVID-RS | Classification used in the COVID-RS | Clinical profiles and main symptoms | Items | Scales' denomination |
|---|---|---|---|---|
| *Coping styles* (e.g., Ainsworth and Bowlby, 1991) | *Avoidant style* | (1) Social anxiety<br>(2) Distant mistrust<br>(3) Invulnerability desire | Items 2, 4, 7, 8, 11, 12, and 13. | Avoidant behaviors or *AB scale* |
| | *Disorganized style* | (1) Irrational beliefs<br>(2) Impersonal contact<br>(3) *Tachypsychia* | Items 1, 3, 5, 6, 9, 10 14, and 15. | Disorganized Behaviors or *DB scale* |
| *Information consumption* (e.g., Pulido et al., 2020b) | *Infodemia* | (1) Anxiety when there is too much information to consult.<br>(2) Feeling of blockage and psychic saturation.<br>(3) Feelings of confusion and difficulties in differentiating between reliable and unreliable information. | Items 16, 19, and 26. | Maladaptive information consumption or *MI scale* |
| | *Acceleration* | (1) Anxiety and obsession to check the latest news.<br>(2) Compulsive use of digital news.<br>(3) Dependence to the digital media. | Items 21, 25, and 27. | |
| Need for social supports (e.g., de Jong-Gierveld and Kamphuis, 1985) | *Loneliness* | (1) Miss someone.<br>(2) Having no close friends.<br>(3) Miss the bustle of people | Items 28, 29, 30, and 31. | Loneliness or *LO scale* |
| Panic Behaviors (e.g., Escolà-Gascón et al., 2020) | *Herd behaviors* | (1) Imitation behaviors.<br>(2) Food obsession.<br>(3) Need to buy a product until it is exhausted.<br>(4) Mass compulsive shopping. | Items 17, 18, 20, 22, 23, and 24. | Herd behaviors or *HB scale* |

### Development of COVID Reaction Scales (COVID-RS) Items

The items were written taking into account 4 sources of information: (1) the theories related to coping and attachment styles (see Ainsworth and Bowlby, 1991); (2) the statistical evidence describing the changes in information consumption during the COVID-19 crisis (e.g., Pulido et al., 2020b); (3) the loneliness model proposed by de Jong-Gierveld and Kamphuis (1985); and (4) the empirical evidence regarding the most common pathological behaviors during the first social quarantine (see Escolà-Gascón et al., 2020). **Table 2** summarizes the clinical indicators of the COVID-RS to specify more clearly the relationship between each construct and item.

In total, 31 items were written in the form of statements or phrases. All of them were reviewed and approved by the research team of this report. Although coding the responses is the same for all items, the COVID-RS was designed to take into account two application contexts: The first 15 items were written to be answered in the current context, and from a more general perspective, they are written in the present tense. The rest of the items are written in the present perfect because they intend to integrate the psychological consequences and possible metric biases derived from the first mass confinement that was experienced in the European Union (e.g., Brooks et al., 2020). This study tests the validity and reliability of the 31 items of the COVID-RS.

### Development of Sampling

The sample was obtained through the online application and distribution of the two questionnaires specified in the previous section. Google Forms was used to digitize the items and responses. The massive online application of the tests on social networks and WhatsApp began on July 22 and ended on August 04, 2020. The first raw data matrix obtained was cleaned and because 27 of the participants were minors, these cases were eliminated from the original matrix. There were no blank responses, and no missing values were identified. Once the matrix was refined, 667 final subjects remained, which are the responses analyzed in this report. All participants checked the acceptance box before responding to the scales.

### Ethics Statement

The *Committee of Ethical Guarantees of Ramon Llull University*, (Barcelona, Spain) reviewed, favorably evaluated, and approved this research. Likewise, the procedures of this study adhere to the Spanish Government Data Protection Act 15/1999 and the Declaration of Helsinki of 1975, revised in 2013.

## Data Analysis

The data were processed with the JAMOVI open-access statistical program (see The Jamovi Project, 2020). First, an *exploratory factor analysis* (EFA) was applied. The factors were extracted by *parallel analysis* and the *unweighted least squares method* (see Reise et al., 2000). The *Promax* rotation was applied. From the solution obtained in the EFA, the *structural equations* were applied adjusting a *confirmatory factor analysis* (CFA) model. The parameters were estimated using the *maximum likelihood* method, and the respective fit indices provided by the AMOS program (an extension of SPSS 25 specialized in structural equations) were applied. According to Kline (2013) and Abad et al. (2015) the following adjustment indices and thresholds were used: *root mean square error of approximation* (RMSEA, threshold ≤0.05); *adjusted goodness of fit index* (AGFI, threshold ≥0.9); *parsimony ratio* (PRATIO, threshold ≥0.9); *parsimony adjustment to the comparative fit index* (PCFI, threshold ≥0.8); *comparative fit index* (CFI, threshold ≥0.95); *Tucker-Lewis coefficient* (TLI, threshold ≥0.95); and *incremental fit index* (IFI, threshold ≥0.95).

Given that this program allows obtaining the *Bayes information criterion* (BIC), *Akaike information criterion* (AIC) and *consistent Akaike information criterion* (CAIC) indices, which indicate the degree of misfit in the model, the *Mismatch Reduction Ratio* (MRR) was estimated following the *deviance* expression developed by Pardo and Ruiz (2015):

$$R^2 = \frac{-2LL_0 - (-2LL_1)}{-2LL_0} \approx \frac{AIC_0 - (AIC_1\ )}{AIC_0}$$

where

$-2LL_0$ is the deviation from the null model,
$-2LL_1$ is the deviation from the proposed theoretical model,
*MRR* is the Mismatch Reduction Ratio,
$AIC_0$ is the AIC index corresponding to the null model and
$AIC_1$ is the AIC index corresponding to the theoretical model.

The reliability of the COVID-RS was calculated from the internal consistency indices based on Cronbach's alpha. Given that the items are ordinal variables, the *omega* coefficient by McDonald (1999) is:

$$\omega_t = \frac{\left(\sum \lambda_j\right)^2}{\left[\left(\sum \lambda_j\right)^2 + \sum\left(1 - \lambda_j^2\right)\right]} = \frac{\left(\sum \lambda_j\right)^2}{\left[\left(\sum \lambda_j\right)^2 + \left(\sum \psi\right)\right]}$$

where $\lambda_j$ is the factor loading of item *j*,
$\lambda_j^2$ is the communality of item *j*, and
$\psi$ is the unique variance.

According to Abad et al. (2015), the threshold used to interpret omega coefficient and Cronbach's alpha coefficient is 0.6. The results of this coefficient above this value indicate acceptable internal consistency values. However, for the BIC, AIC, and CAIC indices, there are no specific thresholds values and for this reason the MRR index is used (check this information in Pardo and Ruiz, 2015).

# RESULTS

## Exploratory Factor Analysis

The EFA of all the items of the COVID-RS is presented in **Tables 3**, **4**.

A total of 5 factors were extracted that together explained 35.08% of the variance of the data. The first factor was composed of items 1, 3, 5, 6, 9, 10, 14, and 15. Taking into account the content of the items (see **Table 2**), it was called *Disorganized*

**TABLE 3 |** Exploratory factor analysis.

| Items | Extracted factors | | Uniqueness |
|---|---|---|---|
| | Disorganized behaviors | Avoidant behaviors | |
| 15 | 0.649 | | 0.621 |
| 9 | 0.645 | | 0.602 |
| 3 | 0.600 | | 0.632 |
| 5 | 0.556 | | 0.667 |
| 14 | 0.556 | | 0.671 |
| 10 | 0.528 | | 0.712 |
| 6 | 0.508 | | 0.697 |
| 1 | 0.471 | | 0.717 |
| 11 | | 0.663 | 0.599 |
| 4 | | 0.632 | 0.607 |
| 7 | | 0.599 | 0.664 |
| 8 | | 0.578 | 0.618 |
| 12 | | 0.563 | 0.647 |
| 2 | | 0.558 | 0.672 |
| 13 | | 0.542 | 0.631 |
| Explained variance (%) | 8.67% | 8.20% | Total = 35.08% |
| Average variance extracted | 0.564 | 0.591 | – |

*Explained variance was taken from the original factorial solution without rotation. Promax rotation was applied (N = 667).*

**TABLE 4 |** Exploratory factor analysis.

| Items | Extracted factors | | | Uniqueness |
|---|---|---|---|---|
| | Maladaptive information consumption | Herd behaviors | Loneliness | |
| 16 | 0.672 | | | 0.555 |
| 19 | 0.660 | | | 0.572 |
| 25 | 0.648 | | | 0.603 |
| 27 | 0.612 | | | 0.619 |
| 21 | 0.607 | | | 0.594 |
| 26 | 0.548 | | | 0.675 |
| 20 | | 0.677 | | 0.636 |
| 22 | | 0.567 | | 0.665 |
| 23 | | 0.551 | | 0.645 |
| 18 | | 0.524 | | 0.686 |
| 24 | | 0.492 | | 0.701 |
| 17 | | 0.480 | | 0.663 |
| 29 | | | 0.610 | 0.636 |
| 30 | | | 0.580 | 0.654 |
| 31 | | | 0.553 | 0.696 |
| 28 | | | 0.464 | 0.772 |
| Explained variance (%) | 7.78% | 6.37% | 4.06% | Total = 35.08% |
| Average variance extracted | 0.625 | 0.549 | 0.552 | – |

*Promax rotation was applied (N = 667). Explained variance was taken from the original factorial solution without rotation.*

*behaviors* (DB). The second consisted of items 2, 4, 7, 8, 11, 12, and 13. The content of the items referred to *Avoidant behaviors* (AB). The third group included items 16, 19, 21, 25, 26, and 27, and called *Maladaptive information consumption* (MI). The fourth grouped items 17, 18, 22, 23, and 24, the content of which indicated that it should be called *Herd behavior* (HB). The last factor had items 28, 29, 30, and 31 and was called *Loneliness* (LO). These factors were used for fitting the confirmatory model presented below.

## Confirmatory Factor Analysis

Taking advantage of the results of the EFA, it was then checked whether it was possible to extract new latent variables using a second-order analysis. The content of the items (see **Table 2**) and the theoretical framework suggested that HB and DB could form a higher-order factor related to *dissociation*. Similarly, AB and DB have in common that their items are related to mistrust (insecure coping style). If we take into account that MI also includes attributes of anxiety, then AB, DB, and MI could form a new higher order factor related to symptoms of anxiety. This logic allowed fitting the confirmatory model of **Figure 1**.

The latent variables LA (*Lack of awareness*) and CAI (*Coronavirus Anxiety Impact Index*) were defined. Both factors predicted between 43.8 and 57.6% of the variance of the first-order factors extracted in the first EFA.

**Table 5** shows the fit indices of the null model (independent) and those of the theoretical model related to the COVID-RS. The table also includes the *Mismatch Reduction Ratio* (MRR).

Although the *Chi Square* statistic has yielded a significance critical level, it should be noted that it is highly sensitive to the sample size, so it becomes inconsistent at the statistical level (see Gorsuch, 1983). Instead, the analysis of the comparative fit indices is recommended, which show values greater than 0.95. Likewise, the RMSEA (*root mean square error of approximation*), AGFI (*adjusted goodness of fit index*), and PRATIO (*parsimony ratio*) indices also showed acceptable and satisfactory values that approve model fit. The estimation of the MRR indicated that the model manages to reduce the misfit between 79 and 85%.

These analyses allow us to conclude that the COVID-RS is a valid questionnaire for examining the psychopathological reactions of the general population to the coronavirus crisis.

## Reliability Analysis

**Tables 6–8** present the descriptive statistics associated with the items of both the COVID-RS and of the DJGLS.

The descriptive statistics of the scales of both tests and the Cronbach's alpha and McDonald's omega reliability coefficients were obtained by summing the responses. This information is presented in **Table 9**.

In general, the results obtained satisfactorily highlight the reliability of the scores of both the COVID-RS and DJGLS scales. However, the reliability coefficients of the LA factor were the lowest.

## Analysis of Perceived Loneliness

The correlations between the LO, DJGLS scale and, the number of people with whom each subject had lived during the periods of

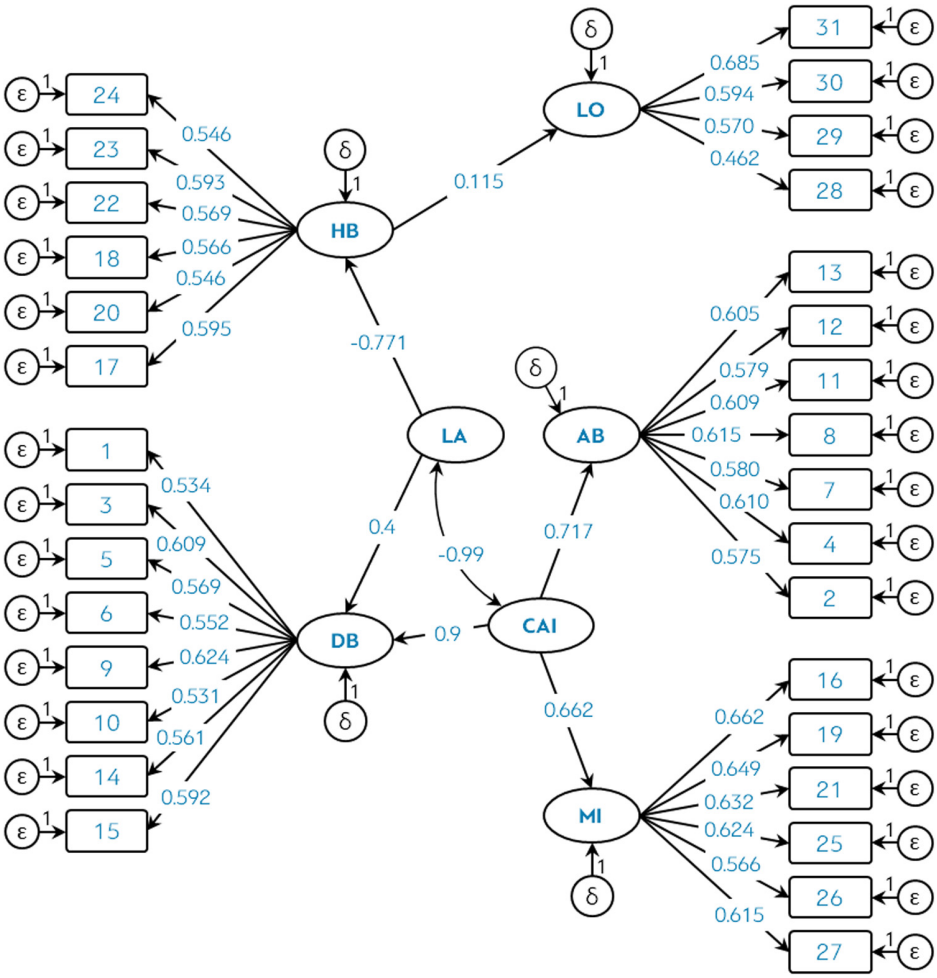


**FIGURE 1 |** Theoretical model of the COVID-RS scale, showing covariance and standardized regression coefficients. *P*-values were not included for each coefficient because all of them were significant <0.05.

confinement (hereinafter NPPL) were calculated. **Table 10** shows the correlation matrix.

The *simple linear regression* of the NPPL and LO indicates that, for every person with whom each participant lives, the levels of loneliness are reduced by 1.1 points (within the LO metric, which ranges between 0 and 16). The value 1.1 is the unstandardized regression coefficient or $\beta_1$. The model constant ($\beta_0$) was 10.398. In total, the NPPL variable explains 18% of the reduction in levels of solitude.

## DISCUSSION

The main objective of this study was to facilitate the validity and reliability of new statistical measures concerning the psychopathological reactions of the population amid the COVID-19 crisis. Analyses using structural equations and internal consistency coefficients revealed that the COVID-RS provides valid and reliable scores to measure the psychopathological reactions of the population to this crisis.

### Interpretation and Speculation on the Results

On the one hand, the indices obtained in the factorial analyses (both in their exploratory format and in the model of **Figure 1**) suggest that the reactions of the population identified in the scientific literature (see Ahorsu et al., 2020; Brooks et al., 2020; Lee, 2020; López and Rodó, 2020; Shanafelt et al., 2020) can be measured validly and reliably in 5 general dimensions: disorganized behaviors (DB), avoidant behaviors (AB), maladaptive information consumption (MI), herd behaviors (HB) and loneliness (LO). This allows for 2 general interpretations:

(1) The presence of the MI dimension supports the results and conclusions obtained in some studies that warn of the social danger of infodemia, disinformation, and the acceleration of digital media. What measures have governments or public organizations applied to control the quality of information about the coronavirus is

**TABLE 5 |** Model fit indices of the theoretical model (see **Figure 1**).

| Models | Threshold used values (see Kline, 2013; Abad et al., 2015) | Independence model | Theoretical model |
|---|---|---|---|
| $\chi^2$ | – | 5019.782 | 611.099 |
| *p* | – | <0.0001 | <0.0001 |
| Normed $\chi^2$ | – | 10.795 | 1.424 |
| RMSEA | <0.05 | 0.121 (0.118–0.124) | 0.025 (0.021–0.030) |
| AGFI | >0.9 | 0.414 | 0.936 |
| PRATIO | >0.9 | 1 | 0.923 |
| PCFI | >0.8 | ∼0 | 0.886 |
| CFI | >0.95 | ∼0 | 0.960 |
| TLI | >0.95 | ∼0 | 0.957 |
| IFI | >0.95 | ∼0 | 0.960 |
| BIC | – | 5221.369 | 1046.786 (4174.583**) *MRR* = 79.95% |
| AIC | – | 5081.782 | 745.099 (4336.683**) *MRR* = 85.33% |
| CAIC | – | 5252.369 | 1113.786 (4138.583**) *MRR* = 78.79% |

*RMSEA, root mean square error of approximation; AGFI, adjusted goodness of fit index; PRATIO, parsimony ratio; PCFI, parsimony adjustment to the comparative fit index; CFI, comparative fit index; TLI, Tucker–Lewis coefficient; IFI, incremental fit index; BIC, Bayes information criterion; AIC, Akaike information criterion; CAIC, consistent Akaike information criterion; MRR, Mismatch Reduction Ratio estimated using equation [1]. **These values are the differences between independence model and theoretical model.*

**TABLE 6 |** Descriptive statistics for all items of the COVID-RS questionnaire.

| Items | Mean | Standard deviation | Skewness (error = 0.095) | Kurtosis (error = 0.189) |
|---|---|---|---|---|
| 1 | 1.48 | 1.095 | 0.138 | −1.017 |
| 2 | 2.03 | 1.433 | −0.051 | −1.332 |
| 3 | 1.52 | 1.174 | 0.202 | −1.154 |
| 4 | 1.99 | 1.415 | 0.017 | −1.277 |
| 5 | 1.52 | 1.178 | 0.188 | −1.11 |
| 6 | 1.52 | 1.139 | 0.156 | −1.099 |
| 7 | 1.98 | 1.432 | 0.022 | −1.332 |
| 8 | 1.97 | 1.392 | −0.034 | −1.273 |
| 9 | 1.56 | 1.193 | 0.173 | −1.105 |
| 10 | 1.67 | 1.188 | 0.082 | −1.076 |
| 11 | 2 | 1.423 | 0.004 | −1.321 |
| 12 | 1.97 | 1.412 | 0.048 | −1.308 |
| 13 | 1.95 | 1.43 | 0.048 | −1.315 |
| 14 | 1.5 | 1.175 | 0.257 | −1.027 |
| 15 | 1.62 | 1.205 | 0.169 | −1.055 |
| 16 | 1.94 | 1.44 | 0.051 | −1.331 |

something that has not been scientifically evaluated (e.g., Escolà-Gascón et al., 2020). However, taking into account the parameters of **Figure 1**, it cannot be denied that the dysfunctional consumption of COVID-19 information is a psychological reaction that negatively affects the mental health of people. This is because the coronavirus anxiety impact index (CAI) can predict up to 43.82% of dysfunctional information consumption ($R^2 \approx 0.662^2 = 0.438$). Although this measure based on $R^2$ is an approximate estimate, it is evidence that shows the strength of the relationship between anxiety and the consumption of COVID-19 information. Therefore, it is necessary to provide the general population with digital and psychological resources to promote the correct use of information.

**TABLE 7 |** Descriptive statistics for all items of the COVID-RS questionnaire.

| Items | Mean | Standard deviation | Skewness (error = 0.095) | Kurtosis (error = 0.189) |
|---|---|---|---|---|
| 17 | 1.6 | 1.185 | 0.101 | −1.113 |
| 18 | 1.57 | 1.152 | 0.009 | −1.267 |
| 19 | 2.01 | 1.408 | −0.028 | −1.289 |
| 20 | 1.63 | 1.185 | 0.065 | −1.163 |
| 21 | 1.98 | 1.357 | 0.051 | −1.181 |
| 22 | 1.54 | 1.154 | 0.086 | −1.152 |
| 23 | 1.51 | 1.149 | 0.162 | −1.082 |
| 24 | 1.62 | 1.152 | −0.032 | −1.238 |
| 25 | 1.96 | 1.43 | 0.017 | −1.307 |
| 26 | 2.05 | 1.343 | −0.006 | −1.165 |
| 27 | 1.98 | 1.404 | 0.004 | −1.288 |
| 28 | 2.04 | 1.399 | −0.005 | −1.288 |
| 29 | 2.15 | 1.406 | −0.124 | −1.26 |
| 30 | 1.97 | 1.392 | 0.014 | −1.23 |
| 31 | 1.96 | 1.375 | 0.071 | −1.237 |

**TABLE 8 |** Descriptive statistics for all items of the de Jong Gierveld Loneliness Scale.

| Items | Mean | Standard deviation | Skewness (error = 0.095) | Kurtosis (error = 0.189) |
|---|---|---|---|---|
| 1 | 0.97 | 0.816 | 0.061 | −1.495 |
| 2 | 1 | 0.81 | −0.003 | −1.476 |
| 3 | 0.99 | 0.809 | 0.022 | −1.472 |
| 4 | 1.01 | 0.816 | −0.022 | −1.499 |
| 5 | 1.04 | 0.804 | −0.076 | −1.45 |
| 6 | 0.96 | 0.806 | 0.071 | −1.458 |
| 7 | 0.94 | 0.802 | 0.117 | −1.435 |
| 8 | 1.02 | 0.821 | −0.031 | −1.516 |
| 9 | 1.04 | 0.822 | −0.075 | −1.516 |
| 10 | 0.96 | 0.809 | 0.079 | −1.467 |
| 11 | 0.96 | 0.837 | 0.085 | −1.568 |

(2) The HB dimension coincides with other studies that warned of the irrational behavior of the population amid the uncertainty related to the COVID-19 crisis (e.g., Pagano et al., 2020; Zhou et al., 2020). Interestingly, the Lack of awareness (LA) index negatively predicted the Herd behaviors (HB) dimension (−0.707). This result is inconsistent with the herd behavior theory since it is precisely the dissociation or disconnection with reality that leads to irrational behaviors that are not logically explained. This negative regression coefficient does not

**TABLE 9 |** Descriptive statistics for all dimensions of the COVID-RS and de Jong Gierveld Loneliness Scale. Reliability coefficients are also included.

| Items | Mean | Standard deviation | *Cronbach's alpha* | *McDonald's omega* |
|---|---|---|---|---|
| Disorganized behaviors | 12.4 | 5.992 | 0.795** | 0.795** |
| Avoidant behaviors | 13.89 | 6.647 | 0.794** | 0.794** |
| Maladaptive information consumption | 11.93 | 5.88 | 0.742** | 0.742** |
| Herd behaviors | 9.48 | 4.612 | 0.794** | 0.794** |
| Loneliness | 8.12 | 3.841 | 0.632* | 0.634* |
| Lack of awareness | 21.88 | 8.888 | 0.55 | 0.6* |
| Coronavirus anxiety impact index | 38.21 | 14.159 | 0.642* | 0.645* |
| Total scores of the de *Jong Gierveld Loneliness Scale* | 10.88 | 2.236 | 0.936*** | 0.936*** |

**Acceptable reliability; **Satisfactory reliability; ***Excellent reliability.*

**TABLE 10 |** Correlation matrix between loneliness scales (LO and DJGLS) and number of people the participant lived with during the social confinement.

| variables | Loneliness | DJGLS | NPPL |
|---|---|---|---|
| LO | – | | |
| DJGLS | 0.168* | – | |
| NPPL | −0.426* | −0.087 | – |

*NPPL, number of people the participant lived with during the social confinement.*
*$p < 0.0001$.

coincide with some studies that positively related herd behaviors with panic behaviors and lack of awareness (e.g., Saglietto et al., 2020). On the one hand, considering the content of the items, this result supports the possibility that HB also measures obsessive-compulsive behaviors, which are positively correlated with cognitive self-consciousness (e.g., Cohen and Calamari, 2004). Then, cognitive self-consciousness would be a mediating variable that could explain the effects of LA on HB. On the other hand, the negative correlation −0.99 between CAI and LA indicates clearly that both indices measure the same construct (anxiety reactions) but from two opposite poles according to the level of consciousness (see Öhman, 2008): LA refers to anxious reactions with low levels of consciousness and CAI is related to anxious reactions with high levels of consciousness. This hypothesis would imply that HB would be positively correlated with CAI. This last logic and classification coincides with the contemporary literature on the psychological evidence identified on coronavirus (e.g., Wang et al., 2020). However, it is recommended in future research to validate the COVID-RS model by including the cognitive self-consciousness variable as a mediator and by estimating an extra parameter that predicts the effects of CAI on HB. Likewise, LA and CAI are hypothetical latent factors. This means that in future studies the concurrent and predictive validity of these two factors should be analyzed with other previously validated anxiety scales.

Finally, the correlation matrix of **Table 10** suggests that LO and DJGLS do not measure the same type of loneliness. Like the LA and CAI indices, it is possible that both scales measure different facets of the "loneliness" construct. Analyzing the items of the LO scale, it can be concluded that their contents express the desire for emotional connection and the illusion of sharing leisure time with other people. In contrast, the items of the DJGLS scale focus on the evaluation of social desire but also include 6 items that examine the lack of emotional support. In this sense, it is completely understandable for a person to miss and look forward to being reunited with their loved ones (concept of loneliness measured in LO) and at the same time feel loved and emotionally supported (loneliness evaluated on the DJGLS scale). Therefore, when using the LO scale, it should be taken into account that it is a kind of loneliness based on social and affective desire but not on the lack of psychological support (social deprivation). This argument justifies why the correlation between both scales is so low. Based on these results and if in the future the population should be confined again, the following health/psychological recommendation can be offered: loneliness is less dysfunctional if the subject lives with at least 2 more people. Therefore, it seems advisable to develop confinement situations where people can live with two other people so that deteriorating mental health is not so harmful to people.

## Possible Limitations

The limitations of this research are focused on methodological, theoretical, and sampling aspects.

First, the methodological limitations are mainly found in the reliability coefficients of the LA and CAI indices. Although the *omega* coefficients of both factors reach the minimum acceptance range, they are still low values (see McDonald, 1999). Something similar occurs with the LO scale. How to mathematically manipulate these scales to improve their reliability is something that in psychometric terms is not salvageable with the data of this research. However, based on the negative correlation observed between LO and NPPL, as an alternative to this limitation, it is proposed to include the following mathematical transformation to try to optimize the LO scale scores:

$$LO' = \frac{\sum_{i=1}^{n} n_{\mathrm{LO}} - W_{\mathrm{NPPL}}}{LO_{\mathrm{max.}}}$$

The expression $w_{\mathrm{NPPL}}$ is the number of people with whom the participant lived during confinement. $\sum n_{LO}$ is the sum of the responses of the items belonging to the LO scale. $LO_{max.}$ is the maximum score of the LO scale, which in this case would be 16.

Although this formula is intended to be a more effective alternative than the total sum of the responses of the LO items, it should be statistically tested before being used to make clinical decisions. For this, it is proposed to use a new sample (if possible a clinical sample) and to replicate the internal structure of the COVID-RS questionnaire. Likewise, as a complement to this methodological limitation, we should highlight the lack of tests regarding the concurrent, convergent, and discriminant validities. These psychometric properties should be examined in future analyses.

Second, at the conceptual level, it should be noted that the items of the AB and DB scales do not directly measure coping styles; they measure coping styles adapted to the current context of the COVID-19 pandemic. In reality, they reinforce or contextualize the theories of Ainsworth and Bowlby (1991). Therefore, these scales should not be used as direct or explicit measures of coping styles. Along the same lines, there are certain difficulties in interpreting the factors CAI, LA, and LO. Although the results of the structural equations and correlations suggest that CAI represents *fear due to excess activation* or anxiety, LA represents *fear due to the absence of insight,* and LO represents loneliness understood in terms of desires to reunite, new models of structural equations would be necessary to validate its theoretical structure. More specifically and as already suggested, new models should be analyzed to test how the presence of a third factor that groups CAI and LA in the same construct influences the fit and the relationship between these variables.

Finally, the sample used was not recruited using probabilistic procedures, so its representativeness is questionable outside the autonomous communities or regions not included in the analysis. This representativeness is also highly questionable if one takes into account that the subjects come from the general population and not from the clinical-psychiatric population. Thus, new psychometric analyses of the COVID-RS would be necessary in a sample of patients with a formal diagnosis. Likewise, an analysis of the invariance of the COVID-RS scores could be performed including vulnerable groups of the population (i.e., COVID-19 survivors, elderly and medical patients with a risk profile).

## Main Conclusions

The main conclusions that can be deduced from the results and discussion are summarized in the following points:

(1) The COVID Reaction Scales (COVID-RS) is a valid and reliable psychometric test to examine the psychopathological reactions of the population to the coronavirus crisis. The COVID-RS scores can be used as decision criteria to predict how the population will react to government and health measures against the spread of COVID-19. However, before using the COVID-RS for this last purpose, the predictive validity of this scale should be examined. These measures could also be included in the mathematical models that predict the contagion curve for coronavirus.
(2) The psychopathological reactions of the population to the coronavirus crisis can be classified according to the attachment style theory proposed by Ainsworth and Bowlby (1991). Specifically, the structural equations identified two of these styles: avoidant and disorganized. These styles do not provide the population with functional tools for the psychological management of preventative health regulations against coronavirus.
(3) In health and psychological terms, there are reasons and statistical evidence that quarantine states do not harm the mental health and emotional loneliness of the subject when they are in the company of loved ones or family members. Specifically, emotional loneliness is reduced by 1.1 points on the LO scale for each person with whom the respective subject lives during the quarantine.

In general, the COVID-RS scale can be used as a valid and reliable tool for psychological and epidemiological measurement of the reactions of people regarding to their way of coping with the consequences derived from the coronavirus crisis. These measurements can be useful to make effective political and health decisions to confront the COVID-19 crisis successfully.

# DATA AVAILABILITY STATEMENT

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

# ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the Committee of Ethical Guarantees of Ramon Llull University, (Barcelona, Spain). Written informed consent for participation was not required for this study in accordance with the national legislation and the institutional requirements.

# AUTHOR CONTRIBUTIONS

ÁE-G conceived and planned the study, collected the sample, performed the statistical analyses and wrote the manuscript in consultation with F-XM and JR. JG supervised the project. All authors contributed to the article and approved the submitted version.

# SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyg.2020.607064/full#supplementary-material

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**Conflict of Interest:** The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Psychiatry Research 295 (2021) 113628

Contents lists available at ScienceDirect

Psychiatry Research

journal homepage: www.elsevier.com/locate/psychres

# Evidence of the psychological effects of pseudoscientific information about COVID-19 on rural and urban populations

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ARTICLE INFO

*Keywords:*
COVID-19
rural municipalities
SARS-CoV-2
Psychological Well-being
Pseudoscientific Information

ABSTRACT

This research aims to analyze the effects of pseudoscientific information (PI) about COVID-19 on the mental well-being of the general population. A total of 782 participants were classified according to the type of municipality in which they lived (rural municipalities and urban municipalities). The participants answered psychometric questionnaires that assessed psychological well-being, pseudoscientific beliefs and the ability to discriminate between scientific and pseudoscientific information about COVID-19. The results indicated the following: the greater the ability to discriminate between false information and true information, the greater the levels of psychological well-being perceived by the participant. The ability to discriminate predicts up to 32% of psychological well-being only for subjects living in rural municipalities. Residents in urban municipalities showed lower levels of well-being than residents in rural municipalities. It is concluded that new social resources are needed to help the general population of urban municipalities discriminate between pseudoscientific and scientific information.

## 1. Introduction

Pseudoscientific beliefs are systems of meanings that accept the existence of impossible facts or contents according to the epistemological bases of the scientific method (e.g., Blancke et al., 2020; Schiele, 2020). Similarly, pseudoscientific information (hereafter PI) refers to references and news that promote false scientific content (e.g., Escolà-Gascón et al., 2020; Tsai et al., 2012). False scientific content is not supported by evidence from academic research (for this reason, it is considered "false") (e.g., Matute et al., 2011; Sugavanam and Natarajan, 2020). In summary, there are three main reasons for creating pseudoscientific information: (1) the subjective misinterpretation of an event or an experience, which acquires a meaning that differs from its formal characteristics (e.g., Lange et al., 2017; Mohr et al., 2019). These misinterpretations are called cognitive biases or causal illusions (e.g., Matute et al., 2015; van Elk, 2019). (2) The presence of a system of meanings whose contents are magical and irrational (e.g., Boudry et al., 2014; Irwin et al., 2013). These two characteristics represent the foundations of pseudoscientific beliefs (e.g., Rogers et al., 2017). (3) The intentional desire for secondary benefits, which usually has an economic or mercantilist purpose (e.g., Reber and Alcock, 2020). In this case, the pseudoscientific belief is a deliberate invention that encourages the buying and selling of alternative therapies (see Houran et al., 2020; Metin et al., 2020 for a review).

Although the causal factors of pseudoscientific information are complex to analyze (e.g., Fasce and Picó, 2018), it is important to know the relationship between pseudoscientific beliefs, pseudoscientific information, and people's quality of life (e.g., Escolà-Gascón, 2020a, 2020b). In this research, the effects of pseudoscientific beliefs and pseudoscientific information related to COVID-19 on people's mental health during the period of coronavirus crisis are analyzed. To what extent does pseudoscientific information about COVID-19 affect us? Can the general population differentiate a scientific news item from another pseudoscientific item?

### 1.1. Theoretical background concerning pseudoscientific information

When information is classified as "pseudoscientific", it loses rational credibility (e.g., Matute et al., 2015; Pigliucci and Boudry, 2013). This expression means that the news lacks scientific and rational foundations. However, Acunzo et al. (2020) observed that subjects who are believers in the paranormal tend to interpret certain extraordinary experiences as "paranormal phenomena" - see the concept of anomalous experiences in Irwin et al. Paranormal beliefs represent a type of pseudoscientific belief

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https://doi.org/10.1016/j.psychres.2020.113628
Received 2 October 2020; Accepted 29 November 2020
Available online 4 December 2020

that attributes supernatural causes to certain extraordinary experiences (see Crowe and Miura, 1995; Lobato et al., 2014). These findings have the following implication: despite the loss of rational credibility, if the subject has pseudoscientific beliefs, he or she will accept as valid the information classified as "pseudoscientific" (e.g., Mikušková, 2018; Wahbeh et al., 2020). Thus, belief systems condition the management and use of pseudoscientific information by each person (e.g., Betsch et al., 2020; Perez-Navarro and Martinez-Guerra, 2020).

What some researchers wonder is what use and with what criteria the general population discriminates scientifically-based information from pseudoscientific information (e.g., Aleixandre-Benavent et al., 2020). Some research has shown that people do not possess sufficient skills or knowledge to discriminate between scientific and pseudoscientific information (e.g., Jupe and Denault, 2019). This evidence indicates that pseudoscientific beliefs have a fundamental role and can foster the credibility confidence attributed to PI (e.g., Irwin, 2009). However, not having pseudoscientific beliefs does not protect people from PI (e.g., Zaboski and Therriault, 2019). It is also possible to mistakenly accept a PI as scientific data, believing it to be evidence-based (e.g., Matute et al., 2015).

According to Denault and Jupe (2017), pseudoscientific information can generate bad decisions that endanger the justice and integrity of the individual (see also Li et al., 2018). The health consequences of PI were investigated earlier, and the following effects can be found: (1) PI confuses and increases anxiety levels in the general population (e.g., Bensley et al., 2019). (2) Pseudoscientific beliefs and PI lead to problematic changes in people's lifestyles (e.g., Imber-Black, 2020). An updated example related to the COVID-19 crisis is the changes in diet and nutrition that some people made intending to achieve "spiritual healing" (e.g., Freire, 2020; Mattioli et al., 2020). In the context of social quarantine, numerous irrational behaviors resulting from collective panic and the effects of pseudoscientific information were also observed during the first months of the pandemic (e.g., Escolà-Gascón et al., 2020; Khan et al., 2020). The most frequent behavior (and one that was observed in many Western countries) was the compulsive purchase of hygiene products (especially toilet paper), which were sold out in supermarkets although there was no risk of shortage (e.g., Pagano et al., 2020; Zhou et al., 2020). However, in other countries such as India, some people relied on pseudoscientific treatments against coronavirus and took cow urine to prevent infection (e.g., Singh, 2020). Other factors that are cultural and religious also play a role in this type of situation. For example, in India, cows are sacred animals, and urine intake could be explained not so much by a pseudoscientific issue but rather by a religious attribution (e.g., Iqbal et al., 2020). In any case, these examples are only intended to illustrate the diversity of the influence of pseudoscientific beliefs and PI on the behavior of the general population.

To protect the patient, health professionals should be aware of and informed about the hoaxes and PIs related to COVID-19 (see Escolà-Gascón et al., 2020). Thus, this kind of false news about coronavirus should be medically and politically addressed not because they are "pseudoscientific beliefs", but because their misuse can put people's health at risk (e.g., Devilly and Lohr, 2008; March and Springer, 2019). Similarly, knowing the way of thinking associated with pseudoscientific beliefs and the use of pseudoscientific information can facilitate the understanding of why some subjects commit these kinds of decisions or behaviors and others do not (e.g., drinking cow urine) (see Ross et al., 2017).

As can be deduced, the more popular the content of pseudoscientific news, the greater the social impact it will have on people (e.g., Pulido et al., 2020a; Pulido et al., 2020b). This means that the consequences of PIs related to COVID-19 may generate dysfunctional and psychopathological social behaviors, which would not facilitate citizen obedience to preventive hygiene, health, and medical safety standards (e.g., De Sousa et al., 2020).

There is a crucial point in this object of study (i.e., pseudoscientific information) that cannot be forgotten: in the psychiatric context, the problem is not whether the patient has pseudoscientific beliefs (e.g., Escolà-Gascón et al., 2020). It is the patient's use of such beliefs to interpret environmental inputs and make decisions (e.g., Lawrence, 2016). For this reason, it is not a matter of judging belief systems in clinical terms, since each patient is free to believe whatever he or she wishes (see Thalbourne and Storm, 2019). It is the management and dysfunctional handling by the patient of his belief system that must be analyzed and addressed in therapeutic terms (see Irwin, 2009).

### 1.2. Objectives and hypotheses

According to the theoretical background described in the previous section, this research aims to analyze the psychopathological and dysfunctional impact of the use of pseudoscientific information on COVID-19. Taking into account the excess information about Coronavirus (e.g., Innerarity and Colomina, 2020a), it is intended to test whether the population (based on their knowledge and beliefs) is able to discriminate between the pseudoscientific news about COVID-19 and news that has scientific support. Likewise, the main debate is also based on the following question: what implications do and will misuse of pseudoscientific information have for the population?

We start from the general hypothesis that pseudoscientific beliefs will be correlated and will predict errors in discrimination between true information and pseudoscientific information on COVID-19. In parallel, the following hypothesis is also raised: successes in discriminating false news about COVID-19 will positively predict the psychological well-being of people.

## 2. Methods

### 2.1. Participants

A total of 782 participants collaborated in this research. Of these, 49.9% were men, and 50.1% were women. All subjects were of legal age (mean= 34.39; standard deviation= 9.569) and came from urban (47.7%) and rural (52.3%) environments. The participants declared that they were not in psychiatric treatment and signed a written informed consent authorizing their collaboration in this study. The data collected were recorded anonymously.

### 2.2. Materials

#### 2.2.1. Spanish adaptation of the Psychological Well-Being Scales (PWBS)

The PWBS is a questionnaire originally developed by Ryff (1989) that measures the psychological well-being of the subject. The Spanish version comprises 29 items that measure 6 dimensions: (1) self-acceptance (SA), (2) positive relations (PR), (3) autonomy (AU), (4) management of environment (ME), (5) life purpose (LP) and (6) personal growth (PG). The answers are coded with a graduated scale ranging from 1 ("strongly disagree") to 6 ("strongly agree"). The higher the scores, the more psychological well-being the participant will present. The psychometric properties of the PWBS were examined several times and were satisfactory in all cases (see van Dierendonck, 2004). Specifically, in the Spanish version validated by Díaz et al. (2006), the reliability indices based on the internal consistency of the responses were very high (>0.7) in all dimensions of the PWBS. This version was the one used in this study.

#### 2.2.2. Australian Sheep-Goat Scale (ASGS)

The ASGS scale consists of 18 items that examine pseudoscientific beliefs focused on paranormal experiences. The ASGS scale was initially proposed by Thalbourne (1981), and the answers can be coded in several ways. In this research, we opted for the recommendation of Drinkwater et al. (2018), who distinguish three categories: 2= "true" (should be marked when the subject believes that he/she has lived the experience that the item expresses); 1= "I doubt my answer" (should be marked

when the subject is unsure about his/her answer); and 0= "false" (should be marked when the subject believes that he/she has not lived the experience that the item expresses). The psychometric benefits of the ASGS show evidence of its validity, and it has a total reliability index greater than 0.8 (see Drinkwater et al., 2018). The Spanish version of the ASGS was developed by Escolà-Gascón and Lance Storm, although it is still under development. Because it has not yet been published, the ASGS questionnaire used in this study is attached as supplementary material.

#### 2.2.3. Discrimination Cognitive test between true and pseudoscientific information about coronavirus

This test was created for the purpose of evaluating each participant's ability to discriminate between scientific and pseudoscientific information on IDOC-19. It is an optimal performance test formed by 18 statements that gather different types of information about coronavirus. The participant must indicate if the contents of each item are supported by scientific evidence. In this test, there are three types of answer options: "yes" (the content is scientifically proven and true); "? (there is not enough scientific evidence to determine if it is true); and "no" (the content of the sentence is not scientific and is false). If the participant is correct in his/her choice of answer, 1 point is added. If the participant fails to choose his/her answer, 0 points are added. Errors were not penalized in this test, and participants had to answer all questions. The contents of the items were based on the list of hoaxes about COVID-19 published by the World Health Organization (2020). Table 1 shows the items in this test with the correct answers for each of them.

### 2.3. Procedure

The design of this research is correlational. Participants were recruited through social networks and media. The questionnaires were digitized and sent online in bulk to several Spanish Facebook and Whatsapp groups. The subjects who wanted to participate had to access the link. The answers were automatically recorded in a raw data matrix that was later refined. The purging of the data consisted of classifying whether the participants resided in a rural or urban environment. To do this, the name of the municipality in which each participant had their first or only residence was asked. We also asked what type of housing was the first residence. This concept should be understood as the housing in which a subject resides regularly and continuously.

#### 2.3.1. Inclusion criteria and sampling

The sampling in this study was not probabilistic. We used the urban indicators of the National Institute of Statistics from Spain (2020) that determine which environments are considered urban and which are considered rural. Although several criteria can be used, in this research, the rule was chosen according to the number of inhabitants in the community (with more than 10,000 inhabitants, the municipality is considered a city). The type of housing was also taken into account: (a) collective housing (block of apartments) and (b) single-family housing (house with or without a garden). The classification criteria were as follows:

[1] **For RURAL environments.** The setting was considered rural only when the number of inhabitants was less than 10,000 and the participant resided in a single-family home.
[2] **For URBAN settings.** The setting was classified as urban when the number of inhabitants of the municipalities exceeded 10,000 and the participant resided in a collective home.

Then, taking into account this information, the criteria for the inclusion of the sample were developed. Specifically, the participants should:

[1] Be of legal age.
[2] Not being in official psychiatric treatment.
[3] **Meet one of the following 2 conditions for residence:** (a) residencein a city (>10,000 inhabitants) and in a collective dwelling; or (b) residencein a town (<10,000 inhabitants) and in a single-family dwelling.

Participants who did not meet these inclusion criteria were removed from the original data matrix. In total, 11 subjects did not meet the criteria [2], and 109 subjects did not meet the criteria [3]. All subjects were of legal age. Finally, the sample was formed by the 782 subjects described in subsection 2.1. ("participants").

**Table 1**
Experimental questions about COVID-19 based on contents published by the World Health Organization (2020).

| N° | Questions | R |
|---|---|---|
| 1 | The coronavirus can be transmitted through mosquito bites. | ? |
| 2 | Coronaviruses can be deadly at any age. | Y |
| 3 | Coronaviruses can be cured with antibiotics. | N |
| 4 | Coronaviruses can cause diarrhea. | ? |
| 5 | Coronavirus can be prevented through vaccination. | Y |
| 6 | Coronavirus can be a chronic disease. | ? |
| 7 | Coronaviruses can cause flu-like symptoms. | Y |
| 8 | Coronaviruses can spread through the air over long distances. | N |
| 9 | Coronaviruses can be spread through physical contact. | Y |
| 10 | Coronaviruses can spread more quickly through electromagnetic fields. | N |
| 11 | Coronavirus can be transmitted through dogs and cats. | ? |
| 12 | Coronavirus can make your nails grow faster. | N |
| 13 | Coronavirus can cause pneumonia. | Y |
| 14 | Coronavirus can cause a loss of smell. | ? |
| 15 | Coronavirus can be a mutation of the AIDS virus. | N |
| 16 | Coronavirus can cause coughing. | Y |
| 17 | Coronavirus can be prevented by taking stimulant substances. | N |
| 18 | The coronavirus may mutate in the future and be more lethal. | ? |

**Note:** R= correct answer; Y= yes; N= no; ?= content not verifiable.

### 2.4. Statistical analysis

The data were processed with the statistical program JAMOVI, which uses the R code and is free of charge (see The Jamovi Project, 2020). *Simple regression models* were applied to quantify and predict perceived psychological well-being. Pseudoscientific beliefs and the degree of discrimination of pseudoscientific information were the predictor variables. The 6 dimensions related to psychological well-being were the dependent or criterion variables.

*Student's t-test* and its nonparametric version (*Mann-Whitney's U test*) were also used to analyze whether differences in scores between residents of rural and urban environments were significant. As a complement, a *Bayesian* estimate was applied to characterize the ex-post distribution regarding the probability that the alternative hypothesis ($H_1$) fits the observed data ($D$). This probability is mathematically represented as $P(H_1|D)$ and can be obtained from the estimation of the Bayes factor in favor of $H_1$ (henceforth $BF_{10}$):

$$BF_{10} = \frac{P(D|H_1)}{P(D|H_0)}$$

On the one hand, $P(D|H_1)$ is the probability that the observed data reproduce the distribution associated with the alternative hypothesis. On the other hand, $P(D|H_0)$ is the probability that the observed data reproduce the distribution associated with the null hypothesis. The main problem is that in classical frequency contrasts, $P(D|H_1)$ is not known, so $P(H_1|D)$ cannot be estimated. On the other hand, in Bayesian statistics, when the probabilities fixed *a priori* are adjusted to 50% (this means that the null hypothesis and the alternative hypothesis have the same probability of being true), the value of $BF_{10}$ can be transformed to the probability metric, and $P(H_1|D)$ is obtained as follows:

$$P(H_1 D) = \frac{BF_{10}}{BF_{10} + 1}$$

This is possible because the $BF_{10}$ is in an odds metric (although it is not technically an odds).

Therefore, the critical level of classical frequency contrasts will only report $P(D|H_0)$. However, if the data do not fit the distribution given by $H_0$ (i.e., $p<0.001$), it does not mean that H1 is valid or true. The degree of certainty between $H_1$ and the data ($D$) is only quantified in terms of probability by $P(H_1|D)$. Then, $P(H_1|D)$ represents a statistical estimate that indicates to what extent H1 is true based on the observed data.

## 3. Results

### 3.1. Descriptive statistics and correlation matrices

The descriptive statistics of the variables analyzed are presented in Table 2.

To check if it was convenient to apply the regression models, Pearson's linear correlations between the variables in Table 2 were calculated. The correlations are shown in Tables 3 (for subjects living in urban environments) and 4 (for subjects living in rural environments).

Table 3 indicates that the pseudoscientific beliefs and the dimensions of psychological well-being are independent of each other (except for the LP dimension, which is positively associated with ASGS scores). The negative correlation between ASGS and CA-PI scores indicates that the more pseudoscientific beliefs a subject has, the less successful he/she will be on the CA-PI test. Similarly, the dimensions of psychological well-being are positively correlated with the scores obtained in the COVID-19 test. Therefore, the better the subject knows how to discriminate between the quality of the COVID-19 information, the greater the psychological well-being he/she will present. This trend is also replicated in the correlation matrix in Table 4.

According to the hypotheses raised, the null hypothesis of independence between ASGS and CA-PI is rejected, and the research hypothesis raised in the introduction is maintained. Likewise, the alternative hypothesis is also maintained, as the hits correlate positively with the scales of psychological well-being.

The correlations in Tables 3 and 4 suggest that it appears convenient to apply several regression models using only the variables AU, ME, LP, PG, ASGS and CA-PI. For the group of rural residents, the SA and PR variables were also included. The other variables do not show sufficiently high correlations to fit a regression-prediction model.

### 3.2. Regression models

The regression models were adjusted as follows: the ASGS and CA-PI variables were set as predictor variables, and the AS, PR, AU, ME, LP, and PG scales were the criteria variables. Multivariate canonical regression was ruled out because of the number of false positives it produces (see Pardo and San Martín, 2015). Tables 5 and 6 show the regression models and the explained variance obtained ($R^2$).

The most significant predictions are seen in the group of rural residents. Specifically, the COVID-19 test scores that contribute most to psychological well-being are observed for the SA and PG variables. The rest of the dependent variables are predicted with a weight between 21% and 26%.

The results of the group of urban residents indicate that the discrimination of false news about COVID-19 only contributes to psychological well-being between 7% and 8%. Although these values are significant, they differ from the predictions made for the group of rural residents. This decrease in the $R^2$ weights of the urban group could be explained by the fact that the average test score of this group is lower than the scores of the rural group. This suggests a comparison between the means associated with the dependent variables measured for the urban group and the rural group.

**Table 2**
Descriptive statistics for each group and variable.

| Measured variables | Residents in urban environments (n= 373) | | Residents in rural environments (n= 409) | |
|---|---|---|---|---|
| | Mean | Standard deviation | Mean | Standard deviation |
| Pseudoscientific beliefs (ASGS) | 18.05 | 10.58 | 15.98 | 9.861 |
| Number of correct answers regarding to COVID-19 exam | 8.13 | 5.026 | 10.82 | 4.982 |
| Self-acceptance (PWBS) | 12.62 | 5.527 | 14.45 | 5.917 |
| Positive relations (PWBS) | 16.19 | 6.268 | 17.58 | 6.514 |
| Autonomy (PWBS) | 22.62 | 6.828 | 25.18 | 7.089 |
| Management of environment (PWBS) | 19.23 | 6.016 | 20.93 | 6.129 |
| Life purpose (PWBS) | 15.36 | 6.391 | 15.32 | 5.824 |
| Personal growth (PWBS) | 8.46 | 2.98 | 9.33 | 3.235 |

Note: ASGS= Australian Sheep-Goat Scale; PWBS= Psychological Well-Being Scales.

### 3.3. Intergroup analysis and Bayesian inference

Table 7 presents the comparison between the rural and urban group averages. Cohen's d was also included as a measure of effect size and the Bayesian inference for $P(H_1|D)$.

## 4. Discussion

The purpose of this research was to analyze the influences of pseudoscientific beliefs and false information about COVID-19 on people's mental health. Participants were classified according to their area of residence (rural or urban). The results indicated the following: the better the pseudoscientific news is discriminated from scientists, the better the psychological well-being indexes are obtained. This tendency is more clearly observed in the group of subjects who reside in rural areas. However, on a general level, pseudoscientific beliefs are not related to psychological well-being. Likewise, the results indicated that subjects residing in rural areas tended to have higher scores in the discrimination of pseudoscientific news and psychological well-being variables.

The interpretation of the results is based on the following point: what implications do these results have on people's mental health? The following questions could also be raised: Why do rural residents discriminate against PI more effectively than urban residents? Why are the correlation predictions between psychological well-being scales and pseudoscience information (PI) discrimination scores higher or more efficient in the rural group than the urban group?

### 4.1. Implications of the pseudoscientific information of the COVID-19 on mental health

The results obtained allow us to conclude that mental health can be at risk when people do not correctly distinguish between pseudoscientific information and scientific information about COVID-19. Subjects living in rural areas presented higher psychological well-being scores than those living in urban areas. This means that rural residents are better protected against the effects of the pseudoscientific information about COVID-19 than are residents of large cities. Therefore, according to the results, the chances of mental health being at risk or getting worse will be especially generalizable for subjects living in large cities. This interpretation is based on the analyses made, but it conflicts with *social isolation theory*. This theory is part of environmental psychology and states that subjects living in less populated geographical areas present more pseudoscientific beliefs than subjects living in large cities (see Escolà-Gascón et al., 2020; Irwin, 2009).

One of the possible arguments that could justify the above paradox is based on the influence of two possible variables: (A) the quality of the information accessed (see Pulido et al., 2020a; Pulido et al., 2020b) and (B) the use of pseudoscientific beliefs or the decisions made by each subject about what he or she decides to believe or not believe (see

**Table 3**
Pearson's correlation matrix for residents in urban environments (n= 373).

| | ASGS | CA-PI | SA | PR | AU | ME | LP | PG |
|---|---|---|---|---|---|---|---|---|
| ASGS | | | | | | | | |
| CA-PI | -0.745* | | | | | | | |
| SA | 0.057 | 0.177* | | | | | | |
| PR | 0.051 | 0.155 | 0.2* | | | | | |
| AU | -0.051 | 0.28* | 0.305* | 0.254* | | | | |
| ME | -0.059 | 0.289* | 0.246* | 0.195* | 0.317* | | | |
| LP | 0.216* | -0.014 | 0.194* | 0.245* | 0.241* | 0.144 | | |
| PG | -0.093 | 0.311* | 0.215* | 0.211* | 0.307* | 0.208* | 0.231* | |

Note:
* p<0.001. ASGS= scores related to the pseudoscientific beliefs; CA-PI= correct answers regarding to COVID-19 pseudoscientific information exam; SA= self-acceptance; PR= positive relations; AU= autonomy; ME= management of environment; LP= life purpose; PG= personal growth.

**Table 4**
Pearson's correlation matrix for residents in rural environments (n= 409).

| | ASGS | CA-PI | SA | PR | AU | ME | LP | PG |
|---|---|---|---|---|---|---|---|---|
| ASGS | | | | | | | | |
| CA-PI | -0.372* | | | | | | | |
| SA | 0.046 | 0.57* | | | | | | |
| PR | 0.062 | 0.515* | 0.508* | | | | | |
| AU | 0.09 | 0.467* | 0.386* | 0.539* | | | | |
| ME | 0.098 | 0.501* | 0.558* | 0.514* | 0.474* | | | |
| LP | 0.024 | 0.483* | 0.491* | 0.421* | 0.451* | 0.41* | | |
| PG | 0.059 | 0.558* | 0.513* | 0.47* | 0.497* | 0.535* | 0.448* | |

Note:
* p<0.001. ASGS= scores related to the pseudoscientific beliefs; CA-PI= correct answers regarding to COVID-19 pseudoscientific information exam; SA= self-acceptance; PR= positive relations; AU= autonomy; ME= management of environment; LP= life purpose; PG= personal growth.

**Table 5**
Regression model using "enter method" for residents in urban environments (n = 373). Criteria variables = AU, ME and PG; Predicting variable = CA-PI. ASGS was also used to predict LP scores.

| Criteria variables | Predicting variable = CA-PI | | | | |
|---|---|---|---|---|---|
| | B | s.e. | $\beta_z$ | $R^2$ | F |
| AU | 0.380* (19.530) | 0.068 (0.647) | 0.28* | 0.078 | 31.547* |
| ME | 0.346* (16.420) | 0.059 (0.569) | 0.289* | 0.084 | 33.804* |
| PG | 0.185* (6.957) | 0.029 (0.280) | 0.311* | 0.094 | 39.776* |
| Criteria variables | Predicting variable= ASGS | | | | |
| | B | s.e. | $\beta_z$ | $R^2$ | F |
| LP | 0.130* (13.012) | 0.029 (0.549) | 0.216* | 0.047 | 18.123* |

Note:
* p<0.001; β= regression coefficients; $\beta_z$= standardized regression coefficients (these values are equal to the Pearson's linear correlations); $R^2$= explained variance per criterion variable; F= Fisher's test that contrasts if observed changes in $R^2$ are significant; ASGS= scores related to the pseudoscientific beliefs; CA-PI= correct answers regarding to COVID-19 pseudoscientific information exam; AU= autonomy; ME= management of environment; LP= life purpose; PG= personal growth. **Constants and the errors associated with each constant are located in brackets.Warning:** SA (Self-Acceptance) and PR (positive relations) were discarded as criteria variables because linear correlations regarding ASGS and CA-PI were not significant.

**Table 6**
Regression model using "enter method" for residents in rural environments (n= 409). Criteria variables= SA, PR, AU, ME, LP and PG; Predicting variable= CA-PI.

| Criteria variables | Predicting variable= CA-PI | | | | |
|---|---|---|---|---|---|
| | B | s.e. | $\beta_z$ | $R^2$ | F |
| SA | 0.676* (7.130) | 0.048 (0.578) | 0.570* | 0.323 | 195.388* |
| PR | 0.673* (10.298) | 0.056 (0.662) | 0.515* | 0.263 | 146.888* |
| AU | 0.664* (17.994) | 0.062 (0.743) | 0.467* | 0.216 | 113.345* |
| ME | 0.617* (14.253) | 0.053 (0.628) | 0.501* | 0.25 | 136.717* |
| LP | 0.564* (9.216) | 0.051 (0.604) | 0.483* | 0.231 | 123.653* |
| PG | 0.362* (5.415) | 0.027 (0.318) | 0.558* | 0.31 | 184.101* |

Note:
* p<0.001. β= regression coefficients; $\beta_z$= standardized regression coefficients (these values are equal to the Pearson's linear correlations); s.e.= standard error related to regression coefficients; $R^2$= explained variance per criterion variable; F= Fisher's test that contrast if observed changes in $R^2$ are significant; ASGS= scores related to the pseudoscientific beliefs; CA-PI= correct answers regarding to COVID-19 pseudoscientific information exam; SA= self-acceptance; PR= positive relations; AU= autonomy; ME= management of environment; LP= life purpose; PG= personal growth. **Constants and the errors associated with each constant are located in brackets.Warning:** ASGS was discarded as predicting variable because linear correlations regarding PWBS's dimensions were not significant.

Lawrence, 2016).

Considering point "A", there is speculation that rural residents are not more informed than city residents, but they are better served and seem to pay more attention to official health information about coronavirus. The information present in the villages may be of better quality because their residents have selective filters of the information that are not so present in the big cities. These filters would "select" the most plausible information with respect to official sources and transmit it to local residents. A simple example of these filters is the intermediary or local media (see Innerarity and Colomina, 2020a). In contrast, large cities are dominated by national and global communication systems, neglecting the dissemination of municipal information (e.g., Innerarity and Colomina, 2020b). This interpretation is also based on the report by Grover et al. (2020), who also warned about the mental health risks during the

**Table 7**
Means comparison between rural and urban environment groups.

| | *Welch's t test* | Mann-Whitney's U test | Cohen's d | $BF_{10}$ (% error) | $P(H_1\|D)$ |
|---|---|---|---|---|---|
| ASGS | -2.816 | 67,174 | -0.202 | 3.9525 (4.63e-7) | 0.7980→ 79.80% |
| CA-PI | **7.493*** | **53,192*** | **0.536** | **3.21e+10= 18.725 (6.64e-17)** | **0.9493→ 94.93%** |
| SA | **4.474*** | **62,272*** | **0.319** | **12,46.0124 (1.60e-9)** | **~1** |
| PR | 3.049 | 66,710 | 0.218 | 7.3748 (2.51e-7) | 0.8805 → 88.05% |
| AU | **5.140*** | **60,427*** | **0.367** | **27,140.6013 (7.53e-11)** | **~1** |
| ME | **3.897*** | **64,036*** | **0.278** | **127.8726 (1.52e-8)** | **~1** |
| LP | -0.101 | 75,644 | -0.007 | 0.0804 (2.04e-5) | 0.0744 → 7.44% |
| PG | **3.944*** | **64,060*** | **0.281** | **146.2673 (1.33e-8)** | **~1** |

Note:
* p<0.001. $BF_{10}$= Bayes factor in favor to the alternative hypothesis; $P(H_1|D)$= probability that the alternative hypothesis fit the data; ASGS= scores related to the pseudoscientific beliefs; CA-PI= correct answers regarding to COVID-19 pseudoscientific information exam; SA= self-acceptance; PR= positive relations; AU= autonomy; ME= management of environment; LP= life purpose; PG= personal growth.Significant differences were observed for the variables CA-PI, SA, AU, ME, and PG, with a risk of error lower than 0.001. For all the above variables, the group of residents in rural areas obtained higher scores than the group of residents in urban areas. Thus, psychological well-being is better in rural residents. The same happens with the hits (CA-PI); subjects who live in rural towns are better informed about COVID-19 than subjects who live in large cities. This conclusion is supported by $BF_{10}$ (>10) and $P(H_1|D)$: the probability that $H_1$ fits the observed data was 99.99%.

COVID-19 pandemic. This point would also explain why rural residents are more discriminating against pseudoscientific information.

According to point "B", it is important to differentiate between the "act of believing in pseudosciences" and the "act of making pseudoscientific decisions" (see Irwin et al., 2013). These two "acts" represent two different dimensions that form "pseudoscientific meanings" and "pseudoscientific attributions" (causal illusions) (see Matute et al., 2015). By way of example, the first dimension would allow us to assume the belief that homeopathy can be beneficial in the treatment of coronavirus (assuming homeopathy as an example of pseudoscience); the second dimension would be observed when someone who has been treated with homeopathy and has suffered from COVID-19 would say: "I have been cured because of the homeopathic treatment". In scientific discourse, causal claims are only acceptable when experimental methodology is used (see Pardo and San Martin, 2015). Considering the successes of the COVID-19 test (see Tables 1 and 2), rural residents do not tend to make as many pseudoscientific causal claims as the urban group does. However, analysis of pseudoscientific beliefs indicates that the differences were not significant between the two groups. This result invites the hypothesis that it is the causal illusions related to pseudoscience (and not the pseudoscientific beliefs themselves) that are the variable that truly is a psychopathological risk for people's mental health (see Matute et al., 2011). Therefore, the "act of believing" or the pseudoscientific belief itself does not represent a health risk; it is the person's use of this belief (in this case, a use based on causal illusions) that proves to be a psychopathological risk. Furthermore, taking into account the contributions of Pérez-Navarro et al. (2020) and Escolà-Gascón et al. (2020), it is possible to infer that this psychopathological risk is essentially related to the symptoms related to the spectrum of psychoses.

A curious result is the $R^2$ coefficients of the self-acceptance (SA) and personal growth (PG) scales. These two dimensions were the ones that gave the highest correlation coefficients. The psychological and clinical model that could best explain these results is the stress reduction theory (from now on SRT) (see Huang et al., 2020). This theory assumes that rural environments with harmless natural elements produce pleasant emotional reactions that eventually reduce the stress perceived by the subject (see also Ulrich et al., 1991). The question that arises from the results and the SRT is whether stress could be a mediating variable between pseudoscientific causal attributions and psychological well-being. Therefore, according to the SRT, it is likely that the stress levels of rural residents are the factor that could explain the increase in SA and PG correlations.

### 4.2. Limitations

One of the main limitations is related to the generalizability of the results. Considering that the sampling was not probabilistic and that the correlations between psychological well-being and pseudoscientific news discrimination were higher for the rural group, the generalizability of the regression models should be limited to subjects living in towns or rural areas. Thus, further research is needed to focus on the effects of pseudoscientific attributions on the psychological well-being of residents in large cities.

As a second limitation, it is important to note that, unlike Escolà-Gascón et al. (2020), in this research, the psychopathological risks related to psychosis were not evaluated using psychometric tests. It was decided to evaluate psychological well-being on the understanding that this study could be complemented with the results obtained by Escolà-Gascón et al. (2020). In this line, it would be necessary for future research to relate (if possible through the models of the structural equations) the levels of psychological well-being, the risk factors measured by Escolà-Gascón et al. (2020), and the pseudoscientific attributions by examining the COVID-19 of Table 1.

Finally, it should also be mentioned that the distinction between subjects who lived in rural areas and those who lived in urban areas did not take into account the presence of green spaces, private gardens, or playgrounds. For statistical purposes, a subject living in a city may have his apartment near a green space that he usually frequents. How these urban elements could influence the levels of psychological well-being of people is a possible strange or moderating variable to take into account in future research. In this study, the criteria of the National Institute of Statistics from Spain (2020) were used as objective governmental criteria, and they are not incorrect. However, the more variables that can be controlled or neutralized, the greater the external validity of the research and the more reliable the results.

## 5. Conclusions

The following conclusions were reached in this research: (1) pseudoscientific beliefs are not related to perceived psychological well-being. Therefore, it is likely that in themselves, they do not represent a risk for the mental health of individuals. (2) Knowing how to correctly discriminate between scientific and pseudoscientific information on COVID-19 allows us to predict between 20% and 32% of the perceived psychological well-being of residents in rural areas. The more difference there is between scientific and pseudoscientific information, the easier it will be for the general population to make effective and safe decisions that will promote their sense of subjective well-being. (3) Rural residents have fewer pseudoscientific beliefs than urban subjects. This challenges social isolation theory as a model for the production of irrational beliefs when a person resides in a rural location with a small population. (4) The mental health of urban subjects is more vulnerable than the health of rural residents. New intermediaries in the media are needed to prevent the *denial beliefs* (i.e., denying that the COVID-19 disease exists) of subjects who misuse pseudoscientific beliefs.

The results of this research show that the use of pseudoscientific beliefs is a variable that conditions and can negatively affect people's psychological health. International and governmental organizations

should provide social resources that allow residents of large cities to know what information is scientific (and therefore reliable) and what is not.

## Ethics approval and consent to participate

The Committee of Ethical Guarantees of *Ramon Llull University*, Barcelona (Spain), reviewed, favorably evaluated and approved this research. Likewise, the procedures of this study adhere to the Spanish Government Data Protection Act 15/1999 and the *Declaration of Helsinki of 1975*, revised in 2013.

## Funding

The authors confirm there has been no significant financial support for this work that could have influenced its outcome.

## Authors' contributions

AEG conceived and planned the study, collected the sample, performed the statistical analyses and wrote the manuscript in consultation with FXM and JR. JG supervised the project.

## Concerning preregistration

This study was not preregistered.

## Declaration of competing interest

The authors confirm that there are no known conflicts of interest associated with this publication.

## Acknowledgements

Not applicable for this section.

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# 8. Conclusiones

Esta investigación tuvo dos propósitos. Por un lado, la medición de los fenómenos inexplicados y sus variables psicológicas relacionadas a través del desarrollo de un nuevo instrumento psicométrico de evaluación. Por otro lado, tenía como finalidad el análisis del impacto de las creencias pseudocientíficas y su relación con los estilos de vida o modos de afrontamiento en la población general española. La crisis del coronavirus determinó el contexto de la investigación y los efectos de las creencias pseudocientíficas se examinaron en las condiciones socio-políticas y socio-sanitarias implementadas durante los meses de la pandemia. Concretamente, los meses en los que se analizaron estos impactos fluctuaron entre marzo y diciembre del año 2020. Igualmente, debe tenerse en cuenta que durante este tiempo se recopiló una parte de la muestra. Considerando los objetivos de la investigación y el propio contexto de la pandemia de la COVID-19, las conclusiones se presentan de forma dividida; unas para las propiedades psicométricas del MMSI-2 y para la recepción anómala de la información (RAI) y, otras, para las creencias pseudocientíficas y su relación con la crisis del coronavirus.

## 8.1. Conclusiones sobre el *Multivariable Multiaxial Suggestibility Inventory-2* (MMSI-2)

Los resultados y conclusiones de los tres primeros artículos tienen una interpretación conjunta que se basa en el proceso de desarrollo de las fases del MMSI-2 (estas fases están explicadas en el informe publicado en *Heliyon,* subsección 7.1.). Inicialmente, el MMSI-2 fue concebido para medir y predecir los fenómenos inexplicados relacionados con la hipótesis psi y las clasificaciones de la APA (siguiendo a Cardeña et al., 2014). Este objetivo se fundamentó en el siguiente dilema: ¿realmente suceden fenómenos psi o fenómenos inexplicados en el comportamiento humano? Si existieran evidencias estadísticas a favor de los fenómenos inexplicados (p. ej, la AAI, CMM, IMM y RAI), ¿cuáles serían las diferencias individuales presentes entre los sujetos que experimentan fenómenos inexplicados, alucinaciones y/o deformaciones perceptivas? Y más aún, ¿cómo se podría discriminar si la experiencia constituye individualmente una alteración perceptiva o un fenómeno psi genuino? Estas fueron las preguntas que se plantearon inicialmente y motivaron el desarrollo del MMSI-2. De hecho, los tres primeros artículos adjuntados –especialmente los de la subsección 7.1. y 7.3.– justifican la causa principal de la creación del MMSI-2 desde esta perspectiva.

Debe tenerse en cuenta que la investigación sobre los fenómenos anómalos es importante porque impacta directamente sobre las decisiones profesionales que pueden tomar los psicólogos y psiquiatras cuando observan esta clase de

experiencias en los individuos que evalúan. De acuerdo con Fernández-Ballesteros (2013) y las normativas de la International Tests Comissision (2021) (de ahora en adelante ITC) la evaluación psicológica y las decisiones derivadas de la misma deben estar fundamentadas en la evidencia científica y no solamente en sistemas de clasificación, hipótesis u opiniones basadas en la experiencia personal del clínico. Aunque las investigaciones con resultados a favor de los fenómenos inexplicados pudieran ser cuestionables metodológicamente y en algunos casos las replicaciones publicadas no fueron satisfactorias (p. ej. Galak et al., 2012), el simple hecho de que existan en la literatura científica actual ponen en duda cómo evaluar a nivel psicométrico los fenómenos anómalos y cómo diferenciarlos de otros fenómenos psicológicos consolidados científicamente (como por ejemplo, la alucinación) (Ey et al., 1980.). El hecho de que las evidencias a favor de los fenómenos psi concluyan que son "fenómenos inexplicados" en términos causales (léase la revisión de Cardeña, 2018), no quiere decir que no puedan detectarse variables psicológicas predictoras relacionadas linealmente con estas experiencias. Precisamente, el modelo conceptual del MMSI-2 (véase la figura 1 del artículo presentado en la subsección 7.3.) se fundamentó en la idea de que las variables predictoras de los fenómenos anómalos son los indicadores psicológicos que permitirían al profesional e investigador conocer si la experiencia del individuo constituye un contenido explicable en términos psicológicos o si se trata realmente de un contenido sin explicación.

En este contexto, la primera conclusión es que el MMSI-2 presenta una validez de constructo y de estructura interna satisfactoria. Gracias al análisis de la invarianza factorial y de las medias latentes con respecto a los grupos de creyentes y no-creyentes en lo paranormal es posible asumir, que la variación de las puntuaciones del MMSI-2 entre los grupos no se debe o no se explica por las propias características del instrumento. Esto permite concluir que el MMSI-2 ofrece medidas no sesgadas de sus puntajes entre los dos tipos de creencias. La fiabilidad mediante los coeficientes *alpha de Cronbach*, *alpha ordinales* y/o *omega de McDonald* también fue satisfactoria y excelente en algunas escalas, especialmente en las escalas de la versión reducida (MMSI-2-R). Además, gracias a los baremos de las puntuaciones diferenciados por sexo ─las tablas de baremos se ofrecen en el artículo 7.1.─, el MMSI-2 también puede ser empleado profesionalmente en la evaluación e interpretación del perfil psicológico del individuo. Esto permite apoyar la hipótesis 1 de esta investigación.

Los modelos de ecuaciones estructurales del MMSI-2 y, concretamente los factores CPT (Tendencias Clínicas de la personalidad), IMA (Manipulaciones Incoherentes) y ASC (Estados Alterados de la Consciencia) llegaron a predecir hasta el 51,2% de la varianza de los fenómenos anómalos evaluados. Aunque este resultado concuerda con los propósitos y la misión del MMSI-2, es importante realizar 2 observaciones metodológicas.

Por un lado, la proporción de varianza explicada ─estimada a partir de los coeficientes de regresión (véase Pardo y San Martín, 2015)─ puede alterarse de

acuerdo a los efectos de otras variables sobre los propios factores del MMSI-2. A modo de ejemplo, en el artículo 7.3. los efectos de la variable IMA sobre la variable CPT se cuantificaron en 0,801 (este es el coeficiente de regresión estandarizado). La interacción IMA×CPT puede ser una de las razones que justifique por qué la escala CPT arrojó un coeficiente de regresión tan bajo en la predicción de APP (Fenómenos Anómalos Percibidos). Como se verá más adelante, otra posibilidad es que sea la propia multicolinealidad entre las variables predictoras la que reduzca el valor del coeficiente de regresión y lo vuelva más conservador.

El coeficiente de regresión en la predicción de CPT y APP cuantifica el promedio de cuánto variará APP para cada unidad o puntuación en la escala CPT, neutralizando los efectos de las variables predictoras IMA y ASC. Dado que el coeficiente está estandarizado, su valor es equivalente a la correlación semiparcial entre CPT y APP. Teniendo en cuenta esta interpretación, se puede deducir que las correlaciones semiparciales no neutralizan los efectos de la interacción y multicolinealidad. Aunque las correlaciones parciales sí que permitirían controlar los efectos de la interacción, para evitar las consecuencias de la multicolinealidad de las variables predictoras sería necesario emplear modelos de regresión más robustos –por ejemplo la regresión de *ridge* (Rozeboom, 1979)–, los cuales serían necesarios en futuras investigaciones para replicar las predicciones de APP a partir de CPT, IMA y ASC. Si no se controlaran los efectos de la multicolinealidad en los pronósticos de APP aumentarían los errores típicos de los coeficientes, el contraste se tornaría más conservador y sucederían errores de tipo II (falsos negativos) (véase Pardo y San Martín, 2015).

Por otro lado, se debe tener en cuenta que las covarianzas estandarizadas de las figuras 2 y 3 del artículo 7.3. fueron bastante bajas (todas ellas fueron <0,2). Concretamente, debe recalcarse que estos parámetros se estimaron sobre las variables CPT, IMA, ASC y APP entendidas como factores latentes y no como variables observadas. Esto es importante, puesto que las puntuaciones de una variable latente se obtienen a partir de las combinaciones lineales de otras variables. Igualmente, considerando que son covarianzas estandarizadas (o sea, coeficientes lineales de correlación) y, con lo cual los efectos de las variables latentes son aleatorios (no están fijados como sucede en la figura 4 del artículo 7.3.), es posible que las relaciones entre CPT vs. APP, IMA vs. APP y ASC vs. APP estén moduladas por el resto de variables predictoras. En otras palabras, por ejemplo en la covarianza CPT vs. APP es posible que intervenga la variable IMA y que genere efectos de mediación reduciendo la covarianza entre CPT y APP. Esto podría explicar por qué las correlaciones entre estas variables fueron tan bajas. Por lo tanto, en futuras investigaciones es importante analizar cómo interfieren estos efectos de mediación. A modo de ejemplo se ilustra el modelo hipotético de mediación para la covarianza CPT vs. APP en la figura 1A.

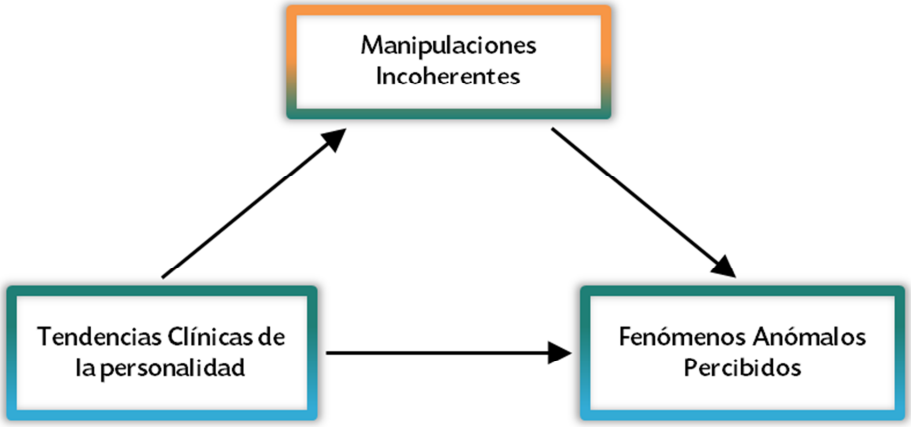


Figura 1A. *Modelo hipotético de mediación que explicaría por qué la covarianza explicada entre CPT y APP fue tan baja en el artículo 6.3. Debe tenerse en cuenta que este modelo hipotético difiere del modelo contrastado en la figura 4 del artículo 7.3.*

Teniendo en cuenta que las escalas ASC, CPT e IMA predicen las puntuaciones de la escala APP, en el artículo 7.3. se añadió como criterio hipotético de interpretación individual de las puntuaciones del MMSI-2 la figura 4. En esta figura se propuso la lógica siguiente: si la puntuación de la escala APP era elevada y se obtenía correlativamente con puntuaciones también elevadas en las demás escalas del test (CPT, IMA y ASC), entonces habrían motivos racionales y psicológicos que podrían explicar el por qué un sujeto cree que experimentó fenómenos anómalos. Aunque esto no explicaría la etiología del fenómeno anómalo percibido, sí que fundamentaría científicamente la decisión del profesional o psicólogo con respecto a cómo explicar los posibles fenómenos anómalos percibidos por el sujeto evaluado. Obviamente, esta lógica también debe ponerse a prueba en futuros estudios que analicen su eficacia en la toma de decisiones del análisis de un perfil psicológico del individuo.

En esta subsección también deben destacarse algunas observaciones sobre el artículo 7.4., el cual trata sobre la recepción anómala de la información. Hasta ahora, los fenómenos anómalos fueron evaluados con el MMSI-2 desde una fuente de datos basada en el autoinforme. En cambio, en el artículo 7.4. los fenómenos anómalos fueron cuantificados mediante una metodología experimental y empleando una prueba de rendimiento óptimo en la que los participantes debían adivinar el contenido (aversivo o positivo) de unas imágenes pertenecientes a la base de datos GAPED (*Geneva Affective Picture Database*) (Dan-Glauser y Scherer, 2011). Se dice que los sujetos debían "adivinar" en lugar de "inducir" o "deducir", porque durante los ensayos experimentales los participantes permanecieron completamente aislados del tipo de contenido que debían acertar. Esto quiere decir que no pudieron emplear los mecanismos perceptivos convencionales reconocidos por la ciencia para establecer una cadena de inducción o deducción causal que les permitiera acertar el contenido de dichas imágenes. Cuando se analizó el modelo de regresión entre las variables psicológicas del MMSI-

2 y el número de aciertos en las pruebas RAI se obtuvieron resultados que no se esperaban. Las escalas CPT y Neurastenia (de ahora en adelante Nt) estaban correlacionadas negativamente con el recuento de los aciertos en las pruebas de la RAI y la predicción se cuantificó con un peso del 25,8%. Las escalas IMA, ASC y Consumo de Sustancias (Cs) no estuvieron correlacionadas con los aciertos de las pruebas de la RAI.

Estos hallazgos no coinciden con la literatura científica predominante, la cual concluye que la RAI (medida experimentalmente) sí está positivamente correlacionada con los estados alterados de la consciencia y determinados rasgos de la personalidad incluidos en el factor CPT (Esquizotipia, Histrionismo, Paranoia, Narcisismo, Sugestibilidad y Búsqueda de Emociones) (véase las revisiones de Beischel et al., 2011; Cardeña et al., 2014). No obstante, se debe recordar que estos resultados fueron obtenidos con una muestra formada exclusivamente por sujetos que declararon ser médiums, dado que practicaban la supuesta comunicación con los seres fallecidos. Las investigaciones que trataron de correlacionar los fenómenos psi (categoría a la que pertenece la RAI según el *APA Dictionary of Psychology*, 2021a) con variables psicológicas como las mencionadas anteriormente, lo hicieron con muestras de sujetos que no eran necesariamente médiums o creyentes en lo paranormal (p. ej. Irwin, 1993). Esto sugiere que las características muestrales podrían afectar a dichas correlaciones arrojando tendencias muy dispares entre sí. El por qué se obtuvieron correlaciones negativas en los resultados del artículo 7.4. es algo para lo que no se ha encontrado una explicación psicológica y/o estadística.

Como segunda conclusión se destaca que existen diferencias en el tipo de covariación presente entre los fenómenos anómalos (especialmente los relacionados con la RAI) y las variables psicológicas relacionadas. Más específicamente, cuando los fenómenos anómalos son evaluados desde una fuente de datos autoinformada, la recta de regresión es creciente o positiva. En cambio, cuando los fenómenos anómalos relacionados con la RAI se miden empleando procedimientos experimentales la recta de regresión es decreciente o negativa. Estas observaciones a partir de los resultados obtenidos invitan a realizar un análisis de las diferencias cualitativas entre los fenómenos anómalos examinados como datos de autoinforme y los examinados empleando procedimientos experimentales.

Un matiz a tener en cuenta es que los datos de autoinforme se basan en declaraciones verbales que contienen o expresan la percepción del sujeto y no el suceso anómalo en sí mismo (véase Fernández-Ballesteros, 2013). Esto quiere decir que se miden experiencias subjetivas y no la probabilidad de que un evento inexplicado suceda significativamente en términos estadísticos (p. ej. un fenómeno psi como la RAI). En esta línea, sería interesante en futuras investigaciones analizar cómo las percepciones del sujeto sobre sus propias experiencias anómalas o inexplicadas interfieren en las correlaciones y predicciones con las variables psicológicas subyacentes. Esta propuesta requeriría incluir la medición de variables procedentes del modelo fenomenológico propuesto por Irwin (2009), las cuales

deberían cuantificar los sistemas de significados y los esquemas cognitivos que el sujeto utiliza en el juicio de sus propias experiencias.

Cuando se compararon los promedios de aciertos entre el grupo de médiums y el grupo de sujetos no creyentes en lo paranormal se obtuvieron diferencias significativas. Estas diferencias basadas en los efectos simples de interacción señalaban que los médiums obtenían mayor número de aciertos en las pruebas RAI que los sujetos no creyentes. Estos efectos estadísticos coinciden con la *teoría de las ovejas y cabras* originalmente propuesta por Schmeidler (1943, 1952). En los diferentes experimentos psi que se realizaron durante las décadas de los años 40 y 50, los investigadores observaron que solamente los sujetos creyentes en lo paranormal tendían a puntuar más alto en las pruebas psi que los sujetos clasificados en el grupo de escépticos (léase Beloff, 1993). Dado que los sujetos creyentes presentaban una actitud colaborativa y obediente durante la realización de los ensayos experimentales psi, fueron denominados "perfil oveja" (en inglés *sheep profile*). Sin embargo, los escépticos mostraban una actitud más desafiante y suspicaz en los experimentos. Los sujetos que presentaban este perfil menos colaborativo se denominaron "perfil cabra" (en inglés *goat profile*). Estas dos denominaciones de los perfiles consolidaron la teoría de las ovejas y cabras, la cual postula que los resultados en los experimentos psi tienden a estar sesgados por las actitudes y predisposiciones de los participantes (Cardeña et al., 2015). A pesar de que el recuento de aciertos no superó la esperanza matemática estimada por el azar, estas tendencias también se observaron en los resultados y grupos del artículo 7.4.

Como tercera conclusión, se debe recalcar que los resultados del artículo 7.4. apoyaron la hipótesis nula núm. 2 de esta investigación: el número de aciertos asociados a la RAI no difirió significativamente de lo esperable por el azar. A esta conclusión debe añadirse que las diferencias entre los aciertos del grupo de médiums y el grupo de sujetos no creyentes sí fueron significativas y apoyan la teoría de las ovejas y cabras establecida por Schmeidler (1943, 1952). Como ya se ha comentado, para explicar por qué se dieron los efectos ovejas y cabras sería necesario replicar estos resultados aplicando la perspectiva fenomenológica de Irwin (2009), la cual incluiría el análisis de los sistemas de significados, creencias, actitudes y esquemas cognitivos.

## 8.2. Conclusiones sobre las creencias pseudocientíficas

La recogida de datos con respecto a las creencias pseudocientíficas se vio afectada por la pandemia de la COVID-19 y se tomó la decisión de aprovechar el contexto de la crisis socio-sanitaria para analizar el impacto de estas creencias en la vida de las personas. Inicialmente, se realizaron antes del mes de marzo del año 2020 (mes de inicio de la pandemia) unas primeras aplicaciones (denominadas *pre-test*) de las escalas MMSI-2-R, ASGS (*Australian Sheep-Goat Scale*) y CAPE-42 (*Community Assessment of Psychic Experiences*). El objetivo de estas aplicaciones

fue analizar la consistencia longitudinal de las puntuaciones del MMSI-2-R y realizar un análisis predictivo y discriminante con respecto a las experiencias psíquicas y a las creencias mágicas evaluadas por la CAPE-42 y la ASGS.

Hubo tres factores considerados causas de fuerza mayor (por ser inesperados, impredecibles e incontrolables) que generaron un cambio en las intenciones iniciales de la investigación: en primer lugar se había iniciado el estado de alarma, se implementó la cuarentena social y las fronteras europeas fueron cerradas con motivo de la expansión del virus SARS-CoV-2. Esto causó un cambio en el estilo de vida de las personas (p. ej. Bonaccrosi et al., 2020; Brooks et al., 2020) y también representaba una condición psicosocial que alteraría la variabilidad y covariabilidad de las puntuaciones del MMSI-2-R. En segundo lugar, los medios generalistas de comunicación y algunas publicaciones científicas advirtieron un aumento exponencial de las conductas mágicas e irracionales en la población general (léase Mattioli et al., 2020); un ejemplo de estos comportamientos fueron las compras compulsivas de papel higiénico —el cual se agotó en tan solo una semana (Khan et al., 2020)—. Finalmente, como tercer punto también se observó que los niveles de paranoia de la población habían aumentado y se manifestaban en forma de ideas conspirativas sobre el origen del virus (véase Zhang y Ma, 2020). En esta línea, se planteó la posibilidad y se hipotetizó que estos factores contextuales debían causar unos cambios en las puntuaciones de las escalas MMSI-2-R, ASGS y CAPE-42. Entonces, era prioritario analizar y profundizar sobre la relación entre las creencias pseudocientíficas, los fenómenos anómalos y los efectos de estos factores relativos a la crisis del coronavirus. Las medidas *post-test* se llevaron a cabo durante la última semana del periodo de cuarentena social.

Los resultados del artículo 7.5. permiten mantener la hipótesis núm. 3 de la investigación: después del confinamiento los síntomas psicóticos, las percepciones anómalas y las creencias pseudocientíficas aumentaron en la población general no clínica. Este incremento está relacionado con la teoría de la marginalidad social, la cual postula que los estados de aislamiento físico y social promueven el desarrollo de creencias mágicas (Wuthnow, 1976; Brainbridge, 1978). Según esta teoría, el aislamiento social y físico generan en el individuo un empobrecimiento cultural, intelectual y afectivo que lo predisponen a desarrollar pensamientos alternativos que entran en conflicto con el juicio y la razón (véase también Irwin, 1993). La teoría fue cuestionada por Emmons y Sobal (1981), quienes advirtieron que los estados de aislamiento predicen de manera inconsistente las creencias pseudocientíficas, aunque no se llegó a determinar el porqué de dichas inconsistencias. En la literatura científica contemporánea existen evidencias a favor y en contra de la marginalidad social como teoría que predice y explica la creencia paranormal (p. ej. Billows y Storm, 2015, 2016; Maraldi y Krippner, 2019). En este caso, durante el confinamiento, los individuos sí realizaron una cuarentena física por no tener un contacto presencial con las demás personas. Sin embargo, la cuarentena no fue social, ya que muchas de las relaciones pudieron mantenerse gracias a la digitalización y telematización de las comunicaciones. Cómo interfiere

la telematización de las relaciones sociales en la sensación de marginalidad puede ser una variable clave para comprender qué dimensiones o facetas de esta teoría son las que predicen realmente las creencias pseudocientíficas.

Teniendo en cuenta estas observaciones y los resultados del artículo 7.5. se puede concluir que, si bien los resultados parecen apoyar la teoría hipotética de la marginalidad social, sus efectos sobre el incremento de las creencias pseudocientíficas pueden estar condicionados por dos variables: por un lado, por la propia telematización de las relaciones sociales y, por el otro, por el exceso de información y desinformación sobre el coronavirus (léase el concepto de *infodemia* Innerarity y Colomina, 2020). Aunque la sociedad occidental haya permanecido conectada sobre lo que sucede en la realidad gracias a las tecnologías de la información y comunicación (de ahora en adelante TIC), es posible que el aislamiento físico (y no social) haya alterado la cualidad afectiva de las relaciones y los estilos de afrontamiento de las personas. Esta hipótesis está en la línea de las investigaciones de Rogers et al. (2006), quienes relacionaron las creencias pseudocientíficas con los estilos de afrontamiento y la teoría de la marginalidad social (léase también Rogers et al., 2007).

Desde esta perspectiva basada en los estilos de afrontamiento, se decidió desarrollar una nueva herramienta que pudiera evaluar las reacciones conductuales de la población española ante las consecuencias de una crisis internacional como la del coronavirus. Esta información puede encontrarse en el artículo 7.6. de esta investigación. Más concretamente, este nuevo instrumento se denomina *Covid Reaction Scales* (COVID-RS) y permite medir distintos estilos de afrontamiento incorporando las creencias pseudocientíficas y el impacto psicológico de la infodemia en la vida de las personas.

Principalmente, como conclusión de la publicación 7.6. deben resaltarse las propiedades psicométricas que otorgan validez y fiabilidad a esta escala. La COVID-RS reúne las reacciones conductuales y los estilos de afrontamiento adaptados a la crisis del coronavirus a partir de dos constructos: la falta de consciencia (abreviado LA) y los niveles de ansiedad percibidos (abreviado CAI). El grado de consciencia y la ansiedad representan dos facetas que explican los estilos de afrontamiento siguiendo la clasificación de Ainsworth y Bowlby (1991) y también describen operativamente las respuestas sociales ante el coronavirus según lo observado en la literatura científica:

- Predominan respuestas caracterizadas por ideas conspirativas, pensamientos paranoides y creencias mágicas o irracionales (se corresponde con el apego desorganizado).
- Se identifican respuestas basadas en automatismos, estados de pánico e impulsividad (se corresponde con el apego ambivalente aunque en el artículo 7.6. recibe el nombre de “conductas rebaño”).
- Se pueden encontrar respuestas que reflejan sensaciones de máxima vulnerabilidad, distanciamiento emocional y falta de control (equivale al apego evitativo).

- Se observan conductas excesivas en el consumo de la información relacionada con el coronavirus, abuso de los medios de comunicación y dificultades para distinguir entre la información fiable vs. no fiable (estos comportamientos se corresponden con la infodemia durante la pandemia).
- Se destacan comportamientos relacionados con la tristeza, sentimientos de soledad, añoranza y falta de apoyo afectivo (estas conductas son análogas al incremento de los niveles de soledad emocional percibidos durante el confinamiento).

En este sentido, la COVID-RS permite comprender y predecir las reacciones desadaptativas que caracterizaron el comportamiento de la población general durante esta pandemia siguiendo la teoría del apego y de los estilos de afrontamiento. Igualmente, teniendo en cuenta que los factores latentes de la COVID-RS estuvieron intercorrelacionados, se concluye a favor de la hipótesis núm. 4 de la investigación, que las creencias pseudocientíficas forman parte de los estilos de afrontamiento y representan un tipo de respuesta de la población general ante la incertidumbre atribuida a la crisis del coronavirus. En esta línea, tiene sentido que las creencias y experiencias anómalas hayan aumentado durante este periodo de crisis; no solamente por el aislamiento afectivo, sino porque la propia población ha desarrollado estilos de afrontamiento que son inclusivos de estas creencias y experiencias.

Considerando las observaciones y los contenidos discutidos en los artículos 7.5. y 7.6. ─especialmente aquellas que relacionan las creencias paranormales con la infodemia─ una de las incógnitas que se plantearon fue qué sucede cuando una creencia pseudocientífica es difundida en los medios de comunicación y es presentada ante la sociedad como un contenido "científico". Entonces, en la publicación 7.7. se abordaron dos puntos clave: por una parte, se examinaron los efectos de la información pseudocientífica en el bienestar psicológico percibido de la población; y, por otra parte, también se quiso analizar en qué tipo de comunidades-municipios los residentes discriminan con más facilidad la información científica de la pseudocientífica (dentro de la temática y del contexto del coronavirus).

Para la discriminación de la información pseudocientífica y científica los participantes tuvieron que responder a un examen compuesto por 18 preguntas o enunciados que trataban sobre el coronavirus. Los contenidos de los ítems podían ser "ciertos" (probados científicamente), "falsos" (desaprobados científicamente) y "no concluyentes" (no verificables o con investigación científica insuficiente). Los sujetos debían especificar si los contenidos eran ciertos, falsos o no concluyentes a nivel científico. Es importante destacar que los contenidos falsos eran noticias, información y datos divulgados en los medios de comunicación españoles y estaban clasificados por la *Organización Mundial de la Salud* (OMS) como *fake-news* (en español "falsas noticias"). La puntuación total del examen reflejaba el recuento de respuestas correctas de cada participante. Este punto es importante para la conclusión que se desea destacar.

Con respecto a la primera parte, en los artículos anteriores las creencias pseudocientíficas se midieron exclusivamente empleando la escala de autoinforme ASGS. Esta escala está basada exclusivamente en las creencias paranormales y parapsicológicas. No obstante, como se ha explicado en la subsección 2.4. del marco teórico, las creencias pseudocientíficas es una expresión generalista que agrupa contenidos y dimensiones que van más allá de la parapsicología, lo mágico y lo paranormal. En realidad, el examen realizado en el artículo 7.7. es una medida de rendimiento óptimo de la discriminación cualitativa de la información según su contrastabilidad científica dentro de la temática del coronavirus. De este modo, la medida que se establece en este caso alude a conocimientos o destrezas y no tanto a un rasgo psicológico. En esta línea y según los resultados, discriminar correctamente entre la información científica y pseudocientífica predice entre el 20 y el 32% de la varianza del bienestar psicológico percibido. Esta conclusión está apoyada por la correlación negativa entre las puntuaciones de la escala ASGS y el número de aciertos del examen ($r >$ -0,7).

El hecho de que los aciertos en el examen (o sea, el grado de destreza para diferenciar lo científico de lo pseudocientífico) prediga positivamente el bienestar psicológico no significa que las creencias pseudocientíficas sean disfuncionales o negativas con respecto al bienestar percibido. Además, las correlaciones entre las escalas de bienestar y las puntuaciones de la prueba ASGS no fueron significativas, lo cual refuerza esta conclusión. Lo que se constata con estos resultados —y es la conclusión principal del estudio— es que lo importante no recae en cómo combatir las pseudociencias, las creencias pseudocientíficas o las creencias paranormales. Lo esencial es fomentar el pensamiento crítico, el análisis estratégico y ofrecer recursos conceptuales a la población general para que pueda realizar esta discriminación de manera eficaz. Otra conclusión paralela y crucial es que, en sí mismas, las creencias pseudocientíficas no son un problema o no deberían serlo; cada individuo tiene la libertad de creer en la existencia de lo que desee. Los resultados obtenidos sugieren que el problema está en el uso de las creencias pseudocientíficas para tomar decisiones sobre la propia vida o la vida de los demás. Serán estas decisiones o juicios a partir de lo pseudocientífico lo que debe preocupar a las autoridades sanitarias y no el valor personal o ideográfico de las creencias.

En cuanto a la segunda parte, se tuvo en cuenta que en los municipios españoles con alta densidad de población (metrópolis y ciudades con más de 10.000 habitantes,) las restricciones socio-sanitarias y los efectos de la pandemia de la COVID-19 tuvieron un impacto mayor en la vida de las personas que en los municipios considerados rurales (población inferior a 10.000 habitantes). Esto se explica por las tres evidencias siguientes: (1) el cierre de negocios por la falta de liquidez económica, los cuales se concentran en las zonas urbanas de las metrópolis; (2) la saturación de los servicios de salud, cuyos hospitales se localizan en las grandes ciudades; y (3), los recursos culturales, académicos, formativos y asistenciales, que son más frecuentes en las ciudades que en los municipios más pequeños. En este sentido, la aplicación de las restricciones debía ser más habitual

en las ciudades que en las zonas rurales. Se analizó cómo afectaron estas características entre municipios rurales y urbanos a las creencias pseudocientíficas y al bienestar percibido.

Se concluye que el bienestar psicológico percibido durante la crisis del coronavirus es mayor en los residentes de zonas rurales frente a los residentes de zonas urbanas. En cambio, tal y como se planteó en la hipótesis 5 del apartado de objetivos, las creencias pseudocientíficas fueron más frecuentes en los habitantes de las grandes ciudades y no en los residentes rurales. Este dato es muy importante porque el resultado no apoya la teoría de la marginalidad social comentada al inicio de esta subsección. En términos cuantitativos y espaciales, el aislamiento físico y social es más predominante en los municipios con baja densidad de población que en las ciudades. Según esta lógica, deberían observarse matemáticamente mayor cantidad de creencias pseudocientíficas en los municipios considerados "pueblos" o "aldeas" y no en las metrópolis. Esto pone en duda y sigue cuestionando la explicación de la teoría de la marginalidad social como hipótesis de las creencias paranormales y pseudocientíficas. Precisamente, en el artículo 7.7. se especula que esto puede estar relacionado con la desinformación y la infodemia habida durante la pandemia, la cual tuvo más incursión en las ciudades que en los pueblos. En este sentido, es posible que los residentes rurales hayan invertido más tiempo contrastando críticamente las fuentes de información sobre el coronavirus que los habitantes de las ciudades.

Estas conclusiones sugieren la necesidad de seguir investigando sobre la teoría de la marginalidad social relacionada con las creencias paranormales, pero también inicia una nueva discusión transversal para todos los artículos adjuntados en esta investigación. Específicamente, el debate que plantea trata sobre si las creencias pseudocientíficas podrían tener un rol mediador entre los estilos de afrontamiento, las variables psicológicas especificadas en el MMSI-2 y el bienestar psicológico percibido. En otras palabras, si las reacciones ante la crisis del coronavirus pueden representarse conceptualmente siguiendo los estilos de afrontamiento, los propios estilos de afrontamiento incluyen las creencias pseudocientíficas (véase la escala COVID-RS) y, las variables del MMSI-2 están relacionadas con estas creencias, el impacto de las creencias pseudocientíficas podría tener unos efectos que modularan el bienestar percibido al incluir la interacción triple COVID-RS×ASGS×MMSI-2. Así, en futuros estudios sería interesante analizar las relaciones estadísticas entre los estilos de afrontamiento, las creencias pseudocientíficas, las variables del MMSI-2 y el bienestar psicológico. Esto permitiría realizar un abordaje inclusivo y multinivel, en el cual se combinarían linealmente los estilos de afrontamiento, el modelo estructural y las variables del MMSI-2, las creencias pseudocientíficas y el bienestar psicológico percibido.

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# 10. Apéndice de materiales suplementarios

En las próximas páginas se adjuntan los ejemplos de los cuestionarios e ítems utilizados en los artículos.

NO ESCRIBA NADA EN ESTE CUADERNO

# MMSI-2

## Inventario Multiaxial de Sugestibilidad Multivariable-2

## INSTRUCCIONES

Por favor, antes de empezar, lea cuidadosamente las instrucciones. Marque sus contestaciones en la hoja de respuestas y escriba solamente en el lugar que se le indica. **NO escriba nada en este cuaderno.** Este inventario consta de 174 frases o ítems. Lea cada frase con atención y marque en la hoja de respuestas la opción que más refleje su grado de acuerdo o desacuerdo con lo que dice la frase:

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| A | En total desacuerdo | B | En desacuerdo | C | Algo de acuerdo | D | Bastante de acuerdo | E | Totalmente de acuerdo |

No hay respuestas correctas o incorrectas. El **MMSI-2** está diseñado para detectar y examinar su grado de sinceridad; por lo tanto, **responda de manera sincera y no trate de mostrar una imagen deseable de Vd.** Exprese su opinión de manera precisa e intente no marcar solamente las dos opciones extremas de la prueba (opción "A" y "E"). Dé una respuesta a todos los ítems y no deje ninguno sin responder. Si se equivoca, borre o tache lo que ha marcado y señale la nueva opción elegida.

Tómese su tiempo para la realización de esta prueba. Le recordamos, que sus respuestas serán tratadas de manera anónima y confidencial. Gracias por su tiempo y participación.

**PASE DE PÁGINA PARA COMENZAR LA PRUEBA**

psimetrika

| A | En total desacuerdo | B | En desacuerdo | C | Algo de acuerdo | D | Bastante de acuerdo | E | Totalmente de acuerdo |
|---|---|---|---|---|---|---|---|---|---|

030 Las personas con tal de ser famosas son capaces de mentir.

031 He identificado olores nauseabundos o simplemente malos olores sin explicación alguna.

032 Últimamente he tomado medicamentos (con o sin prescripción médica) para potenciar mi concentración.

033 He podido sentir los pensamientos de otras personas.

034 Algo o alguien me ha tocado y no había nadie ahí.

035 Creo que la magia o los rituales me pueden ayudar a sentirme mejor.

036 He buscado placer en la masturbación.

037 Me gustan los colores llamativos.

038 Me gusta dar respuestas impactantes cuando la pregunta que me formulan es incómoda.

039 Me ha parecido escuchar música que otros no han podido oír.

040 Confío muy poco en la lealtad de las personas que conozco.

041 Permito que mis emociones afecten a mis pensamientos.

042 Me resulta embarazoso tratar con gente desagradable y maleducada.

043 Últimamente he notado una presión en el pecho fuera de lo común.

044 Alguna vez me han dicho que finjo mis sentimientos, pero yo no lo percibo así.

045 Suelo desconfiar de la gente.

046 Recientemente he tomado alguna droga estimulante, (por ej. éxtasis, cocaína, cristal, etc.).

047 He percibido susurros o voces que no tienen una explicación.

048 He percibido los olores más intensos de lo habitual.

049 Se me han escapado gases o eructos mientras estaba con más gente.

050 Me cuesta concentrarme en aquella tarea que debo realizar.

051 Me dejo influenciar con facilidad.

052 A pesar de todo, tengo una buena familia.

053 Para mí, la fama y el dinero son aspectos poco importantes.

054 He tenido extrañas sensaciones alrededor de mi cuerpo.

055 La sociedad ha perdido el sentido ético de la vida.

056 He pasado unos días muy complicados.

057 En estos días he tomado alguna sustancia que me ha estimulado y excitado fuera de lo común.

058 He notado cambios inopinados en el aroma de mi alrededor.

CONTINÚE EN LA PÁGINA SIGUIENTE

# MMSI -2

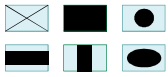
**Inventario Multiaxial de Sugestibilidad Multivariable-2**



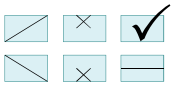
| Identificador | | |
|---|---|---|
| Edad | Sexo | Fecha |
| ¿Tiene Vd. antecedentes psiquiátricos? | | |
| Provincia en la que reside | | |
| Profesión | | |

**ANTES DE COMENZAR, LEA LAS INSTRUCCIONES ATENTAMENTE**

Señales correctas



Señales incorrectas



## Compruebe que el número de la frase es igual en cuadernillo y hoja

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Consiento expresamente el tratamiento de los datos necesarios para la corrección de esta prueba, por medios manuales o mecánicos, con los requisitos establecidos en el Reglamento (UE) 2016/679 y disposiciones de desarrollo. Le informamos que sus datos personales serán tratados por parte de la entidad organizadora de la prueba como responsable del tratamiento, actuando *Psimetrika* o la *Universidad Ramon Llull* como únicos encargados. Usted puede ejercitar los derechos de acceso, rectificación, cancelación oposición y demás derechos en los términos establecidos en la normativa vigente dirigiéndose a la entidad organizadora.

Firma (no sobrepase el recuadro)

Uso privado y CONFIDENCIAL

# MMSI -2R

## Multivariable Multiaxial Suggestibility Inventory -2

## Reduced

psimetrika



**Sexo:** _____ **Edad:** _____

**Últimos estudios realizados:** _____

**Fecha de hoy:** _____

**¿Se considera creyente en lo paranormal?** _____

# INSTRUCCIONES

Por favor, antes de empezar, lea cuidadosamente las instrucciones. **Marque sus contestaciones en las casillas que aparecen debajo de cada pregunta.** Este inventario consta de 49 frases o ítems. Lea cada enunciado con atención y marque la opción que más refleje su grado de acuerdo o desacuerdo con lo que dice la frase. **Puede señalar:**

| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|
| En total desacuerdo | En desacuerdo | Algo de acuerdo | Bastante de acuerdo | Totalmente de acuerdo |

No hay respuestas correctas o incorrectas. Intente ser lo más **SINCERO POSIBLE** y exprese su opinión de manera precisa. Dé una respuesta a todos los ítems. Solo se admite una respuesta por pregunta. **No limite sus respuestas a las opciones 1 o 5; recuerde que también dispone de otras alternativas intermedias.** Finalmente, le recordamos que los datos se almacenarán de manera anónima y confidencial. Gracias por su colaboración.

**SI HA ENTENDIDO LAS INSTRUCCIONES, PUEDE COMENZAR**

| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|
| **En total desacuerdo** | **En desacuerdo** | **Algo de acuerdo** | **Bastante de acuerdo** | **Totalmente de acuerdo** |

**01** He sido capaz de oír cosas inexplicables que las personas junto a mi no han oído.

1 2 3 4 5

**02** He notado cambios inopinados en el aroma de mí alrededor

1 2 3 4 5

**03** Tengo o he tenido marcas en la piel que han aparecido de forma inexplicable.

1 2 3 4 5

**04** He tenido la sensación de elevarme sin levantarme cuando estaba reposado.

1 2 3 4 5

**05** He tenido la sensación de que algo inexplicable intentaba controlarme.

1 2 3 4 5

**06** He observado luces o puntos de luz que otras personas no han visto.

1 2 3 4 5

**07** He oído cosas raras que no tenían una explicación.

1 2 3 4 5

**08** He notado cambios inexplicables en el sabor de algunas comidas.

1 2 3 4 5

**09** He tenido la sensación como algunos aparatos electrónicos (por ej. la televisión) se han activado y desactivado inexplicablemente.

1 2 3 4 5

**10** He percibido olores inexplicables que otras personas no han notado.

1 2 3 4 5

**11** He notado una sensación extraña en mi cuerpo o en alguna parte de él.

1 2 3 4 5

**12** He percibido susurros o voces que no tienen una explicación.

1 2 3 4 5

**13** He percibido el olor de alguien fallecido sin causa alguna.

1 2 3 4 5

**14** He notado energías inexplicables alrededor de mi cuerpo.

1 2 3 4 5

**15** Creo que he visto espíritus o energías de seres fallecidos.

1 2 3 4 5

**16** He sentido la presencia de otro ser, aunque no he sido capaz de verlo.

1 2 3 4 5

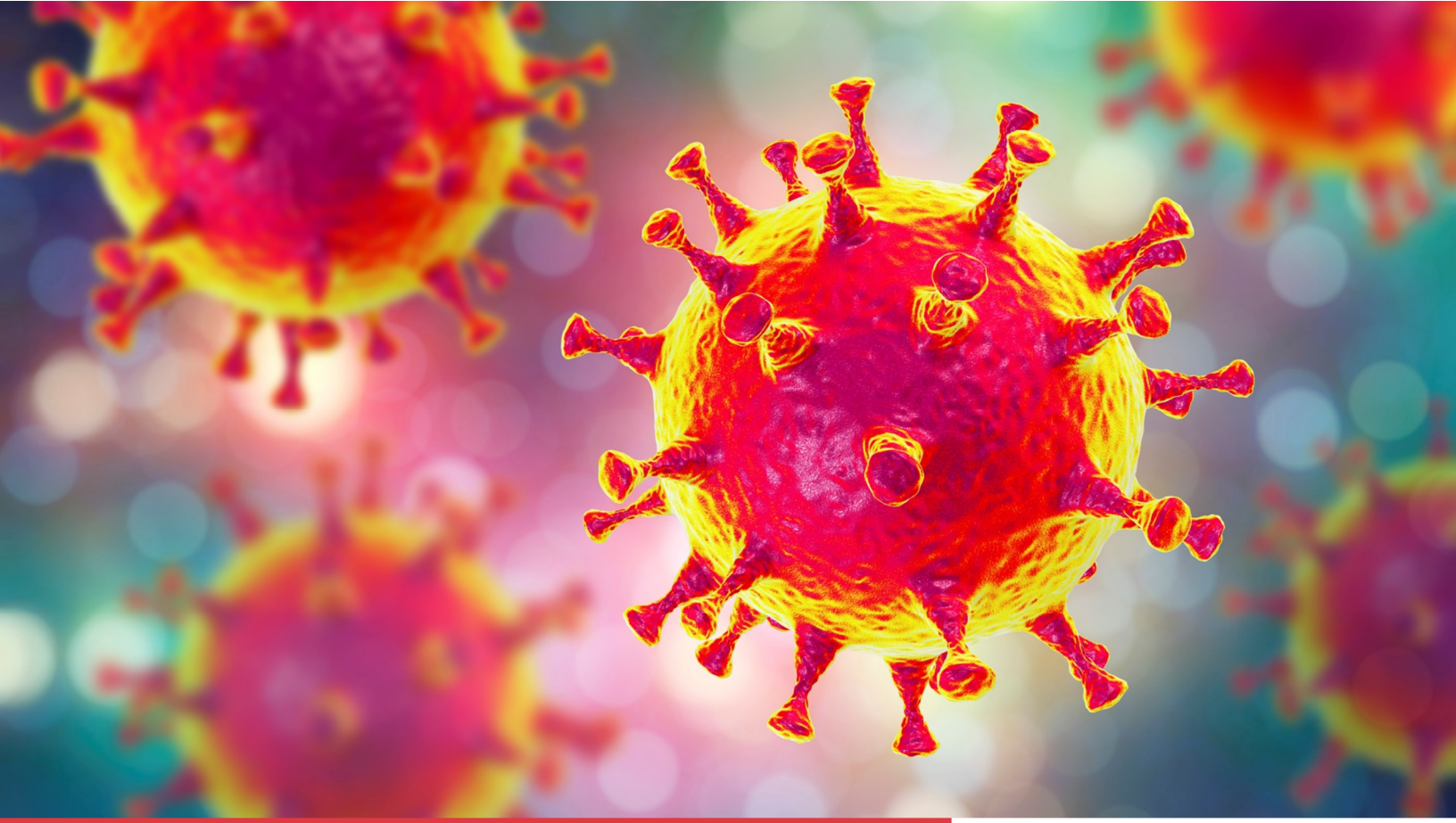
**17** He tenido la sensación de haber vivido con anterioridad, situaciones que son completamente nuevas para mí.

1 2 3 4 5

**18** He tenido la sensación de sentir palabras o frases inexplicables en mi mente.

1 2 3 4 5

CONTINÚE EN LA PÁGINA SIGUIENTE



# COVID-RS

## COVID Reaction Scales

## Escalas de reacción a la COVID

Álex Escolà-Gascón
Francesc-Xavier Marín
Jordi Rusiñol
Josep Gallifa

psimetrika



**Reacciones** Conductuales **Desadaptativas** al **Coronavirus**

psimetrika

# COVID-RS

## COVID Reaction Scales

## Escalas de Reacción a la COVID

Localidad _____ Fecha de hoy ☐☐/☐☐/☐☐

Sexo: ☐ Hombre ☐ Mujer Antecedentes psiquiátricos: ☐ Sí ☐ No

Nivel educativo: ☐ Educación Primaria ☐ Educación Secundaria Obligatoria (ESO)
☐ Formación Profesional ☐ Bachillerato o Módulos Superiores
☐ Estudios universitarios, máster o doctorados

¿Padeció o padece Vd. la enfermedad COVID-19? ☐ Sí ☐ No ☐ No lo sé

## INSTRUCCIONES

Este cuestionario trata sobre sus experiencias y maneras de reaccionar ante la crisis del coronavirus y su impacto socio-sanitario. A continuación, encontrará 31 frases que expresan opiniones y situaciones relacionadas con el coronavirus y la COVID-19. En cada enunciado, debe señalar su grado de acuerdo mediante una escala gradual del 0 al 4. El 0 significa «completamente en desacuerdo» y el 4 «completamente de acuerdo». Este cuestionario no tiene respuestas correctas o incorrectas. Por lo tanto, **sea sincero y no responda según lo que se espere de Vd.** No piense mucho sus respuestas, cuando dude qué debe contestar señale su primera impresión. Responda a todas las preguntas. Muchas gracias por su colaboración.

### PUEDE COMENZAR LA PRUEBA

| | | 0 | 1 | 2 | 3 | 4 |
|---|---|---|---|---|---|---|
| 1 | El gobierno y las autoridades no nos dicen la verdad sobre los peligros del coronavirus. | ○ | ○ | ○ | ○ | ○ |
| 2 | Tengo mucho miedo de contagiarme de coronavirus. | ○ | ○ | ○ | ○ | ○ |
| 3 | El coronavirus es una creación de los laboratorios, gobiernos o de las grandes organizaciones. | ○ | ○ | ○ | ○ | ○ |
| 4 | Aunque tomo las precauciones sanitarias recomendadas, no me siento seguro/a saliendo a la calle. | ○ | ○ | ○ | ○ | ○ |
| 5 | El coronavirus es una enfermedad que "mata" más de lo que nos dicen. | ○ | ○ | ○ | ○ | ○ |
| 6 | Creo que el coronavirus forma parte de alguna conspiración. | ○ | ○ | ○ | ○ | ○ |
| 7 | Me siento incómodo/a cuando alguien "tose" por la calle y está cerca de mí. | ○ | ○ | ○ | ○ | ○ |
| 8 | Me pongo nervioso/a cuando veo a gente sin mascarilla por la calle. | ○ | ○ | ○ | ○ | ○ |
| 9 | El coronavirus fue "soltado" expresamente para acabar con una parte de la población mundial. | ○ | ○ | ○ | ○ | ○ |
| 10 | El coronavirus generará una nueva "guerra" entre países. | ○ | ○ | ○ | ○ | ○ |
| 11 | Por muchas precauciones que tome, me siento constantemente desprotegido/a. | ○ | ○ | ○ | ○ | ○ |
| 12 | Siento ansiedad si no me desinfecto o no me lavo las manos de forma habitual. | ○ | ○ | ○ | ○ | ○ |

CONTINÚE EN LA PÁGINA SIGUIENTE



**Título del test:** COVID Reaction Scales (COVID-RS) | Escalas de Reacción a la COVID | **Año:** 2020
**Autores:** Álex Escolà-Gascón*, Francesc-Xavier Marín, Jordi Rusiñol & Josep Gallifa. Universidad Ramón Llull, Barcelona, España | ***E-mail:** alexeg@blanquerna.url.edu

| | | 0 | 1 | 2 | 3 | 4 |
|---|---|---|---|---|---|---|
| 13 | Me siento ansioso/a cuando la gente no mantiene las distancias sociales. | ○ | ○ | ○ | ○ | ○ |
| 14 | El coronavirus puede curarse con remedios naturales y alternativos a la ciencia. | ○ | ○ | ○ | ○ | ○ |
| 15 | Creo que toda la población contraerá la enfermedad del coronavirus. | ○ | ○ | ○ | ○ | ○ |

## DURANTE LOS PERIODOS DE CUARENTENA SOCIAL...

*Conteste solamente sobre lo que hizo durante los confinamientos realizados.*

| | | 0 | 1 | 2 | 3 | 4 |
|---|---|---|---|---|---|---|
| 16 | He sentido ansiedad cada vez que leía, escuchaba o miraba las noticias que trataban sobre el coronavirus. | ○ | ○ | ○ | ○ | ○ |
| 17 | He comprado más cantidad de comida de lo habitual. | ○ | ○ | ○ | ○ | ○ |
| 18 | En algún momento he creído que los supermercados estaban desabastecidos. | ○ | ○ | ○ | ○ | ○ |
| 19 | Me he sentido saturado por la cantidad de información que he recibido sobre el coronavirus. | ○ | ○ | ○ | ○ | ○ |
| 20 | He comprado productos que no necesitaba. | ○ | ○ | ○ | ○ | ○ |
| 21 | He invertido mucho tiempo consultando noticias sobre el coronavirus. | ○ | ○ | ○ | ○ | ○ |
| 22 | Me he auto-medicado para prevenir el contagio (sin prescripción médica). | ○ | ○ | ○ | ○ | ○ |
| 23 | He comprado más papel higiénico del que necesitaba (en esta pregunta también se pueden incluir "el rollo de cocina" y las servilletas de papel). | ○ | ○ | ○ | ○ | ○ |
| 24 | He sentido impulsos por comprar productos alimentarios cuando no los necesitaba. | ○ | ○ | ○ | ○ | ○ |
| 25 | No he parado de leer, escuchar o ver las noticias que hablaban sobre el coronavirus. | ○ | ○ | ○ | ○ | ○ |
| 26 | Cuando he consultado noticias sobre el coronavirus he sentido "terror". | ○ | ○ | ○ | ○ | ○ |
| 27 | Me he sentido estresado por la información que los medios de comunicación transmitieron sobre el coronavirus. | ○ | ○ | ○ | ○ | ○ |
| 28 | Me hubiera gustado hacer planes de ocio con otras personas. | ○ | ○ | ○ | ○ | ○ |
| 29 | He extrañado tener gente a mÍ alrededor. | ○ | ○ | ○ | ○ | ○ |
| 30 | Me he sentido distanciado de mis amistades y/o familiares. | ○ | ○ | ○ | ○ | ○ |
| 31 | He añorado verme físicamente con mis amigos y/o familiares. | ○ | ○ | ○ | ○ | ○ |



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# ASGS

**Australian Sheep-Goat Scale**
Escala Australiana de Ovejas-Cabras
o Creencias Paranormales

Michael A.
Thalbourne

**Adaptación española:**
Álex Escolà-Gascón
Lance Storm

Cuadernillo y hojas
de respuesta en español

**Spanish Test Booklets
and answer sheets**



psimetrika

**Serial number:** 022020 | Spain

psimetrika

# ASGS

## Australian Sheep-Goat Scale

Escala Australiana de Ovejas-Cabras o *Creencias Paranormales*

Localidad _____ Fecha de hoy ☐☐/☐☐/☐☐ Sexo: ☐ Hombre ☐ Mujer Antecedentes psiquiátricos: ☐ Sí ☐ No

Nivel educativo: ☐ Educación Primaria ☐ Educación Secundaria Obligatoria (ESO) ☐ Formación Profesional ☐ Bachillerato o Módulos Superiores ☐ Estudios universitarios, máster o doctorados

¿Cree Vd. en la existencia de lo paranormal? ☐ Sí ☐ No ☐ No lo sé

NO ESCRIBA NADA EN ESTAS CASILLAS

ID _____ Observaciones _____

## INSTRUCCIONES

Señale sus respuestas con una cruz en las casillas ubicadas al final de cada enunciado. Marque **V** cuando **considere ciertos los contenidos** de cada frase; Indique **¿?** cuando no **entienda la pregunta**. Tenga en cuenta que algunos conceptos pueden ser técnicos o excesivamente específicos para Vd. cuando se encuentre en esta situación, le pedimos que marque esta alternativa; y señale **F** cuando **considere falsos los contenidos** de la frase. Gracias por su colaboración. Si ha entendido las instrucciones puede comenzar.

| | V | ¿? | F |
|---|---|---|---|
| **1.** Creo en la existencia de la percepción extrasensorial (PES) | | | |
| **2.** Creo que he tenido una experiencia personal de PES | | | |
| **3.** Creo que soy psíquico o médium | | | |
| **4.** Creo que es posible adquirir información de una situación del futuro antes de que ésta ocurra, que no dependa de la predicción racional o los canales sensoriales normales | | | |
| **5.** He tenido alguna vez una corazonada que se hizo realidad y que no se debió a una coincidencia | | | |
| **6.** He tenido alguna vez una premonición acerca del futuro que fue verdadera y que no fue una coincidencia | | | |
| **7.** He tenido alguna vez un sueño que fue verdadero y que no fue una coincidencia | | | |
| **8.** He tenido alguna vez una visión que no era una alucinación y de la cual he recibido información que no pude haber tenido en ningún otro momento ni en ningún otro lugar | | | |
| **9.** Creo que hay vida después de la muerte | | | |
| **10.** Creo que algunas personas pueden conectarse con los espíritus de los muertos | | | |
| **11.** Creo que es posible adquirir información de los pensamientos, sentimientos o circunstancias de otras personas, que no dependa de la predicción racional o los canales sensoriales normales | | | |
| **12.** Creo que es posible enviar un «mensaje mental» a otra persona, o influir de alguna manera a otro a distancia, por medio de otros canales de comunicación | | | |
| **13.** Creo que he tenido alguna vez una experiencia de telepatía con otra persona | | | |
| **14.** Creo que la mente puede influir sobre un sistema físico, sin la mediación de energía física conocida | | | |
| **15.** Estoy convencido de que en alguna ocasión mi mente ha influido sobre un sistema físico, sin la mediación de energía física conocida | | | |
| **16.** Creo que poseo habilidades psíquicas para influir sobre un sistema físico, sin la mediación de energía física conocida | | | |
| **17.** Creo que en alguna ocasión un evento físico inexplicable (pero no persistente) ha ocurrido en mi presencia | | | |
| **18.** Creo que algunas perturbaciones físicas persistentes e inexplicables, han ocurrido en mi presencia alguna vez en el pasado (p. ej. un poltergeist) | | | |

*Designed by Álex Escolà-Gascón



**Título del test:** *Australian Sheep-Goat Scale* (ASGS) | Escala Australiana de Ovejas-Cabras o Creencias Paranormales | **Año:** 2020
**Autor original:** Michael A. Thalbourne†, *University of Adelaide*, Australia (elaboración y validación entre 1981-1991).
**Autores de la adaptación española:** **Álex Escolà-Gascón**, Universidad Ramón llull, Barcelona, España | **Lance Storm**, School of Psychology, University of Adelaide, Australia.