
# Tesis Doctoral

## Neurociencia Cognitiva:

## Diferencias entre distintas poblaciones en tareas de toma de deciones

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# UNIVERSIDAD DE GRANADA

## Departamento de Psicología Experimental


**Tesis doctoral**

**NEUROCIENCIA COGNITIVA: DIFERENCIAS ENTRE DISTINTAS POBLACIONES EN TAREAS DE TOMA DE DECISIONES**

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# "Neurociencia cognitiva: Diferencias entre distintas poblaciones en tareas de toma de decisiones"

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## Estudios sobre diferencias de edad



## Estudios sobre diferencias de género



## Estudio de Salto a conclusiones en esquizofrenía

## PREFACIO

Los capítulos que contienen esta tesis son diferentes artículos de investigación que han sido aceptados o enviados a diferentes revistas científicas. Aunque corresponde a una tesis en formato clásico, cada capítulo puede leerse independientemente. El objetivo principal es estudiar las diferencias existentes entre distintas poblaciones en la toma de decisiones y una mejor comprensión de los mecanismos que subyacen a esa toma de decisiones, fundamentalmente en relación a la ideología política. Por ello, recopilamos múltiples estudios llevados a cabo con distintas poblaciones (ancianos versus jóvenes; conservadores vs. liberales; creyentes vs. no creyentes; hombres vs. mujeres; pacientes esquizofrénicos vs. controles…etc.) en el marco de la toma de decisiones aunque centrándonos en el estudio de los sesgos cognitivos (tareas sobre salto a conclusiones, sobre sesgo contra la evidencia desconfirmatoria o a favor de la evidencia confirmatoria, toma de riesgos, impulsividad…), pero concentrándonos más detenidamente en el estudio del sesgo cognitivo "Salto a conclusiones", a través, de una tarea modificada con respecto a la tarea original llamada "Drawing Decision Task" (DDT o PDT en español) de Moritz y Woodward (2006). Nuestra tarea modificada lo que añade son nuevos parámetros como son la Exactitud de respuesta y la Sensibilidad al Feedback.

Debemos destacar que la investigación sobre toma de decisiones es un inmenso océano, donde la diversidad de modelos explicativos, enfoques posibles, tareas de decisión, poblaciones diana posibles (pacientes psicóticos, consumo de sustancias, normales en diferentes situaciones de riesgo o juego…) y tipos de decisiones o factores de influencia (conscientes e inconscientes) son ilimitados. Para evitar "perdernos desde el principio" en este océano, decidimos usar una brújula, la de nuestra intuición, siguiendo a Damasio y su idea de los marcadores somáticos. Nuestra intuición nos dice

que el cerebro es un dispositivo de contraste de hipótesis o de comparación entre expectativas y datos o feedback sensorial pero imperfecto, con sesgos en su funcionamiento. Estábamos de acuerdo en mostrar más interés en la experimentación que en la teorización, así que nuestra exploración, comienza precisamente, de un modo humilde eso sí, tomando decisiones sobre la población diana y sobre el tipo de tarea experimental a utilizar para medir el proceso de decisión. Buscamos un paradigma experimental ecológico, que nos aproximase a nuestras intuiciones de investigación sobre la toma de decisiones.

De otro lado, teníamos también el problema de por quién empezar, a qué población aplicar nuestra tarea. Habitualmente ha sido aplicada a esquizofrénicos y puede que alguien piense que este sesgo cognitivo es propio de ellos y que está relacionado exclusivamente con sus alucinaciones. Hay autores que piensan que es un juicio clínico o un marcador de predisposición a la esquizofrenia. Nosotros estamos interesados en mostrar que no es así, que todos "alucinamos todo el rato" (no sólo mientras soñamos): Alucinar es no confrontar las hipótesis con los datos. Una población a priori de personas normales o población no clínica, pero que no deja que la realidad estropee sus interpretaciones de la realidad es la clase política (bien se autoengañan o engañan a los demás), tan solo los creen a pies juntillas sus seguidores o personas con una ideología congruente que tienden a no ver sino lo que les interesa ver o quieren creer, que lo bueno es atribuible a su partido y lo malo al partido opuesto, y a no castigar a políticos que hacen mala gestión, son corruptos o incompetentes. La ideología nos ciega, tal vez tenga que ver con nuestra irracionalidad, con ponernos una venda en los ojos o con nuestro miedo a la incertidumbre. Por eso decidimos empezar utilizando la Pictures Decisión Task modificada en políticos, bueno en seguidores políticos, en función de la ideología, para ver si muestran el sesgo cognitivo salto a conclusiones.

Esto es, no queremos engañar al lector, el orden de la tesis corresponde a los pasos reales que hemos dado en función de nuestros intereses y no obedece a una lógica falsa aplicada a posteriori que nos ha llevado a reconstruir la serie experimental en un orden diferente al que ocurrió en realidad. Bueno, nos movemos entre estas dos opciones intentando no sacrificar el orden real ni tampoco hacer el hilo argumental difícil de seguir (lo explicamos para cada capítulo en su comienzo). Por eso nuestra introducción comienza con una entrada muy genérica al campo de estudio sobre la toma de decisiones. En la segunda parte nos centramos en la descripción de los sesgos cognitivos y de la tarea DDT usada en nuestra investigación. En esta parte nos enfocamos especialmente en los sesgos: salto a conclusiones, BADE (Bias Against Disconfirmatory Evidence en inglés) y BACE (Bias Against Confirmatory Evidence en inglés). Por último, realizamos una descripción de nuestra población diana inicial (la ideología política). Una revisión de las principales diferencias entre conservadores y liberales, y una explicación de cómo estas diferencias nos llevaron a pensar que los conservadores reproducirían el sesgo salto a conclusiones.

Sin embargo, como iremos contando capítulo a capítulo, no sólo utilizamos esta tarea ni sólo nos centramos en esta población, sino que a continuación nuestros intereses se extienden a otras tareas y poblaciones, hasta un cierto punto, pues nuestra investigación continua hoy día, ramificándose,con estudios sobre sesgos en el diagnóstico mèdico o en la investigación científica. Esta es la razón de un título tan general para la tesis.

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# INTRODUCCIÓN

## 1.1. EL ESTUDIO DE LA TOMA DE DECISIONES

La toma de decisiones es una función esencial en la vida cotidiana de cualquier individuo. Como seres humanos, constantemente, a lo largo de nuestra vida, tenemos que decidir entre diferentes actividades (ocupacionales, recreativas, políticas, económicas, familiares…), ya sean transcendentales (como puede ser elegir una carrera o casarnos) o intrascendentales (por ejemplo, decidir cómo se quiere un café o el color de la ropa).

Desde el nacimiento de la psicología y la neurociencia, los investigadores han estudiado exhaustivamente la toma de decisiones para intentar comprender los procesos psicológicos que subyacen a esta. La toma de decisiones es un proceso cognitivo de evaluación y selección sobre un conjunto de opciones, con el fin de satisfacer una serie de objetivos (económicos, morales, políticos, religiosos, sexuales... ).

De acuerdo con Ernst y Paulus (2005), en la toma de decisiones existen tres procesos independientes que se combinan para llevar a cabo una decisión. Estos tres procesos serían: evaluación de los estímulos u opciones; selección o ejecución de una acción y evaluación de la experiencia obtenida o evaluación de las consecuencias de las elecciones seleccionadas.

Cada uno de estos procesos podría estar afectado diferencialmente por varios factores psicológicos. Por ejemplo, la mayoría de las distintas alternativas a elegir estarían ligadas explícita o implícitamente a consecuencias positivas y/o negativas, que podrían convertirse en una realidad a corto o largo plazo. La toma de decisión derivaría de una evaluación emocional de las consecuencias futuras de las posibles opciones de conducta, a través de un análisis de costes y beneficios (Bechara y cols., 2000).

El proceso de toma de decisiones se ha estudiado ampliamente en distintas poblaciones, tanto clínicas como no clínicas: Por ejemplo, se ha estudiado en pacientes con daño cerebral (Bechara y cols., 1994; Bechara y cols., 1997), en pacientes adictos a drogas (Bolla y cols., 2003), en pacientes con trastornos psicológicos (Moritz y cols., 2007; Fear y cols., 1997), en adolescentes (Lejuez ycols., 2003), en ancianos (Denburg, y cols., 2005), en hombres y mujeres (Bolla y cols., 2004), en personas con distinta ideología política (Shook y Fazio, 2009; Westen y cols., 2006), con distinta creencia religiosa (Harris y cols., 2009), se han examinado posibles asociaciones entre rasgos de personalidad y toma de decisiones (Davis y cols., 2007), etc.

Para el estudio sobre toma de decisiones se han diseñado distintas tareas dependiendo de lo que se quería estudiar. Por ejemplo, para el estudio de la impulsividad tenemos la famosa Iowa Gambling Task (Bechara y cols., 1994), En esta tarea el participante debe intentar ganar tanto dinero como sea posible. La tarea consta de cuatro barajas, dos conservadoras y dos arriesgadas. Al participante se le explica que cuando coja una carta ganara dinero, pero que a veces, también perderá. Las barajas conservadoras te dan menos dinero, pero cuando pierdes, el castigo es menor. Las barajas arriesgadas te dan más dinero, pero cuando pierdes, el castigo es mayor. La tarea ha sido diseñada para examinar los mecanismos implícitos que gobiernan las elecciones individuales en los contextos de recompensa y castigo. Ver la figura 1.

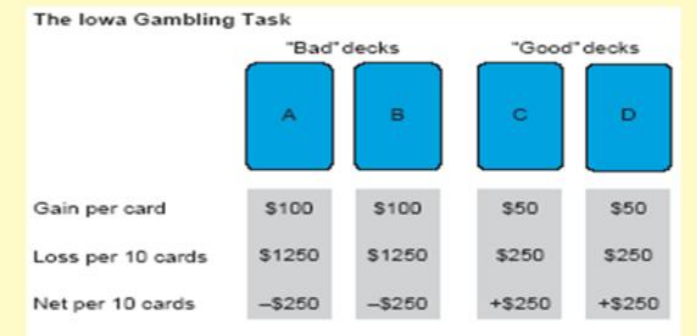


*Figura 1*. Iowa Gambling Task

Otra tarea conocida sobre toma de decisiones es la Ballon Analogue Risk (BART, Lejuez y cols., 2002) que mide la conducta de riesgo. La toma de riesgos es un proceso relacionado, pero distinto fenomenológicamente al de la impulsividad. En la tarea, al participante se le presenta un globo con el que puede ganar dinero, mediante el bombeo de este apretando un botón. Cada clic hace que el globo se infle de forma incremental y se vaya ganando más dinero. Sin embargo, llegado a un punto el globo explota. Si el participante ha guardado su dinero antes de que explote el globo, se mantiene ese dinero para el siguiente globo. Ahora bien, si el sujeto no lo ha guardado, lo pierde. Cada bombeo implicaría un riesgo pero también una posible recompensa. Ver la figura 2.

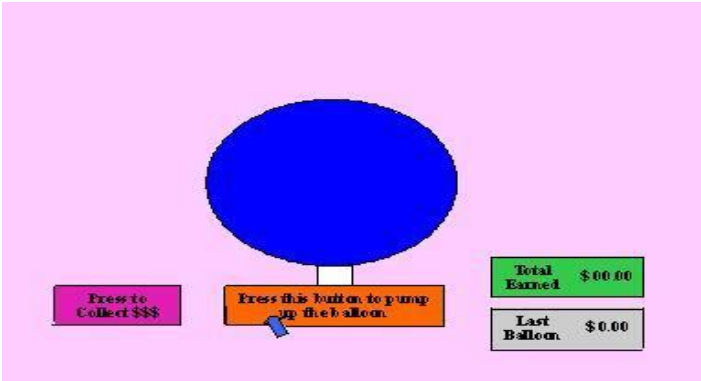


*Figura 2*. Ballon Analogue Task

Un ejemplo del estudio de toma de decisiones usando esta tarea es el de Lejuez y cols., (2003). Estos autores encontraron en adolescentes que un menor riesgo en el BART, estaba relacionado con la percepción de conductas de asunción de riesgo en la vida real. Además, estos mismos autores encontraron en otro estudio que el comportamiento en el BART estaba relacionado con el consumo de tabaco (Lejuez y cols., 2003).

El estudio de los procesos subyacentes a la toma de decisiones ha estado dominado generalmente por teorías económicas. Prueba evidente de ello son los distintos modelos en donde la persona sopesa los costes y beneficios de su acción.

Los modelos computacionales de toma de decisiones se pueden clasificar en tres modelos principales: a) *modelos conexionistas* (la toma de decisiones se basa en "la acumulación de la evaluación afectiva producida por cada acción" (Busemeyer y Johnson, 2004) hasta que un umbral se cumple); b) *modelos probabilísticos* (se centran principalmente en la toma de decisiones en condiciones de incertidumbre, en donde se llevan a cabo inferencias probabilísticas, por ejemplo, Dougherty y cols., 1999); c) *modelos cualitativos* (estos modelos tienen en común un método para representar los grados de preferencias, creencias y objetivos en medidas cualitativas, por ejemplo, Pearl, 2000).

**Estudios en neurociencia**

Centrándonos en la investigación neurocognitiva, los estudios de neuroimagen han establecido una red neuronal que estaría implicada en la toma de decisiones. Esta red neuronal estaría distribuida en las regiones corticales y subcorticales (corteza orbitofrontal, corteza cingulada anterior, corteza prefontal dorsolateral, tálamo, corteza parietal, y caudado (Ernst & Paulus, 2005; Krain, Wilson, & Arbuckle, 2006). La toma de decisiones que implican ambigüedad se asociarían con la actividad en la corteza prefrontal dorsolateral (DLPFC), la corteza cingulada anterior (ACC) y la corteza parietal. La toma de decisiones que implican toma de riesgos se asociarían con actividad en porciones rostrales de la corteza orbifrontal (OFC), la ACC y la corteza parietal (Krain, Wilson, & Arbuckle, 2006). Ver la figura 3.

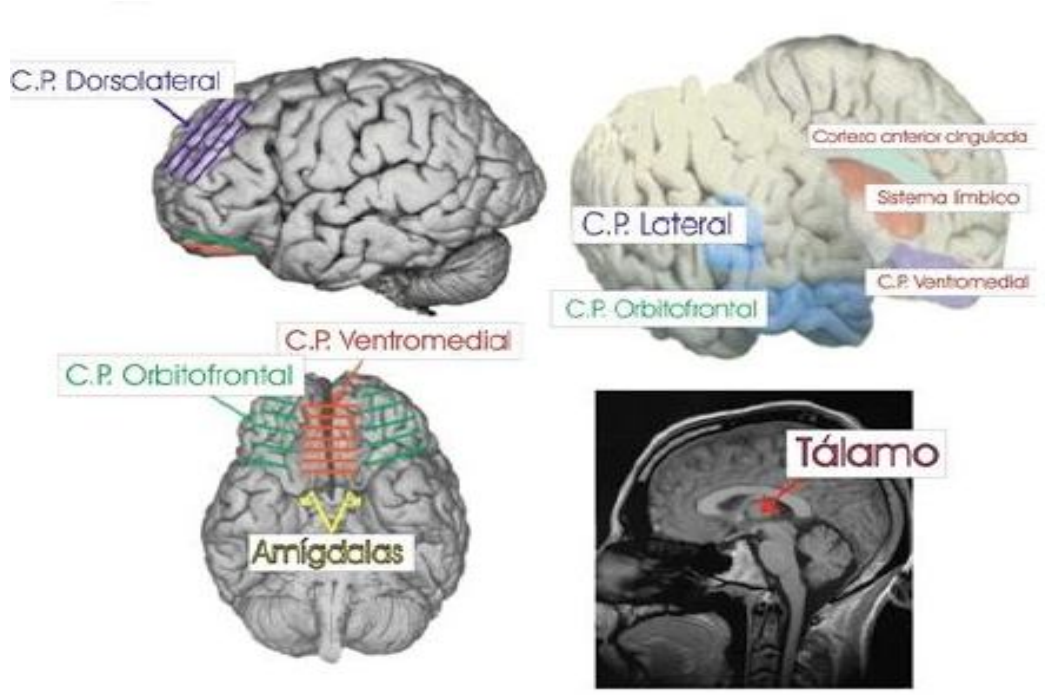


*Figura 3*. Áreas implicadas en la toma de decisiones

Diversos estudios indican que la corteza orbifrontal (OFC) podría ser esencial en el proceso de toma de decisiones. La OFC estaría implicada en el procesamiento y evaluación de información emocional y social. Estudios neuropsicológicos apoyan la implicación de esta en la representación de información sobre incentivos (Elliott y cols., 2000). Es más, en estudios con poblaciones que tienen un empobrecimiento en su toma de decisiones se observan anormalidades en la OFC (Bechara y cols., 1997; Bolla y cols., 2003). Por ejemplo, en los estudios de Bechara y colaboradores encontraron que los adultos con daños en las regiones orbitofrontales mostraban déficits en la toma de decisiones (Bechara y cols., 1997; Bechara, y cols., 1996). La habilidad de la corteza orbifrontal para interpretar las propiedades emocionales de los estímulos es el núcleo de la conocida teoría de toma de decisiones de Damasio (1994), la llamada teoría del marcador somático.

Según Damasio (1994), decidir y actuar en un contexto social no puede separarse de nuestra habilidad para evaluar y procesar la información emocional de las señales sociales, que nos proveen una retroalimentación emocional. El mecanismo que provee una métrica común para evaluar las opciones con respecto a su potencial beneficio es el marcador somático. Damasio y colaboradores, observaron que los pacientes con daño en la corteza prefrontal ventromedial podían detectar las implicaciones de una situación social, pero no podían tomar decisiones adecuadas en la vida real. Un ejemplo es el caso de Elliot, un paciente con daño prefrontal ventromedial que tenía intactas las capacidades cognitivas, el conocimiento y acceso a las reglas sociales. Sin embargo, Elliot era ineficaz socialmente e incapaz emocionalmente de gestionar sus asuntos y de seleccionar la acción más ventajosa en su vida personal. El caso de Elliot llevó a considerar que la falta de emoción podría ser la responsable de una toma de decisiones empobrecida y de un comportamiento irracional. Estos autores sugirieron que estos pacientes no podían tomar decisiones adecuadas, debido a que, carecían de la señal que nos ayuda a distinguir automáticamente las desventajas de las acciones perniciosas. El modelo del marcador somático viene a ser una explicación de porqué los pacientes con daño en la corteza prefrontal ventromedial pueden todavía razonar sobre los problemas sociales, pero fallan cuando se encuentran en un ambiente natural.

Un estudio llevado a cabo con la Iowa gambling task (IGT) que apoya esta teoría, es el realizado por Bechara y colaboradores (1994). Los resultados del estudio demostraron que los individuos sanos desarrollaban una respuesta de conductancia galvánica anticipatoria cuando ellos pensaban elegir una carta de la baraja arriesgada. Debido a ello, comenzaban a elegir la baraja conservadora, antes de que fuesen conscientes de la estrategia buena. Sin embargo, los pacientes con daño en el prefrontal

ventromedial tendían a elegir cartas de las barajas arriesgadas. Estos pacientes no tenían estas respuestas autonómicas anticipatorias, es decir, tenían una incapacidad para anticipar las emociones asociadas a las acciones. Esto producía que la acción asociada a una emoción aversiva, se realizaba. Como consecuencia, perdían una mayor cantidad de dinero. Los pacientes se comportaban como si fuesen insensibles a las consecuencias futuras, negativas o positivas, guiándose prioritariamente por la recompensa inmediata. Es decir, el marcador somático no regulaba la conducta de ellos.

Esta línea de trabajo es compatible con los efectos contextuales. Además, integra cognición y emoción, permite hacer predicciones que pueden ser medidas y ha sido sostenida por datos neuropsicológicos y clínicos. Podemos concluir que el marcador somático se establece como una guía que nos ayuda en la toma de decisiones y conductas sociales.

## 1.2. SESGOS COGNITIVOS

*¿A quién va usted a creer, a mí o a sus propios ojos?*

**Groucho Marx**

Las personas a lo largo de nuestra vida tomamos una gran cantidad de decisiones, muchas de ellas basadas en la duda, el conflicto o la incertidumbre. La información que tenemos para tomar cada una de nuestras decisiones es de suma importancia. En base a esta información podremos tomar decisiones con total certeza o no, o bajo riesgos. Un sesgo cognitivo es un patrón de desviación en el juicio, en el que las inferencias que hacemos acerca de otras personas y/o situaciones, pueden ser ilógicas (Haselton y cols., 2005). Los sesgos cognitivos pueden llevarnos a una distorsión perceptual, a hacer un

juicio inexacto, o una interpretación ilógica. Estos sesgos están influenciados por varios factores (contextuales, motivacionales, sociales…) y muchos de ellos cumplen un papel adaptativo. Por ejemplo, llegamos a casa y nos encontramos la puerta abierta, seguramente pensaremos que algún extraño ha entrado, cuando lo más probable sea que nos hayamos dejado la puerta abierta. Aunque, esta deducción no es la más probable, sí es la más eficaz, ya que, nos alerta de un posible peligro. Este sesgo cognitivo nos permitiría tomar una decisión más rápida cuando lo más importante no es la precisión. Ahora bien, los sesgos cognitivos se pueden producir simplemente por las propias limitaciones de procesamiento de información del cerebro (Simon, 1955), o ser debidos a la influencia social (Wang y cols., 2001), a las distintas motivaciones morales o sociales de la persona (Pfiste y cols., 2008) o debidos a procesamientos heurísticos (Kahneman & Tervsky, 1972). Es por todo ello que el estudio de los sesgos cognitivos es de gran relevancia, porque nos ayuda a entender mejor los procesos psicológicos llevados a cabo en la toma de decisiones, además de las posibles implicaciones prácticas en distintas áreas sociales, políticas, económicas….(Kahneman, 2011).

Las teorías clásicas sobre toma de decisiones basadas en teorías económicas muestran a los seres humanos como seres racionales que evalúan exhaustivamente las diferentes opciones antes de realizar una elección. Por ejemplo, cuando jugamos al póker el cálculo de posibilidades es básico para poder ganar. Sin embargo, uno no puede pensar siempre un valor objetivo para cada una de las alternativas que tenemos. En base a estas limitaciones, Kahneman y Tervsky en los años setenta introdujeron un nuevo enfoque sobre heurística y sesgo, revolucionando el estudio de este campo. Para estos autores, cuando una persona debe tomar una decisión bajo incertidumbre, resuelve está basándose en un conjunto de heurísticos, más que a través de un razonamiento algorítmico. Los procedimientos heurísticos son juicios intuitivos basados en la

experiencia, conocimiento parcial, son suposiciones que pueden ser o no correctas. Kahneman y Tervsky demostraron que los juicios humanos a menudo se apartan de los estándares normales de probabilidad o simple lógica.

Los individuos emplean un número limitado de heurísticos, los cuales reducen la compleja tarea de medir la probabilidad y predicen valores que simplifican estos juicios (Tervsky y Kahneman, 1974). Dentro de su enfoque, describieron tres tipos generales de heurísticos: la accesibilidad, la representatividad y el anclaje o ajuste.

La accesibilidad vendría dada cuando se evalúa la frecuencia de una clase o la probabilidad de un acontecimiento según la facilidad con la que logra evocarse. Es decir, recordaríamos más fácilmente los eventos que ocurren con mayor frecuencia que los que no, aunque no siempre sea así (Tversky & Kahneman, 1974). La representatividad se usaría cuando se juzga la probabilidad de que personas, cosas o situaciones pertenezcan a misma categoría o clase. Por ejemplo, estos autores presentaron a distintos sujetos una descripción de la personalidad de una mujer tal como esta: "Linda tiene 31 años, es soltera, sincera y muy brillante. Se especializo en filosofía. Como estudiante, estaba profundamente preocupada por temas de discriminación y justicia social y participaba en demostraciones antinucleares". Posteriormente los sujetos debían decidir cuál era la opción más probable a) Linda era cajera de un banco o b) Linda era cajera de un banco y activista del movimiento feminista. Aunque las dos opciones eran igual de probables, los sujetos elegían entre un 80% y 90% la opción b. La descripción de Linda era representativa de una feminista, es por ello, que los sujetos elegían más la opción b que la a simplemente. Denominaron a este efecto como la "conjunción de la falacia" (Tversky & Kahneman, 1983). Los estereotipos pues entrarían dentro de este tipo de sesgos (Worchel y cols., 2002).

Y por último, el anclaje se emplearía en la predicción numérica cuando un valor relevante está disponible. Puede verse un ejemplo de este en un estudio de Tversky & Kahneman (1982). En el experimento a los sujetos se les pedía que intentaran estimar en sólo 5 segundos cuál era el resultado de una multiplicación presentada de manera secuencial. El grupo a debía calcular 1x2x3x4x5x6x7x8 y el b, 8x7x6x5x4x3x2x1. Aunque la multiplicación era la misma, el grupo b daba una estimación mayor, debido a que los sujetos se anclaban en los primeros números.

Todos estos datos nos llevan a la conclusión de que los heurísticos serían atajos mentales que nos proporcionan estimaciones rápidas, las cuales, suelen ser muy eficaces pero que muchas veces nos llevan a equivocarnos (Kahneman y Tervsky, 1974).

El estudio de las diferencias de las dos formas de pensamiento (intuición y razonamiento) se ha visto ampliado en los últimos años (Jacoby, 1981, 1996; Chaiken y Trope, 1999; Myers, 2002). En 2002, Kahneman & Frederick formularon la Teoría de las Perspectivas, la cual, postula que hay dos sistemas (llamados 1 y 2) responsables que guían la toma de decisiones. En la actualidad, existe un considerable consenso sobre las características que distinguen estos dos tipos de procesos cognitivos (Stanovich y West, 2000).

El sistema 1 permite la formulación de juicios intuitivos. Las operaciones del Sistema 1 son rápidas, automáticas, se realizan sin esfuerzo a partir de asociaciones, y son difíciles de controlar o modificar. Por otro lado, el sistema 2 incluye a los juicios controlados conscientemente, a los razonamientos deliberados y de tipo secuencial. Las operaciones del Sistema 2 son más lentas, seriales, se realizan con esfuerzo, y están controladas deliberadamente, además son relativamente flexibles y pueden ser controladas por reglas potenciales.

El sistema perceptivo y el Sistema 1 generan impresiones no voluntarias de los atributos de los objetos percibidos y pensamientos. Y el sistema 2 está implicado en todos los juicios, tanto si proceden de las impresiones como del razonamiento deliberado. Es decir, el Sistema 2 monitorea en mayor o menor medida las impresiones que genera el Sistema 1. Sin embargo, el sistema 2 es lo suficientemente laxo como para que muchos de los juicios intuitivos sean expresados aunque sean erróneos. Siguiendo esta línea, Kahneman (2002) ponen de manifiesto que las personas también usan atajos heurísticos afectivos para asumir riesgos o realizar elecciones conservadoras. Las reacciones afectivas permitirían que los heurísticos se hiciesen accesibles, generando impresiones que condicionarían al sistema 2 a la hora de formar juicios o tomar decisiones. Además, en un estudio de Tervsky y Kahneman (1981) observaron que los individuos en situaciones de incertidumbre en los que se destacaban las ganancias tendían a evitar elecciones riesgosas. Y al revés, cuando se destacaban las pérdidas tendían a asumir riesgos. La aversión por las pérdidas era más potente que la atracción por las ganancias. Este efecto desaparecía si las ganancias o pérdidas eran pequeñas (Kahneman y cols., 1993).

Estos estudios hablan de sesgos cognitivos en población normal. Sin embargo, diversos estudios han asociado diferentes sesgos cognitivos a la presencia de delirios y alucinaciones en pacientes esquizofrénicos (Moritz & Woodward, 2006; Moritz y cols., 2007). Ahora bien, que ocurriría si estos sesgos no fueran tan específicos de estas poblaciones y se diesen en personas sanas. Es una de las dudas que intentaremos esclarecer a lo largo de nuestro trabajo. Ver la Figura 4.

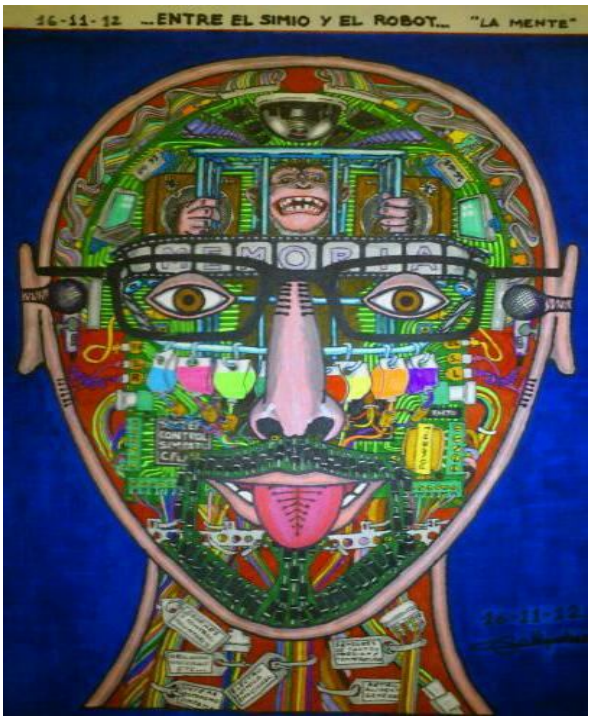


*Figura 4*. Entre el simio y el robot "La Mente" (Dibujo de Francisco Riquelme): Como el autor ve la toma de decisiones humana.

**Sesgos cognitivos: "Salto a conclusiones", BADE (Bias Against Disconfirmatory Evidence en inglés) y BACE (Bias Against Confirmatory Evidence en inglés)**

Estos tres sesgos cognitivos han sido ampliamente estudiados en el campo de la esquizofrenia (Moritz & Woodward, 2006; Moritz y cols., 2007).

El sesgo cognitivo "Salto a Conclusiones" consiste en tomar una decisión precipitadamente aun cuando hay poca evidencia para tomarla (Huq y cols., 1988). Para examinar este sesgo cognitivo se han usado tareas con paradigmas de razonamiento probabilístico (Phillips y Edwards, 1966). Dentro de estas tareas, la más conocida es la "tarea de las jarras". En esta tarea al participante se le muestra dos recipientes (A y B) que contienen bolas de dos colores diferentes en una proporción determinada, por ejemplo 70/30%. A los participantes se les informa de tal proporción y se retiran los

recipientes. Estos deben decidir en que recipiente se encuentra la proporción mayor de bolas, es decir, tienen que llevar a cabo juicios de probabilidad sobre la proporción de esas bolas. La tarea lo que mide es el número de bolas que el participante necesita para tomar una decisión, y la probabilidad estimada de hacer una elección correcta.

Por otra parte, el sesgo en contra de la Evidencia Desconfirmatoria (BADE) es un sesgo cognitivo, en donde la persona, independientemente de la información inconsistente, mantiene dicha creencia o hipótesis a pesar de las evidencias contrarias. Y al revés, en el sesgo en contra de la Evidencia Confirmatoria (BACE), la persona, independientemente de la información inconsistente, mantiene dicha creencia o hipótesis debido a las evidencias a favor de esta (Moritz y Woodward, 2006). Por ejemplo, en derecho se debe demostrar que la persona es culpable no que es inocente. En el caso de Rocío Baninkof debía decidir este supuesto un jurado popular. Este jurado debía realizar un adecuado contraste de hipótesis, sin embargo, rechazaron la información incongruente con su prejucio y le dieron gran peso a los indicios confirmatorios. Como consecuencia, declararon a una persona culpable cuando era inocente.

A través de distintos estudios se han observado consistentemente estos tres sesgos en pacientes esquizofrénicos, sobre todo, en aquellos que tienen alucinaciones (Moritz & Woodward, 2006; Moritz y cols., 2007). Además, estos sesgos cognitivo también se ha estudiado en otras poblaciones ya sean clínicas (Fear y cols., 1997) o no clínicas (Freeman y cols., 2008; Mckay y cols., 2006; Lincoln y cols., 2011; Lee y cols., 2011; Buchy y cols., 2007). En la literatura científica hay una hipótesis que intenta explicar estos sesgos cognitivos. La "hipótesis de la aceptación liberal" formulada por Moritz y Woodward (2004), asume que estos sesgos se deben a un bajo umbral de aceptación. Los sujetos necesitarían poca información para tomar una decisión. Además,

encontramos otra segunda hipótesis que intentaría explicar el salto a conclusiones, la cual, sostiene que estos sujetos sobrestimarían la certeza de sus elecciones al inicio del proceso de decisión (Hulq y cols., 1988). Actualmente, la relación entre estos sesgos cognitivos no está esclarecida, ni hay un consenso mayoritario, siendo una cuestión abierta y compleja. Por lo tanto, no queda claro si estos sesgos de razonamiento son independientes o comparten bases comunes (Munz, 2011). Según Munz (2011) el salto a conclusiones jugaría un papel facilitador en la formación de nuevos sistemas delirantes, y BADE.

En los capítulos 3, 4, 7, 8, 10 de este trabajo se estudiará estos sesgos cognitivos en distintas muestras poblacionales tanto clínicas (pacientes con esquizofrenia) como no clínicas (individuos con ideología conservadora vs. liberal, con creencia en Dios vs. no creyentes, hombres vs. mujeres, ancianos vs. jóvenes) en una nueva versión de la tarea probabilística BADE (Bias Against Disconfirmatory Evidence, en inglés; Moritz & Woodward, 2007; Rubio y cols., 2011). En nuestra tarea el participante tiene que acertar cual es el dibujo que se va formando durante ocho etapas. El dibujo es cada vez menos ambiguo debido a la disminución de grados de fragmentación visual. Dentro de los estímulos se distinguen dos tipos. Por un lado, tenemos los estímulos que dan posibles alternativas sobre la identidad del dibujo. Y por otro lado, tenemos los estímulos que no dan ningún tipo de alternativas en donde el sujeto debe hacer sus propias interpretaciones. En nuestra tarea, las etapas del dibujo no se interrumpen aunque el sujeto haya pulsado que está totalmente seguro antes de la última etapa. Además, conceptualmente hemos divido la tarea en dos partes: las cuatro primeras etapas, en donde, dominan los elementos formales del dibujo (círculos, líneas, etc....). En esta etapa sólo se puede desarrollar hipótesis interpretativas. Y las cuatro últimas etapas, en donde, el dibujo empieza a perfilarse, y la suma de nuevos elementos actúa como

retroalimentación sobre la respuesta anterior. Además de los parámetros clásicos (índice de plausibilidad y de llegada a una decisión, BADE/BACE), esta división nos permitió calcular nuevos parámetros, en concreto, el número de respuestas correctas en la etapa 8 y la sensibilidad a la retroalimentación. Este último parámetro se define como el número de errores frente al número de hipótesis erróneas realizadas en las últimas cuatro etapas. Nos viene a mostrar si la persona cuando se da cuenta de su equivocación cambia su hipótesis cuando recibe nueva información o reitera su respuesta errónea. Cuánto menor es el índice de sensibilidad a la retroalimentación, más utiliza el individuo la retroalimentación, ya que, es más sensible a ella. Ver la Figura 5.

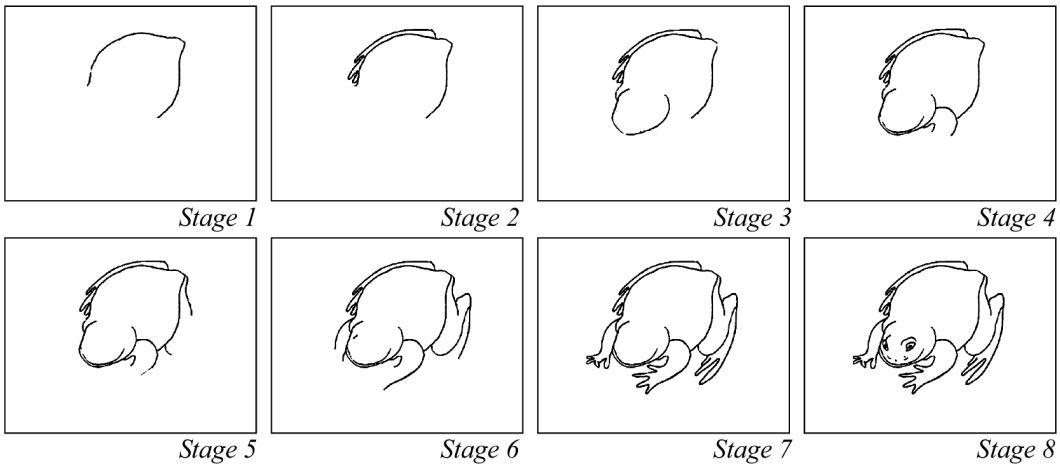


*Figura 5*. Ejemplo de uno de los 10 dibujos de la tarea de decisión de dibujos.

Nosotros elegimos esta tarea porque nos daba una gran oportunidad de estudiar más exhaustivamente estos sesgos y entender mejor los mecanismos subyacentes a estos. Basándonos en estudios previos, en los capítulos 3 y 4 quisimos estudiar si existían diferencias entre conservadores versus liberales y creyentes vs. no creyentes con respecto a estos tres sesgos cognitivos. En diversos estudios se habla de diferentes estilos cognitivos y se observa que los conservadores/creyentes muestran gran "necesidad de cierre cognitivo", es decir, una mayor intolerancia a la ambigüedad (por

ejemplo, Jost y cols., 2003; Amodio, y cols., 2007; Inzlicht y cols., 2009). Una necesidad de cierre que ha sido relacionada con el sesgo “salto a conclusiones”. (Moritz y cols., 2007).

En el capítulo 7 comparamos a través de la ejecución de distintas tareas, la toma de decisiones y la sensibilidad a la retroalimentación en ancianos sanos versus jóvenes. Nos basamos en una gran variedad de estudios que han evidenciado diferencias en la toma de decisiones en ancianos, debido al deterioro cognitivo que se ha producido con la edad (Wild-Wall, Hohnsbein, & Falkenstein, 2007). Pero como ya dijimos en el prólogo, nuestra primera población diana fueron las personas con una ideología política clara. No obstante, hay correlaciones significativas entre ideología, creencias religiosas y edad.

En el capítulo 8 comparamos las diferencias de género ante el sesgo salto a conclusiones y su posible relación con las actitudes de riesgo. Diversos estudios sobre asunción de riesgo habían evidenciado una tendencia de los hombres a tomar mayores conductas de riesgo que la mujeres (por ejemplo, Byrnes y cols., 1999; Mittal & Vyas, 2011). Además estábamos interesados en averiguar si está tendencia podría llevar a los hombres a tomar decisiones equivocadas, es decir, a cometer un mayor número de errores. Siguiendo a este y otros estudios sobre diferencias de género realizamos otro estudio (capítulo 9) sobre diferencias de género ante la risa que produce las cosquillas. La cuestión es que las cosquillas (sobre todo las autocosquillas) se han vinculado a los delirios esquizofrénicos y a la destrucción del mecanismo comparador o mecanismo de la agencia (Blakemore y cols., 2000) que funciona como un mecanismo de contraste de hipótesis motrices, que compara la orden eferente con la reaferencia sensorial y desata las cosquillas cuando las expectativas motoras no se cumplen o ambas ordenes (eferencia y reaferencia) no se emparejan. Esto es similar a lo que ocurre en la PDT y en

los sesgos cognitivos que estudiamos como el JTC o BADE: se estudia el emparejamiento entre hipótesis o expectativas y datos o retroalimentación sensorial. Es curioso cómo tanto las cosquillas como estos sesgos cognitivos se convierten en objeto de estudio científico por su manifestación en la esquizofrenia, para más tarde descubrir que hay un continuum o una línea mental entre los llamados normales y la psicosis, como indican los modelos dimensionales de la esquizofrenia (Buchy, Woodward y Liotti, 2007). En esta tesis, vamos a estudiar este continuum en las cosquillas también. Empezamos estudiando si las personas con alta esquizotipia podían hacerse cosquillas a sí mismos como los esquizofrénicos con delirios de pasividad (Blakemore y col., 2000), con la lógica de que la esquizotipia es cuantitativamente distinta pero cualitativamente igual a la esquizofrenia, pero no obtuvimos resultados significativos. Por otro lado, las cosquillas implican una decisión (que puede discutirse si es inconsciente o consciente, voluntaria o no), la de reírse. Por eso vamos a estudiar la risa de las cosquillas.

Por último, en el capítulo 10 llevamos a cabo un estudio control de salto a conclusiones, en pacientes con esquizofrenia pero añadiendo como novedad la relación de este sesgo con el índice de sensibilidad a la retroalimentación, es decir, quisimos averiguar si la retroalimentación era una variable más que influía en este sesgo cognitivo y su nexo de unión con otro sesgo cognitivo: el sesgo contra la evidencia desconfirmatoria (BADE). Ambos están presentes en la esquizofrenia con síntomas positivos. Los modelos dimensionales de la esquizofrenia proponen que hay un factor común subyacente a los sesgos cognitivos y que descubrirlo puede conducirnos a un marcador de riesgo o a un predictor de un primer episodio psicótico.

Los capítulos 5 y 6 son estudios cerebrales sobre la voz interna y sobre las creencias religiosas (hablar con seres reales e imaginarios). La razón de incluirlos es que cada subserie (en este caso la de creencias religiosas que empieza en el capítulo 4) tiene

su propia razón de ser y despierta nuestra curiosidad, llevándonos a crear una rama nueva en nuestro propio árbol de la ciencia o la investigación o árbol de decisiones. Ver la figura 6. La voz interna también se ha vinculado con la activación de la red por defecto o la atención interna o la representación del yo. Se piensa que tanto en la esquizofrenia, como en los casos particulares de las cosquillas y los sesgos cognitivos como JTC, lo que se pierde al no haber emparejamiento entre retroalimentación y expectativa es la atribución de la acción (el agente) o el curso del pensamiento, bien se pierde la fuente ¿es mi pensamiento o es una voz externa (la de los dioses)? o se pierde la procedencia o el destino de los mismos (su vínculo con la meta), lo que puede convertir razonar en irracionalidad.

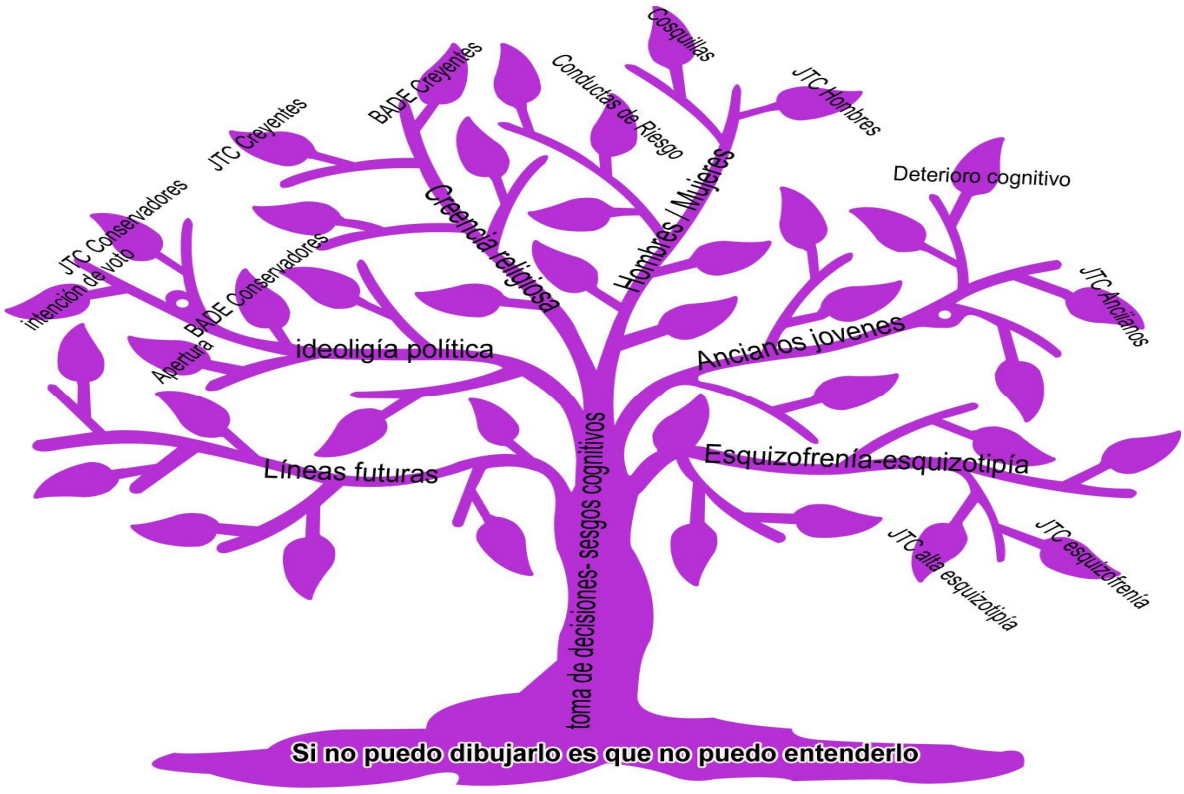


*Figure 6.* Árbol de decisiones. Al pie, frase de Einstein.

A continuación describimos en profundidad a nuestra población diana principal, las ideologías políticas.

## 1.3. EL ESTUDIO SOBRE LAS DIFERENCIAS PSICOLÓGICAS ENTRE CONSERVADORES Y LIBERALES

*La visión de la vida ha devenido en la ideología que crea la ilusión de que ya no hay vida.* **Theodor Adorno**

### Definición

El término ideología fue formulado por Destutt de Tracy (Mémoire sur la faculté de penser, 1796), y originariamente denominaba la ciencia centrada en el estudio del origen de las ideas. Posteriormente, el concepto se dota de contenido epistemológico con Karl Marx, que entiende por ideología la doctrina que recibe su fuerza. La razón de ser de la ideología consiste en asegurar una justificación del sistema y del poder que allí se ejerce.

Actualmente, según la Real Academia Española, la ideología es el conjunto de ideas fundamentales que caracteriza el pensamiento de una persona, colectividad o época, de un movimiento cultural, religioso o político, etc… En base a esta descripción se puede decir que las ideologías procuran al individuo una forma de interpretar el mundo, la historia, las realidades sociales, económicas y políticas que le rodean. La persona dependiendo del tipo de ideología que tenga percibirá y actuará ante el mundo de una u otra manera.

Dentro de las etiquetas ideológicas, es bien conocida la dimensión izquierda-derecha. Está distinción de gran connotación cristiana, comenzó a usarse en la Revolución Francesa. La derecha se "asociaba con el gusto por la aceptación social y de las jerarquías religiosas". Por otro lado, la izquierda se asociaba con "la ecualización de condiciones a través del desafío a Dios y al príncipe" (Laponce 1981). Esta etiqueta

ideológica de derechas-izquierdas (liberales-conservadores en E.E.U.U.) se ha mantenido relativamente estable hasta nuestros días. Sin embargo, aunque está distinción es común en el lenguaje cotidiano de partidos políticos, gobiernos, medios de comunicación y ciudadanos de a pie, existe un gran debate sobre si los ciudadanos en verdad hacen uso de los contenidos ideológicos específicos asociados a la izquierda o a la derecha, para organizar sus actitudes políticas. En este debate encontramos autores escépticos al respecto (por ejemplo, Converse 1964; Feldman 1988) y a favor de esta premisa (por ejemplo, Jacoby 1991; Jost y cols., 2003; Jost 2006).

En un lado del debate situaríamos por ejemplo, a Converse (1964). Converse asegura que el pensamiento político de muchos ciudadanos no puede ser descrito como ideológico, en el sentido de razonamiento deductivo de un conjunto general de principios integrados del mundo político y social. También tendríamos a Feldman (1988) que encontró en su estudio que las actitudes políticas y creencias de muchos ciudadanos americanos no estaban estructuradas ideológicamente. Sus actitudes y creencias no eran consecuencia de un razonamiento ideológico. El autor sugirió que estas preferencias y actitudes políticas podían estar estructuradas más por valores y creencias centrales del individuo.

En el lado opuesto encontraríamos a autores como Jacoby (1991) que encontró efectos positivos de estas variables en el pensamiento liberal-conservador. Para ello, realizó un análisis de datos del estudio de elección nacional de 1984, focalizándose en las variables, educación y nivel de conceptualización. Jacoby concluía que estas variables conducían a sustanciales diferencias individuales, en el grado en que los ciudadanos orientaban las actitudes ante sus problemas a lo largo de líneas ideológicas. Benoit y Laver (2006) encontraron además que las dimensiones sociales y económicas

de la ideología estaban intercorrelacionadas positivamente en 41 de 44 países examinados.

Otros autores como Jost y cols., (2003) basándose en fuentes históricas, filosóficas y psicológicas propusieron un modelo de ideología política como "cognición motivada socialmente". Estos autores postulan que hay dos dimensiones básicas que separan a los individuos de izquierdas de los de derechas. Una dimensión sería "defender frente resistirse al cambio social" (a diferencia de la tradición). Y la otra sería "rechazar versus aceptar la desigualdad". Basándose en estudios anteriores (Adorno y cols., 1950; Rokeach, 1960; Tomkins, 1963; Wilson, 1973) aseguran que las preferencias individuales de cada individuo con respecto a estas dos dimensiones provienen de las propias orientaciones psicológicas básicas con respecto a la incertidumbre, la amenaza y la conformidad. Jost y cols., (2003) llevaron a cabo una revisión meta-analítica de 88 estudios realizados en 12 países entre 1958 y 2002. Los resultados confirmaron que las variables de situación y disposición asociadas a la gestión de la amenaza y la incertidumbre eran predictores robustos de la orientación política. Específicamente, la ansiedad ante la muerte, la inestabilidad del sistema, el miedo a la amenaza y a la pérdida, el dogmatismo, la intolerancia a la ambigüedad y las necesidades personales de orden, estructura y cierre se asociaban positivamente con el conservadurismo (y negativamente con el liberalismo). Actualmente este modelo de cognición motivada socialmente es el más usado para explicar las diferencias entre individuos de distinta orientación ideológica. De hecho, la mayoría de los estudios (capítulo 1, 2, 3) que vamos a describir a continuación aportan datos que apoyan este modelo.

Dentro del estudio de la orientación ideológica hay dos grandes líneas de investigación: las centradas en el estudio sobre intención de voto y las focalizadas en las

diferencias individuales entre personas de distintas ideología. Nosotros nos vamos a centrar más en explicar los estudios de la segunda línea de investigación. Como resumen, en la línea de investigación sobre actitudes y comportamiento hacia el voto, en general, se observa que los individuos que se identifican como conservadores tienden a votar a partidos de derechas-centro y a evaluar positivamente a los candidatos más tradicionales. Al contrario, los liberales tienden a votar a partidos de izquierdas-centro y a evaluar positivamente a candidatos liberales (por ejemplo, Jacoby, 1991). Además, diversos estudios encuentran que la ideología y el partidismo son grandes predictores de la preferencia política (Jacoby, 1991; Jost, 2006).

La otra línea de investigación se centra en el estudio de las diferencias psicológicas individuales (en personalidad, estilos cognitivos y motivacionales) dependiendo de la ubicación ideológica que se tenga. Los individuos tendrían distintas formas de analizar la realidad social, política y económica. A continuación, exponemos los resultados de distintos estudios en el campo de la personalidad, la cognición, la genética y de la neurociencia.

**Estudios de personalidad y conductuales**

Durante más de cincuenta años, las investigaciones de políticos y psicólogos, en gran parte, han estado centradas en las diferencias existentes entre individuos con ideología de derechas y de izquierdas (conservadores vs. liberales) (por ejemplo, Adorno y cols., 1950; Jost & Amodio, 2012, para ver una revisión). En general, los conservadores son vistos como personas más tradicionales, convencionales y metódicas. Y los liberales como personas más flexibles, creativas y abiertas de mente.

Las primeras teorías sobre diferencias de personalidad entre personas de distinta ideología política estaban más centradas en el autoritarismo. Estas calificaban a los

individuos de derechas como rígidos, convencionales, intolerantes, xenófobos y obedientes ante las figuras autoritarias (Adorno y cols., 1950). Posteriormente, el estudio se centro más en las diferencias de rasgos. Por ejemplo, Tomkins (1963) postulaba que las personas adoptaban posturas afectivas-ideológicas hacia el mundo. Los ciudadanos de izquierdas se focalizaban más en la libertad y el humanismo. Los ciudadanos de derechas se centraban más en seguir las normas y las reglas.

Actualmente las teorías sobre diferencias de personalidad en personas con distinta ideología se centran en la escala de apertura a nuevas experiencias. Diversos estudios, siguiendo el modelo de personalidad de los cinco factores han obtenido resultados consistentes en las escalas de apertura a nuevas experiencias y meticulosidad. Los liberales obtendrían puntuaciones más altas en la escala de apertura a nuevas experiencias. Mientras que los conservadores puntuarían más alto en la dimensión de meticulosidad (Carney y cols., 2008; Jost 2006; Mondak y Halperin, 2008; Gerber y cols., 2010). Basándonos en estos datos, en el capítulo 1 y 2 presentamos dos estudios sobre distintos rasgos de personalidad para averiguar si estos datos eran replicables en la población española.

En las otras tres dimensiones (afabilidad, neuroticismo y extroversión) no se han encontrado diferencias consistentes entre liberales y conservadores. Por ejemplo, Carney y cols., (2008) encontraron que la afabilidad tenía cierta relación con el conservadurismo. Sin embargo, en general, los estudios realizados no han encontrado relación entre este rasgo y la localización política (por ejemplo, Mondak y Halperin, 2008). En el estudio realizado por Carney y cols., (2008) los liberales parecían ser más abiertos, tolerantes, creativos, curiosos, expresivos, entusiastas y abiertos a la diversidad y a la novedad. Por otro lado, los conservadores parecían ser más convencionales, metódicos, organizados, limpios, pulcros, reservados y rígidos. Además, estos autores

examinaron la relación entre los cinco grandes factores de la personalidad y las actitudes políticas sociales y económicas. Carney y colaboradores encontraron que los participantes consideran que la apertura se asociaba con el liberalismo social y la extraversión se asociaba con el conservadurismo social.

Dentro de la investigación sobre diferencias de personalidad dependiendo de la orientación política, también encontramos estudios longitudinales. De gran importancia es por ejemplo, el de Block y Block (2006). Estos autores evaluaron a distintos sujetos a lo largo de dos décadas, desde que iban a la escuela infantil hasta los 23 años de edad. Encontraron que a los 3 años de edad, los sujetos que fueron descritos por los profesores como niños que se sentían incómodos ante la ambigüedad, susceptibles al sentimiento de culpa, tímidos, rígidos, indecisos, vulnerables, tranquilos, obedientes e inhibidos, resultaban ser políticamente más conservadores de adultos. Por el contrario, los niños que fueron calificados como más energéticos, resistentes, autónomos, expresivos, dominantes, con más recursos, con mayor confianza en sí mismos y orgullosos, eran más propensos a ser liberales de adultos. Estos datos proveen un gran apoyo sobre la existencia de una relación entre los rasgos de personalidad y la orientación política.

Como en este mismo estudio se nombra, la intolerancia a la ambigüedad se ha asociado al conservadurismo. En multitud de estudios se observa que los conservadores muestran menor tolerancia a la ambigüedad o intolerancia a lo no familiar (Wilson y cols., 1973; Sidanius, 1978; Jost y cols., 2003; Shook and Fazio, 2009). Mientras el liberalismo se ha asociado a una mayor tolerancia a la novedad y ambigüedad (Wilson y cols., 1973; Carney y cols., 2008; Shook and Fazio, 2009). Por ejemplo, en el estudio de Wilson, Ausman, & Mathews (1973), aseguraban que un temor generalizado a lo desconocido era la variable psicológica que explicaba la organización de las actitudes sociales de la orientación política. Para probar esta hipótesis usaron veinte pinturas

elegidas por un experto en arte. Esta pinturas se dividían en cuatro categorías: figurativo simple, abstracto simple, figurativo complejo y abstracto complejo. Por tanto, se clasificaban en dos dimensiones: complejidad y abstracción. La dimensión simplicidad-complejidad se refería al número y concentración de diferentes elementos (líneas, formas, colores, objetos, etc...) que contenía la pintura. La dimensión figurativa-abstracta se refería a la medida en que los elementos eran familiares e identificables y el grado en el que el cuadro mostraba correspondencia con la realidad visual. Los cuadros complejos y abstractos estaban destinados a representar menor familiaridad y mayor ambigüedad. Los participantes conservadores preferían las pinturas figurativas simples y mostraban aversión hacia las figurativas abstractas complejas. Sin embargo, los liberales preferían las pinturas complejas y abstractas. Además, encontraron que la dimensión de complejidad era el principal discriminador de las sentencias de los liberales y conservadores. Los autores interpretaron estos resultados como un reflejo de una mayor tolerancia hacia la incertidumbre o falta de familiaridad por parte de los liberales. Posteriormente, Sidanius (1978) en una muestra de 195 estudiantes suecos a través de dos escalas de auto-informe (una de intolerancia/tolerancia y otra de conservadurismo) encontró relaciones entre intolerancia a la ambigüedad y el racismo o el prejuicio étnico y entre el conservadurismo general e intolerancia a la ambigüedad.

Siguiendo esta línea, un estudio más reciente es el realizado por Shook y Fazio (2009), en donde examinaron las relaciones entre ideología política, comportamiento exploratorio y formación de actitudes hacia nuevos estímulos. Para llevar a cabo este estudio, los autores usaron una tarea de aprendizaje probabilístico. Los participantes debían averiguar si los estímulos presentados (unas judías que se diferenciaban en la forma y el número de motas) producirían ganancias o pérdidas. El aprendizaje dependía de las decisiones que tomaban los participantes con respecto a probar nuevos estímulos

y descubrir la valencia asociada. Para descubrir que formas de las judías daban mayores ganancias versus pérdidas debían adoptar una estrategia de exploración temprana. Esta estrategia producía un riesgo a corto plazo pero beneficio a largo plazo. Shook y Fazio encontraron que la ideología política correlacionaba con la exploración de una situación nueva. La ideología conservadora se asoció con una estrategia más prudente a la hora de realizar la tarea y de aprender sobre nuevos objetivos (tenían menor número de objetivos con respecto a los liberales). Los liberales realizaron mejor la tarea de exploración que los conservadores, ya que, tomaban más riesgos que les reportaba mayores beneficios. Además, los conservadores mostraron una mayor asimetría en el aprendizaje de judías positivas y negativas, estos aprendían mejor los estímulos negativos. Estos estudios son un apoyo consistente a la posible relación entre intolerancia a la ambigüedad y el conservadurismo y por tanto a la teoría de Jost y cols., (2003).

Otros estudios también han evidenciado que los conservadores tienden a percibir el mundo como más peligroso y amenazante (Altemeyer, 1998; Jost y cols., 2003; Nail y McGregor, 2009; Federico y cols., 2009). Por ejemplo, Nail y McGregor, (2009) realizaron tres estudios donde encontraron que los liberales se mostraban más conservadores cuando se les inducía amenazas. De hecho, la percepción de amenazas consistentes producía que los liberales tuviesen las mismas actitudes conservadoras que los propios conservadores Estos autores se basaron en los estudios de Jost y cols., (2003), donde se aseguraba que las amenazas propician un cambio hacia actitudes más conservadoras.

Estos resultados se ven acentuados en personas con alto conocimiento político, como evidencia el estudio de Federico y cols., (2009). Los datos de este estudio mostraban que la experiencia se relacionaba fuertemente con las creencias de un mundo

peligroso y competitivo. La experiencia no sólo fortalecía las relaciones entre las actitudes explícitamente políticas, sino también la relación entre las actitudes políticas y sus antecedentes psicológicos.

En un estudio longitudinal de Bonanno y Jost (2006) con víctimas supervivientes del ataque terrorista del 11-S, observaron que los demócratas y los independientes (así como republicanos) eran más propensos a cambiar hacia el conservadurismo y a alejarse del liberalismo en los 18 meses posteriores al ataque. El giro conservador por parte de los supervivientes también se asoció con aumento de la religiosidad, patriotismo y la percepción de que los acontecimientos del 11-S creaban nuevos intereses y oportunidades. Estos datos sugieren que este giro hacia el conservadurismo puede contener características adaptativas (así como desadaptativas). Datos complementarios se encuentran en otros estudios, donde se observa que el simple hecho de recordar otras amenazas existenciales aumenta la aprobación hacia lideres políticos conservadores (Cohen y cols., 2004, 2005). Por ejemplo, en el estudio de Cohen (2005) evaluaron el efecto de un recordatorio de muerte sobre las intenciones de voto en las elecciones presidenciales de EE.UU. de 2004. Observaron que el senador John Kerry recibía más votos que George Bush en la condición de control (sin recordatorio de la muerte). Ahora bien, Bush se vio favorecido tras el recordatorio de muerte. Para los autores estos datos sugerían que la re-elección del presidente Bush podía haberse favorecido por las preocupaciones inconscientes sobre mortalidad provocadas después del 11 de septiembre de 2001.

En otro estudio longitudinal Matthews y cols., (2009) evaluaron la relación entre las percepciones de amenaza, de amenaza real y ansiedad intergrupal y los motivos ideológicos de justificación del sistema y de orientación de dominancia social y el conservadurismo político. Los que tenían mayores percepciones de amenaza real y

ansiedad intergrupal, al final de su primer año de universidad mostraron niveles más altos de justificación del sistema. Y al final de su segundo y tercer año, mayores niveles de orientación de dominancia social. Los niveles más altos de estos dos motivos ideológicos al final, se asociaron positivamente con el conservadurismo político en el cuarto año de universidad.

Por último, Oxley y cols., (2010), realizaron un estudio psicofisiológico con 46 adultos con creencias políticas fuertes. Estos autores encontraron que los individuos que tenían una menor sensibilidad a los ruidos repentinos y a las imágenes de amenaza, apoyaban más la ayuda externa, las políticas de inmigración liberales, pacifismo y control de armas. Sin embargo, los que mostraban mayores reacciones psicofisiológicas antes estos mismos estímulos estaban a favor de gasto en defensa, pena capital y patriotismo y la guerra de Iraq. Los autores concluyeron que los individuos sensibles a la amenazas abogan más por políticas que protegen su estructura social.

Otra característica que se ha unido al conservadurismo es la gran necesidad de certeza personal, orden y estructura y la mayor necesidad general de cierre y seguridad por parte de estos individuos (Jost y cols., 2003; Kemmelmeier, 2007; Chirimbolo y cols., 2004; Leone y Chirimbolo, 2008; Federico y cols., 2011). En el estudio de Kemmelmeier (2007) usando una muestra de 96 funcionarios de política exterior, examinaron las relaciones entre el conservadurismo y la identificación con un partido y las diferencias individuales en rigidez y dogmatismo. Halló que el conservadurismo se relacionaba con la rigidez pero que solo era significativo en individuos con alto interés político y que el dogmatismo se relacionaba con la identificación hacia un partido.

Con respecto a la necesidad de cierre cognitivo, Chirimbolo y cols., (2004) examinaron en 234 participantes esta necesidad de cierre cognitivo dentro de las

diferentes actitudes políticas y en la dimensión de culpa. La necesidad de cierre cognitivo se trata actualmente como una variable latente que se manifiesta a través de varios aspectos diferentes: el deseo de previsibilidad, la preferencia por el orden y la estructura y el malestar con la ambigüedad (need of clouse, Webster & Kruglanski, 1994). Los resultados mostraron que los individuos con alta necesidad de cierre (vs. baja) habían votado a favor de un partido de derechas y tenían actitudes más conservadoras. Es más, estos individuos mostraban más actitudes negativas hacia los inmigrantes, eran más nacionalistas, preferían un liderazgo autocrático y una forma centralizada del poder político. También valoraban más la religiosidad y obtenían puntuaciones más bajas en pluralismo y multiculturalismo. La necesidad de cierre además se ha relacionado con variables que conceptualmente se relacionan con el conservadurismo. Como por ejemplo, una mayor preferencia hacia grupos endógenos de alto status (Kruglanski y cols., 2002) o con una mayor reticencia a incorporar nueva información a la creencias ya existentes (Ford & Kruglanski, 1995).

Un estudio muy interesante por los datos obtenidos sobre necesidad de cierre cognitivo como predictor de orientación política es el de Federico y cols., (2011). Según Federico y cols., (2011), a las personas con alta necesidad de cierre les disgusta la incertidumbre y prefieren llegar a conclusiones rápidamente y con certeza. Se trataría de alcanzar el objetivo "apoderándose" rápidamente de la información disponible para llegar a las conclusiones y "congelando" estas conclusiones una vez se alcanzan. En sus dos estudios de auto informe, usando escalas de necesidad de cierre y de actitudes, encontraron relaciones entre la necesidad de cierre y varias actitudes políticas. El estudio diferenciaba entre ideología simbólica e ideología operacional. La ideología simbólica sería la identificación con una etiqueta ideológica, es decir, la descripción de uno mismo como conservador o liberal. La ideología operacional sería la tendencia

promedio de uno a mantener posiciones conservadoras versus liberales en los temas políticos. Los resultados mostraban que la necesidad de cierre correlacionaba con una mayor auto-descripción simbólica como conservador, con un mayor conservadurismo político y con una fuerte afinidad al Partido Republicano. Sin embargo, análisis posteriores hallaron un dibujo más complejo. La necesidad de cierre tenía una fuerte relación con el conservadurismo operativo entre los que se describían simbólicamente a sí mismos como liberales más que como conservadores. También obtuvieron una mayor asociación entre la necesidad de cierre y la restricción ideológica entre liberales simbólicos, que entre conservadores. Según los autores, esta investigación indica que la necesidad de cierre también tendría un papel que jugar en la explicación de las actitudes políticas entre los que se identifican como liberales.

Recientemente, también se ha observado en varios estudios que los conservadores muestran mayor sensibilidad al asco (Helzar y Pizarro, 2011; Terrizzi et al., 2010). Por ejemplo, Terrizzi y cols., (2010) encontraron que la escala de sensibilidad al asco correlacionaba con varias medidas de conservadurismo. La sensibilidad al asco y el conservadurismo eran predictores significativos de las actitudes hacia el contacto con los homosexuales, juicios morales sobre los homosexuales y los estereotipos sobre los homosexuales.

En otro estudio, Helzar y Pizarro (2011) demostraron en sus dos experimentos que con el simple de hecho de pedirles a los participantes que se desinfectaran las manos, estos participantes mostraban aumento de afinidad hacia el conservadurismo social, económico y político. Sin embargo, Tybur y cols., (2010) a lo largo de tres estudios no encontraron ninguna relación entre la sensibilidad al asco patógeno y el conservadurismo político.

Finalmente, la felicidad también se ha relacionado positivamente con el conservadurismo. En distintos estudios se observa que los conservadores son más felices (Taylor y cols., 2006; Napier y Jost, 2008). Por ejemplo, Napier y Jost (2008) llevaron a cabo tres estudios con datos representativos de diez países y encontraron que la orientación hacia el conservadurismo se asociaba con un mayor bienestar subjetivo y que esta relación estaba mediada por la racionalización de desigualdad. Posteriormente, un estudio de Choma et al., (2009) intento examinar estas diferencias en felicidad entre conservadores y liberales. Choma y colaboradores demostraron que ambas ideologías estaban relacionadas con componentes de felicidad. Específicamente encontraron que el fuerte liberalismo predecía mayor afecto positivo y que el fuerte conservadurismo predecía un menor afecto negativo. Concluyendo pues que liberales y conservadores tenían distintas rutas para ser felices. Además, las personas que tenían una fuerte orientación liberal o conservadora mostraban mayor satisfacción de vida que los individuos sin ideología.

**Estudios con neuroimagen**

Centrándonos en la investigación neurocientífica, la neurociencia cognitiva social ha empezado a interesarse por el estudio de la política, llegándose incluso a hablar de neurociencia política o neuropolítica. Diversos son los estudios que han examinado los substratos cerebrales de actitudes políticas a través de neuroimagen (por ejemplo, Kaplan y cols., 2007; Knutson y cols., 2006).

Por ejemplo, Knutson y cols., (2006) examinaron las actitudes políticas a través del Test de Asociación Implícita (IAT). A los participantes se les presentaba caras y nombres de conocidos políticos demócratas y republicanos junto a palabras negativas o positivas. Encontraron efecto de IAT comportamental significativo para la condición de

caras, con activación en las cortezas prefrontales ventromediales y anteriores. También había activación de la amígdala y giro fusiforme durante el procesamiento perceptual de las caras conocidas.

En otro estudio con neuroimagen, Kaplan y cols., (2007), examinaron como la afiliación a un partido político y las actitudes políticas modulaban la actividad neural mientras los participantes veían las caras de los candidatos presidenciales (en concreto a George Bush, John Kerry, y Ralph Nader), durante la campaña para las elecciones de Estados Unidos de 2004. Encontraron una mayor actividad mientras se visualizaba al candidato de la oposición en la corteza prefrontal dorsolateral y la corteza cingulada anterior (el circuito de control cognitivo), así como en la ínsula y en los polos temporales anteriores (regiones emocionales). Por tanto, los sujetos intentaban controlar sus reacciones emocionales negativas mediante la activación de redes cognitivas de control.

Datos similares encontraron Westen y cols., (2007) durante la campaña electoral presidencial de los Estados Unidos del 2004. Estos autores estudiaron en 30 sujetos (15 afiliados demócratas y 15 afiliados republicanos), las respuestas neurales ante tareas de razonamiento motivado. El razonamiento motivado es una forma de regulación implícita de la emoción, en la cual, en el cerebro convergen juicios que minimizan los estados afectivos negativos y maximizan las estados afectivos positivos asociados con motivos amenazantes. En la tarea el participante debía realizar juicios sobre información amenazante sobre el propio candidato, el oponente y sobre figuras control. Los sujetos detectaban las contradicciones hechas por el candidato del partido rival y de las figuras neutras, pero no eran capaces de detectar las mentiras del propio candidato. Western y colaboradores concluyeron que el cerebro político era un cerebro emocional. Un estudio parecido a este es el de Zamboni y cols., (2009), en donde, observaron la actividad

cerebral mientras los participantes leían e indicaban su nivel de acuerdo sobre distintos enunciados que variaban en contenido ideológico (liberal vs. conservador), radicalismo (moderado vs. radical) e individualismo (individual vs. colectivo). Encontraron que las tres dimensiones independientes explicaban la variabilidad del conjunto de enunciados políticos. Cada dimensión reflejaba un patrón distintivo de activación neural: el individualismo (corteza prefrontal medial y la unión temporoparietal), el conservadurismo (corteza prefrontal dorsolateral), y el radicalismo (cuerpo estriado ventral y la corteza cingulada posterior).

Otro estudio de neuroimagen interesante es el de Kain y cols., (2011) donde examinaron en una muestra de 90 adultos jóvenes, la relación entre la orientación política y el volumen de materia gris. Encontraron que el liberalismo se asociaba con un aumento de volumen de materia gris en la corteza cingulada anterior. Por otro lado, el conservadurismo se asociaba con un mayor volumen de la amígdala derecha. Estos resultados fueron posteriormente replicados en otra muestra de 28 participantes.

Dentro del estudio de neurociencia cognitiva, otros estudios se han planteado la hipótesis de que estas orientaciones ideológicas (Amodio y cols., 2007;. Shook y Fazio, 2009; Weissflog y cols., 2010) podrían estar relacionadas con las diferencias generales en el funcionamiento cognitivo. Por ejemplo, Amodio y cols., (2007) con una tarea Go-No-Go mediante potenciales evocados encontraron que el fuerte conservadurismo se asociaba con una disminución de la sensibilidad neurocognitiva a estímulos que producían conflictos de respuesta. En contraste, el liberalismo se asociaba con un mayor conflicto, es decir, mayor sensibilidad. Este conflicto se relacionaba con actividad de la corteza cingulada anterior, es decir, un aumento de la sensibilidad a los estímulos neurocognitivos que produjeron conflictos de respuesta. Estos autores obtuvieron por primera vez diferencias entre conservadores y liberales en un mecanismo

neurocognitivo básico como es la auto-regulación. Los autores concluyeron que el constructo "ideología" se refleja en el cerebro humano. Estos resultados han sido replicados posteriormente por Weissflog y cols., 2010. Este estudio es pionero ya que la tarea no contiene información política o juicios políticos. Otro estudio relacionado con estos resultados es el realizado por Inzlicht y cols., (2009) con personas con diferentes creencias religiosas. Nótese que el conservadurismo se ha relacionado con la religiosidad. Los resultados mostraron que la convicción religiosa estaba marcada por la reactividad reducida (a la incertidumbre y error) en la corteza cingulada anterior (ACC). En los capítulos del 4 y 6, realizamos diferentes estudios con personas creyentes o no creyentes. En concreto, en el capítulo 6 llevamos a cabo un estudio de neuroimagen con creyentes mientras hablaban a Dios. Este estudio también se ideo en base a los datos obtenidos en un estudio de neuroimagen que realizamos anteriormente sobre voz interna, que se puede leer en el capítulo 5.

**Estudios genéticos**

Por último, se han realizado distintos estudios en el campo de la genética sobre ideología. En estos se ha observado que hay variabilidad en distintas actitudes políticas en donde se reflejan influencias genéticas (Tedin, 1974; Alford y cols., 2005; Olson y cols., 2011; Fowler y Dawes, 2008). En los primeros estudios, como el de Tedin (1974), observaron que si ambos padres tenían una misma orientación política, sus hijos tendrían una gran probabilidad de tener esa misma ideología. En años posteriores, Fowler y Dawes (2008) estudiaron el poliformismo en dos genes específicos (el gen transportador de la serotonina (5HTT) y el gen A oxidasa monoamina (MAOA), encontrando que ambos eran predictivos de la intención de voto. El 5HTT parece jugar un rol importante en la regulación del estrés y el miedo, a través de interacción con la amígdala (Hariri y Holmes, 2006). Y el MAOA se ha asociado con la conducta

antisocial y agresiva en hombres. Datos complementarios son los de Hatemi y cols., (2011) que observaron que el poliformismo genético unido a flexibilidad cognitiva y a la sensibilidad hacia la amenaza, predecía puntuaciones generales en medidas actitudinales de liberalismo-conservadurismo.

Finalmente, nombramos un reciente meta-análisis de Olson y cols., (2011) de las bases genéticas sobre diferencias individuales en actitudes. Estos autores encontraron que las actitudes políticas (en concreto, capitalismo, aborto, educación y pena) tenían significancia de heredibilidad. El análisis fue realizado con 195 pares de gemelos monozigóticos y en 141 pares de gemelos dizigóticos del mismo sexo.

**Recapitulando**

Nuestra introducción comenzó con una entrada muy genérica al campo de estudio sobre la toma de decisiones. En la segunda parte nos focalizamos en la descripción de los sesgos cognitivos en toma de decisiones (en concreto, en salto a conclusiones, BADE (Bias Against Disconfirmatory Evidence en inglés) y BACE (Bias Against Confirmatory Evidence en inglés)) y de la tarea DDT (Drawing Decision Task) usada en nuestra investigación. Finalmente, llevamos a cabo una descripción de nuestra población diana principal e inicial (la ideología política). Una revisión de las principales diferencias entre conservadores y liberales, y una explicación de cómo estas diferencias se producirían, nos llevó a pensar que los conservadores reproducirían el sesgo salto a conclusiones.

Sin embargo, como iremos contando capítulo a capítulo, no sólo utilizamos esta tarea ni sólo nos centramos en esta población, sino que a continuación nuestros intereses se extienden a otras tareas y poblaciones relevantes en relación a la investigación sobre toma de decisiones.

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# Capítulo 1: Diferencias entre liberales y conservadores en ansiedad, esquizotipía, empatía y autoestima

## 1. Introducción

Durante los últimos 50 años, la investigación sobre política se ha centrado en gran parte en estudiar las diferencias entre la ideología conservadora o derechista y la ideología liberal o izquierdista (Jost & Amodio, 2012).

En general, los conservadores son vistos como personas más tradicionales, convencionales y metódicas; y los liberales como personas más flexibles, creativas y abiertas de mente. El conservadurismo ha sido asociado reiteradamente con una gran necesidad de certeza personal, orden y estructura (Sidanius, 1978; Kemmelmeier 2007). Además, los conservadores suelen tender a percibir el mundo como más peligroso y amenazante (Altemeyer, 1998) que los liberales. Mientras el liberalismo se ha asociado a una mayor tolerancia a la novedad y ambigüedad (Wilson y cols., 1973; Carney y cols., 2008).

Otros estudios se han centrado en investigar las diferencias entre los rasgos de personalidad (siguiendo el modelo de los cinco factores) de liberales y conservadores. En estos estudios se han obtenido resultados consistentes en las escalas de apertura a nuevas experiencias y búsqueda de sensaciones, donde los liberales puntuaban más en apertura a nuevas experiencias mientras que los conservadores puntuaban más alto en la dimensión de meticulosidad (Jost y cols., 2003; Carney y cols. 2008; Jost, 2006). En las otras tres dimensiones no se han encontrado diferencias consistentes entre liberales y conservadores. Por ejemplo, Carney y cols. (2008) obtuvieron una relación entre

amabilidad y conservadurismo pero en otros estudios esta relación no se ha encontrado (Mehrabian 1996; Mondak y Halperin 2008).

Como consecuencia de estas diferencias entre liberales y conservadores, distintos autores han propuesto que la ideología política puede estar asociada a diferencias en los estilos cognitivos (Adorno y cols., 1950; Amodio y cols., 2007, Weissflog y cols., 2010). Los conservadores tendrían un estilo cognitivo más estructurado y rígido y los liberales un estilo cognitivo más flexible y abierto a la complejidad.

En base a estos estudios y a los resultados de nuestro estudio sobre diferencias de rasgos de personalidad entre conservadores y liberales usando el cuestionario NEO PI-R (descrito en el capítulo anterior), realizamos dos nuevos experimentos. En el primer experimento estábamos interesados en profundizar en las posibles diferencias entre conservadores y liberales en ansiedad y esquizotipía (por la relación de estas dos variables con el neuroticismo, donde como vimos puntuaban más los conservadores). En el segundo experimento examinamos las diferencias en empatía y autoestima, ya que, los conservadores puntuaban más alto en altruismo. Para ello, les administramos a los participantes cuatro cuestionarios: Inventario de Ansiedad Estado-Rasgo para Adultos (STAI), Evaluación de la Comunidad de la experiencia psíquica (CAPE) y el test de Empatía afectiva y cognitiva (TECA).

**Experimento 1**

En el primer experimento examinamos las posibles diferencias entre conservadores y liberales en ansiedad y esquizotipía, a través de la administración de los cuestionarios psicológicos STAI y CAPE, ya que los conservadores tendían a tener puntuaciones más altas en neuroticismo en el cuestionario NEO PI-R.

Nuestra hipótesis principal es que los conservadores puntuarán más alto en ansiedad y esquizotipia que los liberales.

## 2. Método

### 2.1. Participantes

Un total de 60 personas participaron en este experimento. Los participantes tuvieron que rellenar un cuestionario sobre participación política. En base a ese cuestionario se utilizó un grupo de 30 sujetos de ideología liberal que votaban al Partido Socialista Obrero Español (PSOE), cuya media de edad fue de 25,34 años (DE = 8,993, rango = 18-50), y un grupo de 30 sujetos de ideología conservadora que votaban a favor de la partido Popular (PP), cuya media de edad fue de 22,86 años (DE = 6,717, rango = 18-46). Los participantes eran estudiantes de la facultad de psicología de la Universidad de Granada que eran captados a través de anuncios.

### 2.1. Procedimiento

Los participantes fueron evaluados grupalmente en una sesión experimental, con una duración de aproximadamente 1 hora en una habitación tranquila sin distracciones. A cada participante se le administró las pruebas en el siguiente orden: Inventario de Ansiedad Estado-Rasgo para Adultos (STAI) y la Evaluación de la Comunidad de la experiencia psíquica (CAPE).

### 2.2.1. Inventario de Ansiedad Estado-Rasgo para Adultos (STAI)

El Inventario de Ansiedad Estado-Rasgo para Adultos (Spielberger, CD., Gorshu, K.L., & Lushene, R.D., 1970) es un instrumento que mide la ansiedad en adultos. El inventario se diferencia claramente entre la condición temporal "estado de ansiedad" y la condición más general "ansiedad rasgo". La prueba consiste en dos partes con 20

preguntas cada parte con escala de Likert de 4 puntos, que va desde nada a mucho para el STAI Estado y desde casi nunca a casi siempre para el Rasgo STAI. La primera parte (A/E) evalúa un estado transitorio emocional caracterizado por sentimientos subjetivos, con atención conscientemente percibida, aprehensión e hiperactividad del sistema nervioso autónomo. La segunda parte (A / R) indica una propensión ansiosa relativamente estable característico de los individuos con tendencia a percibir las situaciones como amenazadoras.

### 2.2.2. Community Assessment of Psychic Experiences (CAPE)

The Community Assessment of Psychic Experiences, CAPE (Konings y cols., 2006) es un instrumento de auto-reporte que mide las experiencias psicóticas vividas. La CAPE tiene 42 preguntas y una escala de Likert de cuatro puntos con respecto a la frecuencia (desde nunca hasta casi siempre) y angustia (de no angustiado a muy apenado) sobre la que el participante debe responder. El CAPE es una escala que evalúa tres dimensiones básicas del espectro de la psicosis (positivo, negativo y depresivo), con el fin de evaluar las experiencias psicóticas y los síntomas psicóticos en la población general. Además, el CAPE permite calcular una puntuación total por cada dimensión y una puntuación total.

## 3.Resultados

Los análisis estadísticos se realizaron con SPSS versión 17.0. Con las puntuaciones directas obtenidas por los participantes en los cuestionarios psicológicos (STAI, CAPE), se realizaron pruebas t-test para muestras independientes.

### 3.1. Cuestionarios psicológicos

Los resultados se muestran en Tabla 1.

Tabla1. Resultados de las pruebas t-test de muestras independientes (grupo de conservadores y liberales) de los puntajes totales de los test psicológicos: STAI, CAPE.

| | Medias Conservadores | Medias Liberales | p |
|---|---|---|---|
| STAI A/E | 18.21 | 15.66 | ,939 |
| STAI A/R | 20.74 | 17.36 | ,023 |
| CAPE puntuación total | 1.43 | 1.49 | ,115 |
| CAPE dimensión positiva | 1.39 | 1.27 | **,000**** |
| CAPE puntuación positiva total | ,192 | ,915 | ,240 |
| CAPE dimensión negativa | 1.495 | 1.676 | ,031 |
| CAPE puntuación negativa total | 1.31 | 1.58 | **,000**** |
| CAPE dimensión depresiva | 1.79 | 1.72 | ,113 |
| CAPE puntuación depresiva total | 1.83 | 1.73 | ,412 |

El grupo de conservadores mostraba más propensión ansiosa que el grupo de liberales, es decir mostraban mayor tendencia a percibir las situaciones como amenazadoras, en términos de rasgo de personalidad. Además, el grupo de los conservadores mostraron una mayor propensión a la sintomatología positiva (delirios ...) y el grupo de los liberales al contrario, mostraron una mayor tendencia a la sintomatología negativa (abulia, anhedonia..).

**Experimento 2**

En el segundo experimento examinamos las diferencias en empatía y autoestima, a través de la administración de los cuestionarios psicológicos TECA y EAR, ya que, los conservadores puntuaban más alto en altruismo en el cuestionario NEO PI-R. Nuestra

hipótesis principal es que los conservadores puntuarán más alto en empatía que los liberales.

## 2. Método

### 2.1. Participantes

Un total de 30 personas participaron en este experimento. Los participantes tuvieron que rellenar un cuestionario sobre participación política. En base a ese cuestionario se utilizó un grupo de 15 sujetos de ideología liberal que votaban al Partido Socialista Obrero Español (PSOE), cuya media de edad fue de 24 años (DE = 1,964, rango = 21-28), y un grupo de 15 sujetos de ideología conservadora que votaban a favor del partido Popular (PP), cuya media de edad fue de 22,53 años (DE = 0,743, rango = 22-24). Los participantes eran estudiantes de la facultad de psicología de la Universidad de Granada que eran captados a través de anuncios.

### 2.2. Procedimiento

Los participantes fueron evaluados grupalmente en una sesión experimental, con una duración de aproximadamente 30 minutos en una habitación tranquila sin distracciones. A cada participante se le administró las pruebas en el siguiente orden: el Test de empatía cognitiva y afectiva (TECA) y la Escala de Autoestima de Rosenberg (EAR).

#### 2.2.1. Test de empatía cognitiva y afectiva (TECA)

El test de empatía cognitiva y afectiva (López Pérez, Fernández Pinto, & Abad, 2008) es una medida global que de empatía, en el que además, se pueden obtener cuatro medidas más específicas. Dentro de la dimensión cognitiva de la empatía obtendríamos

dos escalas: Adopción de perspectivas y comprensión emocional. En la dimensión afectiva tendríamos las escalas de Estrés empático y Alegría empática. La escala de Adopción de perspectivas sería la capacidad de ponerse uno mismo en el lugar de otro. La de Comprensión emocional sería la capacidad de reconocer y comprender los estados emocionales, las intenciones y las impresiones de otros. La escala de Estrés empático nos hablaría de la capacidad de compartir emociones negativas de otra persona; y la escala de Alegría empática sería lo contrario, la capacidad de compartir emociones positivas de otra persona. El cuestionario consta de 33 preguntas, en donde, la persona de valorar en una escala de 5 puntos el grado en que se identifica con las frases que se le presentan (1: Totalmente en desacuerdo, 2: En desacuerdo; 3: Neutro; 4: De acuerdo; 5: Totalmente de acuerdo).

### 2.2.2. Escala de Autoestima de Rosenberg (EAR)

La escala de Autoestima de Rosenberg (Rosenberg, 1965) es una de las escalas de autoestima más utilizada. La EAR consta de 10 afirmaciones de los sentimientos que tiene la persona sobre ella, 5 afirmaciones positivas (por ejemplo, “creo que tengo un buen número de cualidades”) y 5 negativas (por ejemplo, “siento que no tengo muchos motivos para sentirme orgulloso de mi”). La graduación de las respuestas tiene 4 puntos (1 = muy en desacuerdo, 2 = en desacuerdo, 3 = de acuerdo y 4 = muy de acuerdo). Los valores pueden fluctuar entre 10 (baja autoestima) y 40 (alta autoestima).

## 3.Resultados

Los análisis estadísticos se realizaron con SPSS versión 17.0. Con las puntuaciones directas obtenidas por los participantes en los cuestionarios psicológicos (TECA, EAR), se realizaron pruebas t-test para muestras independientes.

### 3.1.Cuestionarios psicológicos

Los resultados se muestran en Tabla 2.

Tabla 2. Resultados de las pruebas t-test de muestras independientes (grupo de conservadores y liberales) de los puntajes totales de los test psicológicos: TECA, EAR.

| | Medias Conservadores | Medias Liberales | p |
|---|---|---|---|
| TECA_ Adopción de perspectivas | 32.46 | 32.60 | ,920 |
| TECA_ Comprensión emocional | 31.13 | 34.06 | ,973 |
| TECA_ Estrés empático | 23.53 | 22.26 | ,620 |
| TECA_ Alegría empática | 35.20 | 33.60 | ,011 |
| TECA_puntuación total | 122.33 | 122.53 | ,716 |
| Autoestima | 26.46 | 27 | ,101 |

En la puntuación total y en las dimensiones no se muestran diferencias. Tampoco se encontraban diferencias significativas entre los dos grupos en autoestima.

### 4.Discusión

Los resultados de nuestro primer estudio sugieren que los conservadores son más propensos a la ansiedad confirmando nuestra primera hipótesis. Los conservadores tienden a ver las situaciones como más amenazadoras. Estos datos apoyarían los resultados de otros estudios, en donde se observa que los conservadores ven el mundo como más amenazante y peligroso (Altemeyer, 1998). También encontramos con relación a la escala de esquizotipía que los conservadores tendrían mayor tendencia a presentar síntomas positivos, es decir, mayor probabilidad de presentar pensamientos mágicos, experiencias inusuales o extrañas…; y a al contrario, los liberales mostraban

mayor tendencia a presentar síntomas negativos, por tanto tendrían mayor probabilidad de mostrar anhedonia (incapacidad para expresar placer, la pérdida de interés o satisfacción en casi todas las actividades). Con respecto, a nuestro segundo estudio no obtuvimos diferencias significativas entre los dos grupos. Estos datos no estarían en concordancia con los estudios en los que se observa que los conservadores son más felices que los liberales (Napier & Jost, 2008) y que tienen menos frecuentemente emociones negativas (Choma y cols., 2009).

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# Capítulo 2: Personality differences in liberals and conservatives

**Abstract**

Political research has shown differences of personality between individuals with a preference to liberalism ideology and individuals with preference to conservatism ideology. The main objective of this study is to examine the differences of personality between individuals with different political orientation. The NEO PI-R test was assessed in 15 liberals and 15 conservatives groups. In addition to the traditional domains of this inventory (neuroticism, extraversion, openness, agreeableness and conscientiousness), we also calculated their six facets of personality that there are under each domain. The results replicated the result of previous studies (Jost, 2006, Carney et al. 2008) where had been found that there existed differentials of personality that depended to political orientation. In concrete, we found that liberals were more openness to new experiences.

Keywords: conservatives, liberals, neuroticism, extraversion, openness, agreeableness, conscientiousness

Abbreviations: NEO PI-R= The Revised NEO Personality Inventory

## 1.Introduction

For more than half a century, political research has shown personality and motivational characteristics associated with political ideology (Adorno et al., 1950, Jost J.T., & Amodio D.M., 2012). These studies have mostly centered on the relationships between personality traits and ideological location (conservatism vs. liberalism). In general, liberals are more creative, curious, open-minded, unconventional and flexible and conservatives are more traditional, dogmatic, better organization and orderly (Jost et al., 2003a). Conservatives showed intolerance of the unfamiliar (Wilson et al., 1973), lower tolerance openness to new experiences (Jost et al., 2003a, Jost, 2006), more conscientiousness (Carney et al. 2008, Mondak and Halperin, 2008); while liberalism has been associated with higher tolerance of ambiguity, novelty, openness to new experiences (Wilson et al., 1973, Carney et al. 2008, Jost, 2006).

There are many studies of the relationship between the Big Five and self reported ideology. The domain of Openness to Experience has been linked with liberalism (for example, Carney et al. 2008, Jost et al. 2003, Mondak and Halperin, 2008).

On the contrary, the domain of Conscientiousness has been related with conservatism (for example, Jost, 2006, Carney et al. 2008, Mondak and Halperin 2008). In the domain of Agreeableness in the study by Carney et al. (2008) found that Agreeableness is weakly associated with conservatism, although in general several studies had not found relationship between this trait and political location (for example, Mondak and Halperin 2008). Neither, it has not been found consist relationship between the domains of Extroversion, Neuroticism and political location (for example, Carney et al. 2008).

In this article is examined the differentials of personality traits between individuals with different political orientation. Moreover, we are interested in replicating the results of previous studies about differences between conservatives vs. liberals in openness and conscientiousness (Jost, 2006, Carney et al. 2008).

To achieve to goal, we used The Revised NEO Personality Inventory (NEO PI-R, Costa & McCrae, 1992), a self-report measure of psychological personality. The NEO PI-R inventory was based on the Big Five Factor Model of trait personality, so measured five domains: neuroticism, extraversion, openness, agreeableness and conscientiousness.

Our hypothesis is that conservatives have scored higher in Conscientiousness whereas liberals have scored higher in Openness.

## 2.Method

### 2.1.Participants

There were a total of 30 participants, of which 15 of them were subjects with liberal ideology who voted to the Spanish Socialist Workers Party (PSOE) whose mean age was years 20.87 (SD=1.506; range=18-24) and 15 of them were subjects with conservative ideology subjects who voted to the Popular Party (PP) whose mean age was years 22.47 (SD= 1.598; range=18-23). Participants recruited via adverts, were students of faculty of psychology at the University of Granada.

See Table 1 for demographic information as a function of age.

Table 1. Mean and standard deviation, in parentheses, of the sociodemographic variables

| Variable | Liberals (N=15) | Conservatives (N=15) |
|---|---|---|
| Age | 20.87(1.506) | 22.47 (1.598) |
| Gender | Men: 4<br>Women:11 | Men: 5<br>Women: 10 |

**2.2.Procedure**

Participants were tested in groups in one experimental session, lasting about 1 hour in a quiet room without distractions. Each participant was administered the Revised NEO Personality Inventory (NEO PI-R).

**2.2.1. The Revised NEO Personality Inventory (NEO PI-R)**

The Revised NEO Personality Inventory (NEO PI-R, Costa & McCrae, 1992) is a self-report measure of psychological personality, what is a widely used in both clinical and non-clinical settings. It consists of 240 items scored on a five point Likert scale. The NEO PI-R consisted of 30 facet scales that it was based on the Big Five Factor Model of trait personality. The five domains are neuroticism, extraversion, openness, agreeableness and conscientiousness. In addition to the five domains, there are six facets of personality under each domain. The facets of each domain are: **neuroticism** (anxiety, angry hostility, depression, self-consciousness, impulsiveness and vulnerability); **extraversion** (warmth, gregariousness, assertiveness, activity, excitement seeking and positive emotions); **openness to experience** (fantasy, aesthetics, feelings, actions, ideas, and values); **agreeableness** (trust, straightforwardness, altruism, compliance, modesty

and tender-mindedness); and **conscientiousness** (competence, order, dutifulness, achievement striving, self-discipline and deliberation).

## 3. Results

Statistical analyses were carried out with SPSS Version 17.0. On raw scores obtained by participants in psychological test (NEO PI-R inventory), we conducted separate independent t-test. For all analyses, the scores were compared between the two groups (conservatives and liberals group).

### 3.1. Psychological test

The results are reported in Table 1, 2, 3, 4, 5, and 6.

Table1. Results of independent samples t-test (conservatives and liberals group) on raw scores of psychological test: NEO PI-R in the five domains.

| | Conservatives Means | Liberals Means | p |
|---|---|---|---|
| Neuroticism | 61.87 | 56.87 | ,564 |
| Extroversion | 49.33 | 55.13 | ,899 |
| Openness | **48.27** | **55.87** | **,001*** |
| Agreeableness | 41 | 41.13 | ,126 |
| Conscientiousness | 42.60 | 38.87 | ,857 |

There are significant differences between groups in the openness domain. (see also Table 4). In the other four domains, there are not significant differences between groups.

Table 2. Results of independent samples t-test (conservatives and liberals group) on raw scores of psychological test: NEO PI-R in the neuroticism domain and their facets of personality.

| | Conservatives Means | Liberals Means | p |
|---|---|---|---|
| Neuroticism | 61.87 | 56.87 | ,564 |
| Anxiety | 54.53 | 51.67 | ,539 |
| Angry hostility | 64.07 | 60 | ,977 |
| Depression | 55.20 | 51.27 | ,756 |
| Self-consciousness | 55.73 | 55.87 | ,292 |
| Impulsiviness | 55.87 | 60.13 | ,731 |
| Vulnerability | 60.40 | 56.13 | ,565 |

There are not significant differences between groups. However, conservatives showed a tendency greater in the neuroticism domain and their facets, they had higher scores than liberals except in impulsiveness and self-consciousness (two groups obtained similar scores).

Table 3. Results of independent samples t-test (conservatives and liberals group) on raw scores of psychological test: NEO PI-R in the extroversion domain and their facets of personality.

| | Conservatives Means | Liberals Means | p |
|---|---|---|---|
| Extroversion | 49.33 | 55.13 | ,899 |
| Warmth | 51.73 | 49.27 | ,502 |
| Gregariousness | 50.60 | 52.80 | ,651 |
| Assertiveness | 49.40 | 51.20 | ,490 |
| Activity | 47.87 | 51.93 | ,243 |
| Excitement seeking | 50.80 | 62.33 | ,053 |
| Positive emotions | 49.33 | 51.20 | ,246 |

There are not significant differences between groups, but it is nearly significant in the excitement seeking. Liberals showed more need for environmental stimulation. In this domain is observed a tendency greater in the extroversion domain and facets in liberals group except in warmth.

Table 4. Results of independent samples t-test (conservatives and liberals group) on raw scores of psychological test: NEO PI-R in the openness domain and their facets of personality.

| | Conservatives Means | Liberals Means | p |
|---|---|---|---|
| **Openness** | **48.27** | **55.87** | **,001*** |
| Fantasy | 62 | 57.40 | ,472 |
| **Aesthetics** | **49.47** | **50.67** | **,003*** |
| Feelings | 48.93 | 59.13 | ,693 |
| Actions | 44.20 | 50.20 | ,383 |
| Ideas | 43.80 | 49.47 | ,476 |
| Values | 44.27 | 59.60 | ,252 |

There are significant differences between groups in the openness domain. Liberals obtained higher scores in this domain, what mean, they were more creative, imaginative and resourceful. Liberals had more curious by the external and internal environment and interested in new ideas and unconventional values. Also, there are significant differences between groups in the aesthetics, where liberals have higher scores, that is, liberals showed more appreciation of art and beauty.

Table 5. Results of independent samples t-test (conservatives and liberals group) on raw scores of psychological test: NEO PI-R in the agreeableness domain and their facets of personality.

| | Conervatives Means | Liberals Means | p |
|---|---|---|---|
| Agreeableness | 41 | 41.13 | ,126 |
| Trust | 40.60 | 41 | ,261 |
| Straightforwardness | 42.13 | 44.33 | ,355 |
| Altruism | 46.93 | 46.53 | ,016 |
| Compliance | 39.20 | 36.93 | ,111 |
| Modesty | 48.20 | 45.73 | ,494 |
| Tender-mindedness | 47.73 | 48.93 | ,099 |

There are not significant differences between groups in altruism.

Table 6. Results of independent samples t-test (conservatives and liberals group) on raw scores of psychological test: NEO PI-R in the conscientiousness domain and their facets of personality.

| | Conservatives Means | Liberals Means | p |
|---|---|---|---|
| Conscientiousness | 42.60 | 38.87 | ,857 |
| Competence | 42.67 | 43.93 | ,570 |
| Order | 51.33 | 50.20 | ,054 |
| Dutifulness | 44.73 | 41.07 | ,721 |
| Achievement | 44 | 38.67 | ,127 |
| Self-discipline | 43.60 | 38.20 | ,216 |
| Deliberation | 43.53 | 40.60 | ,804 |

There are not significant differences between groups, although in the order facet is nearly significant. Conservatives showed more personal organization. Conservatives tended to have a high rate in this domain and all their facets except competence.

**4. Discussion**

The result present study indicates that liberals were more openness to experience than controls. This result was according a several studies where is demonstrated that (for example, Jost, 2006, Carney et al. 2008, Mondak and Halperin 2008) conservatives were less openness to new experience. This result confirms partly our first hypothesis because we found that conservatives were less openness, tend to be more conventional and traditional, but conservatives were not more conscientiousness than liberals. Although, in the data is observed that conservatives tend to order more than liberals, how is demonstrated in the previously cited studies (Jost, 2006, Carney et al. 2008). We did not find differences between liberals and conservatives in Agreeableness. Moreover, we did not find differences between liberals and conservatives in Neuroticism and Extroversion. These results are according to different studies where were not found consistent relationship between these traits and political orientation (Carney et al., 2008). These results support and are a replication of previous studies.

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# Capítulo 3: Differences between liberals and conservatives in Cognitive biases (BADE and Jumping to Conclusions)

**Abstract**

Political research has shown differences in cognitive resources among people with different political orientation, overall among people with liberal ideology and conservative ideology. The main objective of this study is to examine the differences between individuals with different political orientation in a cognitive bias named "Jumping to conclusions" (JTC), defined as a decision made quickly on the basis of little evidence. Drawing to Decision task was assessed in 30 liberals, 30 conservatives and 30 non-ideology participants. In addition to the traditional parameters of this task (Plausibility Rating and Draws to Decision), we also calculated BADE/BACE and new parameters, Feedback Sensitivity and the number a correct answers at stage 8. The results of the study indicate that individual with conservative political orientation showed higher tendency to jump to conclusions and BADE, especially in difficult task-situations. The results are discussed in the following context: if we accept that these cognitive biases may combine to contribute to the formation of delusions, we must consider that conservatives are more “schizotypycal” or less sensitive to reality.

Keywords: jumping to conclusions, Feedback sensitivity, pictures to decision task, political research, conservatives, liberals.

## 1. Introduction

Political research has demonstrated that there are great differences between individuals that have different ideological orientation. Various behavioral studies observed that conservatives and liberals showed differences in the cognitive and motivational styles (see Jost & Amodio, 2012, for a review). In general, these studies found that people with a conservative ideological lean had a more structured and persistent cognitive style. Conservatives showed lower tolerance for ambiguity, openness to new experiences and cognitive complexity (Jost et al., 2003a; Kemmelmeier, 2007; Shook and Fazio, 2009); while people with a liberal ideology had higher tolerance to ambiguity, cognitive complexity, novelty and openness to new experiences (Wilson et al., 1973; Carney et al. 2008; Jost, 2006). Furthermore, conservatives have been related with the need for closure (Chirimbolo et al., 2004). It was observed that individuals with high need for cognitive closure dislike uncertainty and prefer to reach conclusions quickly and with certainty. According to Federico et al., (2011), "They seek to accomplish this goal by "seizing" quickly on any available information to reach conclusions and by "freezing" on these conclusions once they are reached".

Adorno, Frenkel-Brunswik, Levinson and Sanford (1950) linked conservative ideology to lower levels of cognitive functioning. More recently, other studies had hypothesized about these ideological orientations (Amodio et al., 2007; Shook and Fazio, 2009; Weissflog et al. 2010) could be related to general differences in cognitive functioning. For example, Amodio et al. (2007) found that the strong conservatism was associated with lower neurocognitive sensitivity to stimuli that produced response conflicts. In contrast they obtained that greater liberalism was associated with stronger conflict related to anterior cingulate brain activity, that is, increased neurocognitive

sensitivity to stimuli that produced response conflicts. The authors obtained differences between conservatives and liberals in a basic neurocognitive mechanism for self-regulation. The authors concluded that the construct "ideology" would be reflected on the human brain. These results have been replicated (Weissflog et al., 2010).

The present research accepts the premise that political orientation (liberalism vs. conservatism) is related to cognitive resources. In particular, we investigate mainly the cognitive bias called jumping to conclusions between conservatives and liberals. The "Jump to Conclusions" bias has been studied formerly in schizophrenic patients with delusions (Moritz et al, 2007; Speechley et al., 2010). However, more recently it has been also studied in non-clinical populations (Warman and Martín, 2006, Mckay et al., 2006; Lincoln et al., 2010; Lincoln et al., 2011; Lee et al., 2011), overall in schizotypy. The "Jumping to Conclusions" cognitive bias occurs when there is a tendency to take decisions with a high level of precipitation when there is little evidence for this. Currently there are two different hypotheses to explain this cognitive bias (Averbeck et al., 2011). The first hypothesis maintains that people with JTC bias overestimate the conviction in their choices at the beginning of the decision process (Hulq et al., 1988; Lincoln et al., 2010). The second hypothesis postulates that the JTC bias is due to a low threshold for acceptance, that is, needless information to make a decision. This hypothesis was proposed by Moritz and Woodward (2004) has been named “The hypothesis of Liberal Acceptation”. In adittion, we explore the relationship between JTC bias and the Bias Against Disconfirmatory Evidence (BADE) which had also been found in patients with schizophrenia and healthy population (Buchy, Woodward and Liotti, 2007; Moritz and Woodward, 2006), overall schizotypy. The dimensional model of schizophrenia predicts unifying cognitive biases or cognitive biases combined to contribute towards the formation of the delusional aspects of psychosis (Buchy,

Woodward and Liotti, 2007). Up until these days it remains unclear whether these reasoning biases are independent or share common underpinnings (Munz, 2011).

To study these cognitive biases, we used a new version of Drawing to Decision task, previously used in other studies about JTC bias (Moritz et al., 2006; Rubio et al., 2011). In this new version, we have introduced two new parameters (explained in the method section): number of correct answers and Feedback sensitivity, in order to clarify why this cognitive bias happens. The analysis of the Feedback Sensitivity will allow us to find out if this cognitive bias is only present when subjects have been instructed to derive their own interpretations or when more sources of information are available and the context of the decision has been previously defined. This last characteristic allows us to analyze the effect of the context in which the decisions are made. The analysis of accuracy let us know whether JTC is related or not to efficacy. However, like in the previous versions of the task, the main dependent measures were the Plausibility Rating of each stimulus presented at all stages and Draws to Decision (the number of stimulus necessary to reach a final decision about their identity). These measures were analyzed throughout two kinds of trial sessions ("cued" and "uncued"; that is, with and without interpretative cues or easy and difficult versions of the task).

Based on previous results about cognitive functioning (Amodio et al., 2007; Shook and Fazio, 2009; Weissflog et al. 2010; Federico et al., 2011) -where conservatives disliked uncertainty and as a result, they made decisions quickly and maintained these decisions once they made it-, our main hypotheses are that conservatives show higher Jumping to Conclusion bias and BADE. At the same time, as these cognitive biases may combine to contribute to the formation of delusions (Garety & Freeman, 1999; Green et al., 2000) we could discuss whether conservatives are more "schizotypycal" or mind directed.

## 2. Method

### 2.1. Participants

A sample of 90 people participated in this experiment. Participants completed a questionnaire that measured political participation. We used a group of 30 subjects with liberal ideology who voted to the Spanish Socialist Workers Party (PSOE), a group of 30 conservative ideology subjects who voted to the Popular Party (PP) and another group of 30 non-ideology controls who did not support any party. Premorbid intelligence was determined by "Test de acentuación de palabras TAP-30" (González Montalvo, 1991). It is a Spanish adaptation validated through the North American Adult Reading Test (NART; Nelson, 1982). The NART was developed as a measure for estimating premorbid intelligence in patient with schizophrenia (for a review, see O'Carroll, 1995; Russell et al., 2000) and is believed as providing a good estimate of premorbid IQ because it: (a) predicts much of the variance in current WAIS IQ; (b) has high reliability in normal subjects (Kondel et al., 2003). The TAP-30 is a measure of intelligence in which the participant is instructed to reading 30 words of irregular pronunciation. All participants reported an absence of cerebral damage and no clinical evidence of drug abuse during the course of the study. Also, healthy participants reported an absence of mental disorder. Participants were recruited via adverts in the faculty of Psychology at the University of Granada.

We want to know if the results on cognitive biases are due to ideology. Because of this we control that groups do not differentiate into schizotypy, a variable affecting performance in these tasks. For all groups, baseline vulnerability to psychosis was assessed with the Community Assessment of Psychic Experience, CAPE (Konings et al., 2006). This scale evaluates three basic dimensions (negative, positive and the

depressive symptoms) of psychotic spectrum to assess order psychotic experiences and psychotic symptoms in the general population. The positive scale, of 18 items, comprises delusions, hallucinations, suspiciousness/ideas of persecution, unusual thought content. The 14 items of the negative scale cover flat affect, emotional withdrawal, lack of relationship, passive social withdrawal, and lack of spontaneity. The 8 items of the depressive scale included cognitive symptoms of the depression such as sadness, pessimism, hopelessness, feeling a failure or feeling guilty. The CAPE has correct psychometric behavior regarding internal consistency, temporal stability and different evidences of validity (Stefanis et al., 2002; Hanssen et al., 2003), so it would be used as a screening instrument in the general population. The CAPE has been adapted and validated on Spanish healthy population (Fonseca-Pedrero, Paino, Lemos-Giráldez, & Muñiz, 2012; Ros-Morente, Vilagra-Ruiz, Rodriguez-Hansen, Wigman, & Barrantes-Vidal, 2011). See table 1.

**Table 1.** Sociodemographic and psychopathological variables

| **Variable** | **Conservatives(n=30)** | **Liberals (n=30)** | **Non-ideology (n=30)** | **Statistics; LSD post-hoc** |
|---|---|---|---|---|
| *Sociodemographic variables* | | | | |
| Age | 22.70 (4.801) | 24.63 (8.257) | 22.70 (4.154) | $F(2,87)=1.034$ p=.360 NS |
| Gender | 5M, 25F | 5 M, 25F | 4 M, 26F | $\chi^2$ (2)=1.73 p=.917 NS |
| Years of formal education | 12.40(1.544) | 12.26(1.362) | 12.36(1.376) | $F(2,87)=0.71$ p=.932 NS |
| Premorbid intelligence (IQ) | 16.86 (1.736) | 17.13 (1.224) | 16.66 (1.728) | $F(2,87)=0.657$ p=.521 NS |
| CAPE | 1.41(0.296) | 1.43(0.227) | 1.45(0.250) | $F(2,87)=0.142$ p=.864 NS |

## 2.2. Procedure

Participants were tested individually in one experimental session, lasting about 1 hour. Testing was conducted in a distraction-free quiet room. Each participant was screened with the Pictures Decision Task.

### 2.2.1. The Pictures Decision Task

Our experimental procedure is a version of the picture task created by Moritz & Woodward (2007). Ten experimental trials, following two practice trials, were presented. Each trial consisted in a sequence of eight stages, each showing a common object that was increasingly disambiguated by decreasing degrees of visual fragmentation: new object features were added to each new picture until, eventually, the entire object was displayed in the final stage. The objects were depicted as post-edit simple black and white drawings. Instructions and trials were presented using a computer. There were two types of trials (cued and "uncued"). In the cued trials, the drawings were accompanied by a list of six possible interpretations (cues) and the participants were asked to choose an answer and assess the plausibility of their choice on a 5-point Likert scale. In the uncued trials no interpretative cues were provided and the participants were instructed to derive their own interpretations. The practice trials are a guitar with cue and a raft without cue. The experimental trials were run in a fixed order and fully counterbalanced. In all these trials their plausibility was then rated using a five-point Likert scale (1= dismissed, 2= unlikely, 3= possible, 4= likely, 5= positive decision). Examples of the task can be seen in Appendices 4 (cued trial) and 5 (uncued trial). During this new version of this task the presentation of the stages was not interrupted until the participants finish up the drawing, even when the participants evaluated their decision with maximum security before the last stage. We also conceptually divided the task into two parts (the first part consisting of four stages and the last part consisting of four stages). In the first four stages, in the pictures predominated the formal elements of the drawing (circles, lines, etc…) and so the subject could only develop interpretative hypothesis. Throughout the last four stages the

pictures begin to be outlined, and the addition of new elements acted as a feedback on the previous response.

In this new version of the task, different new parameters can be calculated and then used to provide further insight into the underlying mechanisms of JTC bias. Specifically, four parameters were calculated (two old ones and two new ones): Plausibility Rating (PR) BADE/BACE and Draws To Decision (DTD) as the old ones, Number of correct answers (Ac) and Feedback Sensitivity (FS) as the new ones.

**The Plausibility Rating (PR)** was defined as the means to plausibility rating at the eight stages for cued and uncued trials (range 1 to 5). This parameter is used to measure the level of conviction that the subject expresses for his interpretations of the drawing

**The Draws To Decision (DTD)** was defined as the means to number of stages for cued and uncued trials necessary for the participant to reach a final decision about the identity of the objects with absolute certainty (range 1 to 8; the total number of stages per trial). **The Number of correct responses or accuracy (Acc)** at the last stage (max: 5 for cued and 5 for uncued trials).

**The Feedback Sensitivity** (FS) relates the number of errors vs. the number of wrong guesses accomplished in the last four stages. This index checks whether the person realises if he was wrong and tries to change the interpretation of the drawing using the new information received (at each stage) or if he is anchored to the previous wrong answer. To calculate this index, we add to the number of errors (E, taking into account the repetitions) the inverse of the number of wrong guesses (C=number of different wrong conjectures). FS= ($\sum$E + 1/$\sum$C). In this index, a low score means that the feedback is more used.

**Bias Against Disconfirmatory Evidence (BADE)** is the difference score between mean plausibility ratings for incorrect interpretations at the first stage relative to the mean plausibility ratings for incorrect interpretations at later stages. The signature of a BADE effect would be a lower reduction of plausibility ratings for incorrect interpretations across stages (Moritz and Woodward, 2006).

**Bias against confirmatory evidence (BACE)** means plausibility ratings for correct interpretations at the first stage relative to the mean plausibility ratings for correct interpretations at later stages

## 3. Results

### 3.1. Sociodemographic variables

The samples did not differ on any major socio-demographic background variables (age, gender, formal school education, intelligence). Post-hoc group comparisons were more significant than P=0.1 for all parameters, even before correction for multiple comparisons (See Table 1).

### 3.2. Drawing to decision task

Statistical analyses were carried out with SPSS Version 17.0. On the Pictures Decision Task we conducted separate analysis of variance on the different dependent variables. For all analyses, the scores were compared among the three groups (conservatives/liberals and control group). On the Plausibility Rating an ANOVA was performed with a between factor (Group: liberals, conservatives and controls group) and two within factors: condition (with cue vs. without cue), stage (1 to $8^{th}$ stage). For the other parameters (Draws to Decision, Accuracy and Feedback Sensitivity) separate ANOVAs were calculated with a between factor (Group: liberals, conservatives and control group) and a within factor (condition with cue vs. without cue). We calculated

BADE/BACE indexes following Moritz and Woodward (2006). All results are reported as between-groups t-tests differences for the BADE/BACE parameter at the different stages. Finally, correlational analyses were conducted on the entire sample between the indices of the Pictures Decision Task.

3.2.1. Plausibility rating

There was a significant effect of cue [F (1, 87) = 263.105 p<0.001]: The participants were more confident about their interpretations in the cued condition with respect to the uncued condition (3.48 vs. 2.62). There was not a significant cue x group interaction. The stage effect was significant [F (7, 609) = 478.317 p<0.001]: The certainty increased significantly in all stages (1.98, 2.20, 2.37, 2.68, 3.05, 3.47, 4.07, 4.60). Also the cue x stage interaction was significant [F (7, 609) = 27.650 p<0.001]: subjects expressed greater confidence in the cued condition with respect to the uncued condition. In the cued condition the certainty is growing steadily and significantly at different stages.

In the uncued condition there was a certain pattern that may be described in two phases. The first phase is represented by stage 1, 2 and 3: the certainty is consistently low and differs significantly from the certainty expressed in the stages 4, 5, 6, 7, 8. The second phase is represented by stages 4, 5, 6, 7, 8 in which the certainty continues to significantly increase at each stage.

There was a significant stage x group interaction [F (14, 609) = 3.040 p<0.05, see Figure 1]. Conservatives showed more security than liberals and controls. There were significant differences between conservatives and controls in stages 1 (Mean= 2.28 SD= 0.792 Mean= 1.75 SD= 0.512 p<0.05) and 2 (Mean= 2.56 SD= 0.828 Mean= 2.04 SD= 0.565 p<0.05). Also, there were significant differences between conservatives and liberals in stages 2 (Mean= 2.56 SD= 0.828 Mean= 2.02 SD= 0.712 p<0.05), 3 (Mean=

2.63 SD= 0.776 Mean= 2.17 SD= 0.751 p<0.05), stage 4 (Mean= 2.97 SD= 0.581 Mean= 2.49 SD= 0.662 p<0.05) and stage 5 (Mean= 3.33 SD= 0.813 Mean= 2.82 SD= 0.730 p<0.05).

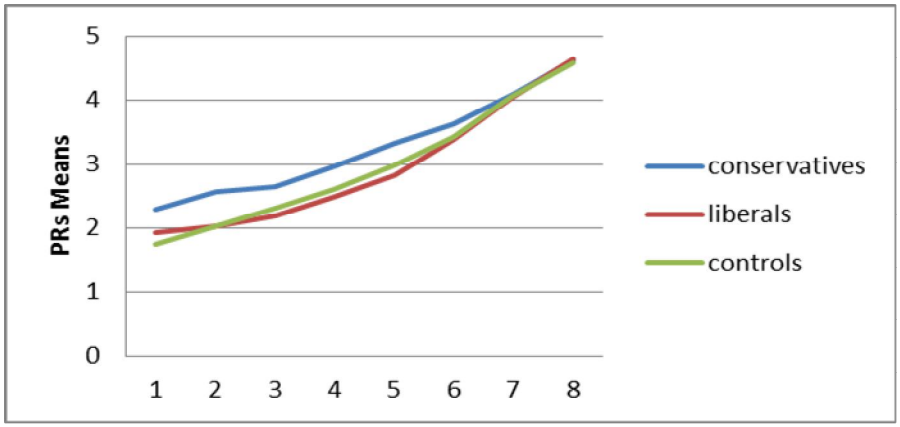


*Figure 1.* Plausibility Rating (PR): comparison between the means of the certainty of the three groups (conservatives, liberals and controls) for each stage (1-8).

3.2.2. Draws to Decisions

There was a significant effect of cue [F (1, 87)=55.531 p<0.001]: Participants showed maximum security before in the cued condition (5.59 vs.6.39). There was a significant main effect of group [F (2, 87)=8.046 p<0.05]. Conservatives showed maximum security in their responses before than liberals and controls (5.46, 6.49 and 6.34 respectively). There are significant differences between conservatives and liberals [F (2, 87)=8.046 p=0.01] and almost significant between conservatives and controls (Mean=5.469 Mean=6.343 p=0.06). There was not a significant cue x group interaction.

3.2.3 Number of correct answers at the stage 8

There was a significant effect of cue [F (1, 87) = 41.359, p <0.001]: participants had higher scores in the cued condition (4.57 vs. 4.00). There was not a significant main effect of group (F<1) or cue x group interaction.

3.2.4 Feedback sensitivity

There was a significant effect of cue [F (1, 87) = 274,231 p <0.001]: in the cued condition feedback is more used than in the uncued condition (5.73 vs. 10.72). There was not significant effect of group, F<1. There was not a significant group x cue interaction. In the two conditions there was not apparent difference between the groups in the use of feedback.

3.2.5. Bias Against Disconfirmatory Evidence (BADE)

The analyses about BADE was collapsed ratings from cued and uncued trials, as Trial Type (cued, uncued) did not yield any significant interaction with Group when entered as an additional within-subject factor. See Figure 2 with Bias Against Disconfirmatory Evidence (BADE): change scores (initial stage to subsequent stages) averaged over uncued and cued trials. Conservatives decreased their plausibility scores significantly less than liberals and non-ideology individuals across time, what means BADE. There were significant differences between groups in the Change 8, where conservatives showed greater scores in plausibility than liberals (Mean=-1.034 SD=1.552 Mean=-2.017 SD=0.861 p<0.05). Also, we obtained significant differences between conservatives and non-ideology participants in the Changes 6 (Mean= -0,790 SD= 1,028 Mean= -1,242 SD= 0,627 p<0.05) and 7 (Mean= -0,816 SD= 1,147 Mean= -1,606 SD= 1,070 p<0.05), where conservatives had higher scores. Finally, there was a

significant difference between liberals and non-ideology group in Change 8 (Mean=-2,173 SD= 0,861 Mean= -1,606 SD= 1,117 p<0.05).

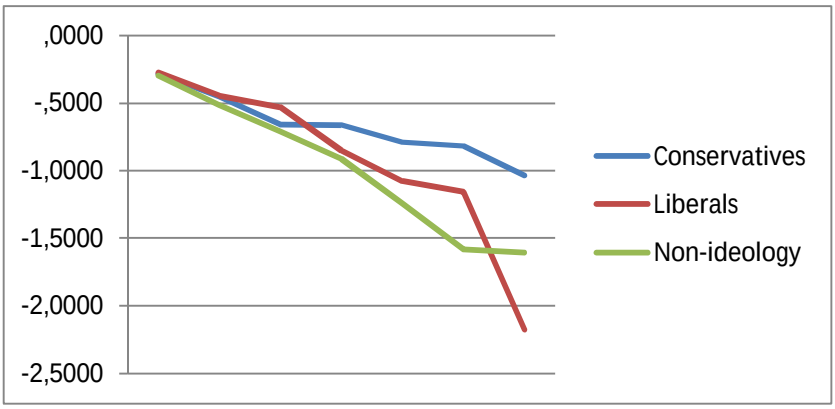


*Figure 2*. Bias Against Disconfirmatory Evidence (BADE) — change Scores in stages 2 to 8, following Moritz and Woodward (2006), figure 1.

3.2.6. Bias Against confirmatory Evidence (BACE)

The analyses about BACE was collapsed ratings from cued and uncued trials, as Trial Type (cued, uncued) did not yield any significant interaction with Group when entered as an additional within-subject factor. Group differences between conservatives and liberals were strongest for stage 7 (Mean= 1.95 SD= 1.457 Mean= 2.71 SD= 0.474 p<0.05) and stage 8 (Mean= 2.26 SD= 1.542 Mean=3.09 SD= 0.425 p<0.05). Conservatives showed lower PR scores increment in the correct responses in last stages, what means higher BACE than liberals. See Figure 3.

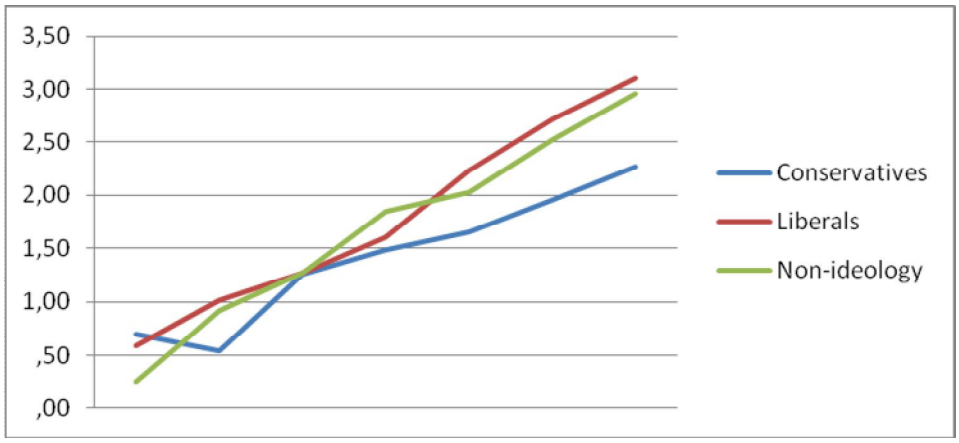


*Figure 3.* Bias Against Confirmatory Evidence (BACE) — significant change scores in stages 7 and 8 between conservatives and liberals.

3.1.7. Correlational analyses.

The correlations show that [see tables 2 to 7 in Appendix 1 (JTC bias), Appendix 2 (BADE/BACE) and Appendix 3]:

• In the cued condition, in the first part of stages all groups showed negative correlations between PR and DTD, it means JTC. Conservatives showed positive associations between number of correct answer and PR at last two stages, so that accuracy is related to PR. However, in the other groups the number of correct answers is not related to PR or DTD. All groups showed negative correlations between accuracy and feedback sensitivity. FS is not related to PR at first stages or to DTD, so that FS is not related to JTC bias.

• In the uncued condition there were negative associations between PR at the first stages and DTD (JTC bias) only in the conservatives and control groups. Conservatives and liberals showed positive associations between number of correct answer and PR at stage 8, so that accuracy is related to PR for them. The number of correct answers is not related to DTD for any group. All groups showed negative correlations between accuracy and feedback sensitivity.

• In the uncued condition, for conservatives a strong conviction which is noticeable at the beginning of the decision-making process, so fewer stages were necessary to arrive at a final decision (lower DTD): what means higher JTC. Conservatives showed more clearly a JTC bias because they showed more confidence at first stages and showed maximum security before than liberals.

•There were positive significant correlations between BADE and PR at stage 1 only for conservatives and backwards there are negative correlations for control ones. In futher, we found negative associations between BADE and PR in all groups. For control ones there were positive correlations between BADE -DTD/accuracy and negative correlations with feedback. With respect to BACE: there were negative significant correlations for conservatives in the last changes and PR1. BADE and BACE showed negative associations between them in all groups. These results reinforce the relationship between these biases and conservatism.

**4. Discussion**

The results of the current study indicate that individuals with conservative ideology showed a higher tendency to Jump to Conclusions than liberals/non-ideology individuals (overall for the difficult version of the task, given uncued condition). However, all groups showed a similar pattern of JTC bias in the cued conditions or the easy version of the task. They made decisions with a high level of confidence when there is little evidence for this. This result confirms our hypothesis because we found that conservatives showed a bigger tendency to JTC bias. Conservatives were more confident in their hypothesis at the beginning of the decision-making process (high PR at the first stages) than liberals and control ones. Also, conservatives were absolutely secured before than liberals and controls (lower DTD).

We did not find differences between liberals and controls in Plausibility Rating and Draws to decision, so liberals and controls behaved similarly. The data evidenced that a Jumping to Conclusions bias may be related to overestimate the conviction in their choices at the beginning of the decision-making process (high PR at first stages). Plausibility Rating and Draws to Decision results may be considered as evidence of a reasoning bias, involving a failure to integrate new evidence when strong initial beliefs exist.

For accuracy and feedback sensitivity, we did not find differences between groups, but the correlational analyses showed a fixed pattern between them (a negative correlation). Accuracy is related to PR and in the two conditions only for the conservative group. In the uncued condition, accuracy is related to PR in the liberal group too. Accuracy is not related to DTD.

For BADE/BACE, we noticed these biases in conservatives only, so it seems that conservadurism is linked to BADE/BACE. These data hold that these cognitive biases can be share common underpinnings. Also, the previous results support the hypothesis that political orientation (liberalism vs. conservatism) is related to cognitive resources (Amodio et al., 2007; Shook and Fazio, 2009; Weissflog et al. 2010; Federico et al., 2011). In these studios, conservadurism is related to differences in cognitive functioning, specifically conservatives displayed lower tolerance to ambiguity, so this leads them to made decisions quickly. In our studio, conservatives showed higher JTC at first stages and higher BADE at last stages. Liberals and controls showed a bias in favor of confirmatory evidence at last stages. Maybe, conservatives made decisions based on intuitions and impressions (Kahneman, 2011) rather than a systematic development of the information. This saving of "mental effort" allows conservatives to maintain and automated surface of the context with which they interact. However,

when heuristics are used indiscriminate can lead sometimes to make bad decisions, as we know by our own experiences. We must remind that these cognitive biases may combine to contribute to the formation of delusions (Garety & Freeman, 1999; Green et al., 2000), what could mean that conservatives are more "schizotypycal" or less sensitive to evidence. We found a significant higher positive correlation between PR at the first stages with schizotypy positive dimension and a higher negative correlation between schizotypy positive dimension and DTD for conservatives versus liberals (See Appendix 3). Conservatives showed more plausibility in their expectative at the beginning of the decision-making process. They also showed less DTD or less time to arrive to a final decision with high confidence. What means that they jump to conclusions and they also showed Bias against Disconfirmatory Evidence, related to their convictions at the beginning of the decision-making process. They also showed higher correlations between the parameters related to JTC (PR and DTD) and the positive dimension of CAPE. It must be said that we have confirmed these cognitive biases in conservatives with an experimental methodology and that these cognitive biases are related with delusions, what means a domain of the idea over the evidence or wishful thinking (Krizan and Windschitl, 2009; Krizan et al., 2010; Meffert et al., 2011; Bastardi et al., 2011).

The result found in the present study should be interpreted considering the following limitations. First, there is the problem inherent to the application any type of self-report. Second, to assess the representativeness of the sample, it would have been favorable to determine additional cognitive (e.g., executive functioning, reasoning) and meta-cognitive measures. Third, the present sample was a small one. Thus, group differences may have failed to emerge due to a lack of power. In future lines of research, we will study JTC and BADE in other age groups and for different educational

levels. Also, we have to investigate more deeply the relationship of schizotypy and conservadurism, especially with the positive dimension. We show interest also in a possible relationship between JTC and wishful thinking (Krizan and Windschitl, 2009; Krizan et al., 2010) or desirability bias.

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## Appendix 1.

Table 2. Results of Pearson's correlation between the parameters of the Picture Decision Task in the cued condition conduct on all groups.

| | JTC (Cued Trial) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Conservatives | | | Liberals | | | Non-ideology | | |
| | DTD | Acc | FS | DTD | Acc | FS | DTD | Acc | FS |
| PR1 | -,329 | **,365*** | -,084 | **-,670**** | ,014 | ,027 | -,323 | 0,018 | 0,115 |
| PR2 | **-,641**** | ,197 | -,003 | **-,713**** | -,107 | ,062 | **-,468**** | -0,225 | 0,328 |
| PR3 | **-,586**** | ,180 | -,090 | **-,643**** | ,100 | ,002 | **-,663**** | -0,285 | 0,055 |
| PR4 | **-,748**** | ,254 | -,111 | **-,691**** | -,205 | ,259 | **-,569**** | -0,177 | 0,091 |
| PR5 | **-,714**** | ,303 | -,103 | **-,642**** | -,177 | ,177 | **-,674**** | -0,01 | -0,087 |
| PR6 | **-,661**** | ,338 | -,273 | **-,569**** | -,207 | ,123 | **-,794**** | 0,113 | -0,153 |
| PR7 | **-,517**** | **,450*** | **-,412*** | -,333 | -,291 | -,217 | **-,559**** | 0,199 | -0,274 |
| PR8 | **-,535**** | **,614**** | -,331 | -,056 | -,208 | -,216 | 0,283 | 0,172 | -0,083 |
| DTD | 1 | -,315 | ,228 | 1 | ,247 | -,169 | 1 | 0,077 | -0,092 |
| ACC | -,315 | 1 | **-,400*** | ,247 | 1 | **-,559**** | 0,077 | 1 | **-,606**** |
| FS | ,228 | **-,400*** | 1 | -,169 | **-,559**** | 1 | -0,092 | **-,606**** | 1 |

* $p < 0.05$; ** $p < 0.001$

Table 3. Results of Pearson's correlation between the parameters of the Picture Decision Task in the uncued condition conduct on all groups.

| | JTC (Uncued Trial) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Conservatives | | | Liberals | | | Non-ideology | | |
| | DTD | Acc | FS | DTD | Acc | FS | DTD | Acc | FS |
| PR1 | **-,756**** | ,050 | ,028 | -,219 | ,141 | ,113 | **-,586**** | -,239 | ,229 |
| PR2 | **-,672**** | ,033 | ,062 | -,212 | ,035 | -,160 | **-,656**** | -,252 | ,282 |
| PR3 | **-,667**** | ,065 | ,023 | -,346 | ,005 | -,178 | **-,511**** | -,275 | ,265 |
| PR4 | **-,566**** | ,053 | -,004 | -,251 | ,070 | -,198 | **-,471**** | -,338 | ,190 |
| PR5 | **-,568**** | ,081 | -,035 | -,345 | ,097 | -,273 | **-,416*** | -,038 | -,095 |
| PR6 | **-,597**** | ,305 | **-,365*** | **-,449*** | -,091 | -,283 | **-,591**** | ,117 | -,166 |
| PR7 | **-,518**** | ,303 | -,286 | -,241 | ,091 | -,320 | **-,526**** | ,215 | **-,377*** |
| PR8 | -,179 | **,383*** | **-,429*** | -,034 | **,397*** | -,261 | -,131 | ,293 | -,325 |
| DTD | 1 | ,101 | -,186 | 1 | ,307 | -,123 | 1 | ,352 | -,214 |
| ACC | ,101 | 1 | **-,790**** | ,307 | 1 | **-,626**** | ,352 | 1 | **-,755**** |
| FS | -,186 | **-,790**** | 1 | -,123 | **-,626**** | 1 | -,214 | **-,755**** | 1 |

* $p < 0.05$; ** $p < 0.001$

**Appendix 2.**

Table 4. Results of Pearson's correlation between the parameters of the Picture Decision Task and BADE/BACE in the uncued and cue condition conduct on conservatives group.

| | **Conservatives** | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **BADE** | | | | | | | **BACE** | | | | | | |
| **Change** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **2** | **3** | **4** | **5** | **6** | **7** | **8** |
| **PR1** | **,370*** | **,385*** | **,488**** | **,484**** | **,538**** | **,439**** | **,609**** | **,769**** | -,386 | -,282 | -,325 | **-,441*** | **-,595**** | **-,633**** |
| **PR2** | -,294 | -,192 | -,086 | -,085 | ,116 | ,002 | ,009 | **,720**** | -,255 | -,272 | -,310 | -,091 | -,241 | -,352 |
| **PR3** | **-,376*** | **-,357*** | -,238 | -,208 | -,057 | -,143 | -,113 | **,734**** | -,414 | -,288 | -,336 | -,102 | -,252 | -,350 |
| **PR4** | -,168 | -,208 | -,192 | -,091 | ,023 | -,130 | -,083 | **,735**** | **-,527*** | -,264 | **-,394*** | -,209 | **-,389*** | **-,490**** |
| **PR5** | **-,377*** | **-,349*** | **-,372*** | -,294 | -,217 | -,283 | -,278 | ,521 | -,218 | -,148 | -,179 | ,019 | -,176 | -,283 |
| **PR6** | **-,339*** | **-,443**** | **-,473**** | **-,394*** | **-,358*** | **-,357*** | -,303 | ,167 | -,016 | ,008 | -,043 | ,225 | ,034 | -,072 |
| **PR7** | **-,397*** | **-,420*** | **-,429**** | **-,366*** | **-,262** | **-,376*** | -,267 | ,341 | -,195 | -,014 | -,088 | ,152 | ,009 | -,089 |
| **PR8** | **-,355*** | **-,374*** | -,275 | -,241 | -,269 | -,234 | -,239 | -,080 | -,163 | ,078 | ,028 | ,221 | ,080 | -,001 |
| **DTD** | ,015 | ,051 | -,008 | -,050 | -,099 | -,077 | -,173 | ,247 | ,378 | ,352 | ,296 | ,183 | -,165 | -,370 |
| **Acc** | -,100 | -,173 | -,230 | -,201 | -,136 | ,020 | -,087 | -,314 | ,191 | ,219 | ,189 | ,204 | ,065 | -,035 |
| **FS** | ,028 | ,154 | ,221 | ,110 | ,212 | ,005 | ,115 | ,141 | -,015 | -,138 | -,060 | -,109 | ,028 | ,069 |

* $p < 0.05$; ** $p < 0.001$

Table 5. Results of Pearson's correlation between the parameters of the Picture Decision Task and BADE/BACE in the uncued and cue condition conduct on liberals group.

**Liberals**

| | **BADE** | | | | | | **BACE** | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Change** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **2** | **3** | **4** | **5** | **6** | **7** | **8** |
| **PR1** | ,094 | ,095 | ,279 | ,259 | ,273 | **,368*** | ,317 | -,496 | -,375 | -,116 | -,020 | -,163 | -,342 | -,331 |
| **PR2** | **-,645**** | **-,397*** | -,356* | -,317 | **-,329*** | -,151 | -,042 | -,088 | -,312 | -,084 | -,012 | -,235 | -,225 | -,327 |
| **PR3** | **-,432*** | **-,490**** | -,241 | -,208 | -,190 | -,005 | -,106 | -,304 | -,300 | ,048 | ,169 | -,148 | -,099 | -,166 |
| **PR4** | -,236 | -,187 | -,297 | -,189 | -,181 | -,058 | -,159 | -,431 | -,399 | ,145 | ,025 | -,102 | -,130 | -,137 |
| **PR5** | -,227 | -,316 | -,330* | -,313 | -,281 | -,139 | -,170 | -,248 | -,201 | ,306 | ,256 | ,116 | ,080 | -,116 |
| **PR6** | -,305 | **-,419*** | **-,384*** | **-,464**** | -,413* | -,321 | -,173 | -,222 | -,070 | **,406*** | ,367 | ,341 | ,274 | -,077 |
| **PR7** | **-,423*** | **-,475**** | **-,532**** | **-,540**** | **-,537**** | -,322 | -,258 | -,013 | -,165 | ,300 | ,223 | -,030 | ,272 | ,277 |
| **PR8** | -,162 | -,225 | -,270 | -,231 | -,135 | -,041 | -,205 | -,363 | -,031 | ,089 | ,101 | -,131 | ,249 | **,480*** |
| **DTD** | ,161 | ,301 | ,071 | ,059 | ,103 | -,204 | -,091 | -,313 | ,067 | ,098 | ,095 | ,151 | -,110 | -,275 |
| **Acc** | ,099 | ,034 | ,163 | ,086 | ,168 | -,052 | -,253 | ,182 | ,370 | -,022 | ,276 | ,091 | ,224 | ,206 |
| **FS** | ,008 | -,013 | -,096 | ,001 | -,088 | ,003 | ,028 | -,216 | -,305 | ,002 | -,191 | -,113 | -,376 | -,266 |

* $p < 0.05$; ** $p < 0.001$

## Appendix 3.

Correlational analyses were conducted on the entire sample between the indices of the Pictures Decision Task and the Community Assessment of Psychic Experience, CAPE. See Table 6.

Table 6. Results of Pearson's correlation between the parameters of the Picture Decision Task and the Community Assessment of Psychic Experience, CAPE.

| | JTC | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Conservatives** | **PR1** | **PR2** | **PR3** | **PR4** | **PR5** | **PR6** | **PR7** | **PR8** | **DTD** | **ACC** | **FS** |
| **Positive** | **,654*** | **,691**** | **,644*** | **,551** | **,518** | **,595*** | ,531 | ,280 | **-,638*** | -,033 | ,326 |
| **Negative** | ,361 | ,251 | ,282 | ,142 | ,277 | ,455 | ,105 | ,237 | -,308 | ,031 | ,139 |
| **Depressive** | ,219 | ,149 | ,077 | ,247 | ,209 | ,183 | ,335 | -,098 | -,303 | -,057 | ,494 |
| **Liberals** | | | | | | | | | | | |
| **Positive** | ,270 | **,467*** | ,348 | ,289 | ,374 | ,266 | -,129 | -,241 | **-,443*** | ,007 | ,358 |
| **Negative** | ,053 | ,113 | ,060 | -,079 | ,091 | ,224 | -,113 | -,121 | -,110 | ,140 | ,340 |
| **Depressive** | ,063 | ,172 | ,075 | -,003 | ,144 | ,252 | -,069 | -,176 | -,200 | -,016 | ,375 |

* $p < 0.05$; ** $p < 0.001$

# Capítulo 4: Differences between believers and non-believers in Cognitive biases (BADE and Jumping to Conclusions)

**Abstract**

Religion is an important aspect of our cultural identity. Neurocognitive research has found differences between religious and non-religious participants. We examine the differences between individuals with different religious beliefs (believers vs. non-believers) in a cognitive bias named "Jumping to conclusions" (JTC), defined as a decision made quickly on the basis of little evidence. Pictures to Decision task was assessed in 30 believers and 30 non-believers participants. In addition to the traditional parameters of this task (Plausibility Rating and Draws to Decision), we also calculated BADE/BACE and new parameters, Feedback Sensitivity and the number a correct answers. We found that individuals with religious beliefs showed a higher tendency to jump to conclusions, especially in difficult task-situations. These results supported that religion is related to cognitive styles.

Keywords: Jumping to conclusions, pictures to decision task, religious research, believers, non-believers.

## 1.**Introduction**

The interest in the field of psychology in Religion is dated from century XIX (Edwin Starbuck, 1899). Psychologists consider that a religious or non-religious identity is an important aspect of our cultural identity. Several studies have found associations between religion and better mental and physical health (Seybold & Hill, 2001), high conscientiousness (Saroglou, 2002), conservatism and traditionalism (Hood et al., 1996) and high agreeableness and negative correlations with openness (Taylor et al., 1999).

Boyer (2003) postulates that religious beliefs emerge from mental categories and cognitive tendencies that are previous to religion. Recently, a cognitive neuro-scientific approach has been adopted to study religious beliefs and try to locate its basis in the brain (Inzlicht et al., 2009; Kapogiannis et al., 2009; Kaplan et al., 2009; Asp et al., 2012). For example, Asp, Ramachandran and Tranel (2012) found that patients with focal damage to the ventromedial prefrontal cortex (vmPFC) expressed higher levels of authoritarianism and religious fundamentalism that increased in specific religious beliefs following their brain injury. The other interesting studio has been realized by Inzlicht et al., (2009) who obtained that religious conviction is marked by reduced reactivity (to uncertainty and error ) in the anterior cingulate cortex (ACC). These results are similar to the results of Amodio et al., (2007) who found that the conservatism was associated with lowers neurocognitive sensitivity to stimuli that produced response conflicts, that is, reduced ACC activity. Believers, then, like conservatives can have a high need for cognitive closure and less tolerance to uncertainty (Jost et al., 2003; Amodio, et al., 2007). In base of these studies we suggest that, like liberalism vs. conservatism (Juárez-Ramos et al., 2012), religious vs. non-religious can be related to different cognitive styles. We are interested in examining jumping-to-conclusions between believers and non-believers using a new version of

Drawing to Decision task, previously used in other studies about this cognitive bias (Moritz et al., 2006; Rubio et al., 2011). The jumping to conclusion bias has been studied mainly in schizophrenia research; in particular, this cognitive bias has been consistently obtained in schizophrenic patients with delusions (Huq et al., 1988; Moritz et al, 2007; Speechley et al., 2010). Recently, several studies have been interested in/focused on (?) examining this phenomenon in non-clinical populations (Warman and Martín, 2006; Mckay et al., 2006; Lincoln et al., 2010; Lincoln et al., 2011; Lee et al., 2011). The "Jumping to Conclusions" cognitive bias is produced when there is a tendency to make decisions with a high level of precipitation when there is little evidence to do this. Nowadays there is not a unified hypothesis to explain the JTC bias, but there are two major hypotheses (Averbeck et al., 2011). The first hypothesis supports that individuals with JTC bias overestimate the conviction in their choices at the beginning of the decision process (Lincoln et al., 2010). The second hypothesis called “The hypothesis of Liberal Acceptation” affirms that individuals with this cognitive bias have a low threshold for acceptance, so they need less information to make a decision (Moritz and Woodward, 2004). Also, we investigated the relationship between JTC bias and the Bias Against Disconfirmatory Evidence (BADE) which was found in patients with schizophrenia and healthy population (Buchy, Woodward and Liotti, 2007; Moritz and Woodward, 2006). The dimensional model of schizophrenia predicts unifying cognitive biases or combined cognitive biases which may to contribute to the formation of the delusional aspects of psychosis (Buchy, Woodward and Liotti, 2007). Up until today it remains unclear whether these reasoning biases are independent or share common underpinnings (Munz, 2011).

In the Pictures to Decision task, we have introduced two new parameters (explained in the method section): number of correct answers at stage 8 and Feedback

sensitivity, in order to clarify why this cognitive bias happens. However, like in the previous versions of the tasks, the principal dependent measures were the Plausibility Rating of each stimulus presented in all stages and Draws to Decision (the number of stimulus necessary to reach a final decision about their identity). These measures were analyzed in two kinds of trial sessions ("cued" and "uncued"; that is, with and without interpretative cues or easy and difficult version of the task). This last characteristic allows us to analyze the effect of the context in which the decisions are made.

Our hypothesis (based on previous results about cognitive functioning) is that believers show a higher Jumping to Conclusion bias and BADE with respect to non- believers.

## 2. Method

### 2.1. Participants

A sample of 60 people participated in this experiment. We used a group of 30 participants with religious belief and another group of 30 non-believers. Premorbid intelligence was determined by "Test de acentuación de palabras TAP-30" (González Montalvo, 1991). It is a Spanish adaptation validated through the North American Adult Reading Test (NART; Nelson, 1982). The NART was developed as a measure for estimating premorbid intelligence in patients with schizophrenia (for a review, see O'Carroll, 1995; Russell et al., 2000) and is viewed as providing a good estimate of premorbid IQ because it: (a) predicts much of the variance in current WAIS IQ; (b) has high reliability in normal subjects (Kondel et al., 2003). The TAP-30 is a measure of intelligence in which the participant is instructed to reading 30 words of irregular pronunciation. All participants reported an absence of cerebral damage and no clinical evidence of drug abuse during the course of the study. Also, healthy participants

reported an absence of mental disorder. Participants were recruited via adverts in the faculty of Psychology at the University of Granada. See table 1.

**Table 1.** Sociodemographic and psychopathological variables

| Variable | Believers(n=30) | Non-believers (n=30) | Statistics; LSD post-hoc |
|---|---|---|---|
| *Sociodemographic variables* | | | |
| Age | 21.60 (2.044) | 22.47 (2.608) | $F(1,58)=2.051$ p=.158 NS |
| Gender | 10M, 20F | 10M, 20F | $\chi^2$ (1)=.000 p=1.000 NS |
| Years of formal education | 13.73(0.739) | 13.80(0.805) | $F(1,58)=0.112$ p=.740 NS |
| Premorbid intelligence (IQ) | 17.30 (1.878) | 16.93 (1.964) | $F(1,58)=0.546$ p=.463 NS |

## 2.2. Procedure

Participants were tested individually in one experimental session, lasting about 1 hour. Testing was conducted in a distraction-free quiet room. Each participant was screened with the Pictures Decision Task.

### 2.2.1. The Pictures Decision Task

Our experimental procedure is a version of the picture task created by Moritz & Woodward (2007). Ten experimental trials, following two practice trials, were presented. Each trial consisted in a sequence of eight stages, each showing a common object that was increasingly disambiguated by decreasing degrees of visual fragmentation: new object features were added to each new picture until, eventually, the entire object was displayed in the final stage. The objects were depicted as post-edit simple black and white drawings. Instructions and trials were presented using a computer. There were two types of trials (cued and "uncued"). In the cued trials, the drawings were accompanied by a list of six possible interpretations (cues) and the participants were asked to choose an answer and assess the plausibility of their choice

on a 5-point Likert scale. In the uncued trials no interpretative cues were provided and the participants were instructed to derive their own interpretations. The practice trials are a guitar with cue and a raft without cue. The experimental trials were run in a fixed order and fully counterbalanced. In all these trials their plausibility was then rated using a five-point Likert scale (1= dismissed, 2= unlikely, 3= possible, 4= likely, 5= positive decision). Examples of the task can be seen in Appendices 3 (cued trial) and 4 (uncued trial). During this new version of this task the presentation of the stages was not interrupted until the participants finish up the drawing, even when the participants evaluated their decision with maximum security before the last stage. We also conceptually divided the task into two parts (the first part consisting of four stages and the last part consisting of four stages). In the first four stages, in the pictures predominated the formal elements of the drawing (circles, lines, etc…) and so the subject could only develop interpretative hypothesis. Throughout the last four stages the pictures begin to be outlined, and the addition of new elements acted as a feedback on the previous response.

In this new version of the task, different new parameters can be calculated and then used to provide further insight into the underlying mechanisms of JTC bias. Specifically, four parameters were calculated (two old ones and two new ones): Plausibility Rating (PR) BADE/BACE and Draws To Decision (DTD) as the old ones, Number of correct answers (Ac) and Feedback Sensitivity (FS) as the new ones.

**The Plausibility Rating (PR)** was defined as the means to plausibility rating at the eight stages for cued and uncued trials (range 1 to 5). This parameter is used to measure the level of conviction that the subject expresses for his interpretations of the drawing

**The Draws To Decision (DTD)** was defined as the means to number of stages for cued and uncued trials necessary for the participant to reach a final decision about the identity of the objects with absolute certainty (range 1 to 8; the total number of stages per trial).

**The Number of correct responses or accuracy (Acc)** at the last stage (max: 5 for cued and 5 for uncued trials).

**The Feedback Sensitivity** (FS) relates the number of errors vs. the number of wrong guesses accomplished in the last four stages. This index checks whether the person realises if he was wrong and tries to change the interpretation of the drawing using the new information received (at each stage) or if he is anchored to the previous wrong answer. To calculate this index, we add to the number of errors (E, taking into account the repetitions) the inverse of the number of wrong guesses (C=number of different wrong conjectures). FS= ($\sum$E + 1/$\sum$C). In this index, a low score means that the feedback is more used.

**Bias Against Disconfirmatory Evidence (BADE)** is the difference score between mean plausibility ratings for incorrect interpretations at the first stage relative to the mean plausibility ratings for incorrect interpretations at later stages. The signature of a BADE effect would be a lower reduction of plausibility ratings for incorrect interpretations across stages (Moritz and Woodward, 2006).

**Bias against confirmatory evidence (BACE)** means plausibility ratings for correct interpretations at the first stage relative to the mean plausibility ratings for correct interpretations at later stages.

## 3. Results

### 3.1. Sociodemographic variables

The samples did not differ on any major socio-demographic background variables (age, gender, formal school education, intelligence). Post-hoc group comparisons were more significant than P=0.1 for all parameters, even before correction for multiple comparisons (See Table 1).

### 3.2. Drawing to decision task

Statistical analyses were carried out with SPSS Version 17.0. On the Pictures Decision Task we conducted separate analysis of variance on the different dependent variables. For all analyses, the scores were compared among the three groups (conservatives/liberals and control group). On the Plausibility Rating an ANOVA was performed with a between factor (Group: liberals, conservatives and controls group) and two within factors: condition (with cue vs. without cue), stage (1 to $8^{th}$ stage). For the other parameters (Draws to Decision, Accuracy and Feedback Sensitivity) separate ANOVAs were calculated with a between factor (Group: liberals, conservatives and control group) and a within factor (condition with cue vs. without cue). We calculated BADE/BACE indexes following Moritz and Woodward (2006). All results are reported as between-groups t-tests differences for the BADE/BACE parameter at the different stages. Finally, correlational analyses were conducted on the entire sample between the indices of the Pictures Decision Task.

3.2.1. Plausibility rating

There was a significant effect of cue [F (1, 58) = 268.022 p<0.001]: The participants were more confident of their hypothesis in the cued condition with respect to the uncued condition (3.49 vs. 2.59).

The stage effect was significant [F (7, 406) = 444.517 p<0.001]: The certainty increased significantly at all stages (1.85, 2.14, 2.37, 2.65, 3.02, 3.49, 4.07, 4.70). In addition, the cue x stage interaction was significant [F (7, 406)= 31.394 p<0.001]: Participants express greater confidence in the cued condition with respect to the uncued condition. In the cued condition the certainty is increasing steadily and significantly at different stages.

In the uncued condition the certainty followed a pattern that may be described in three phases. The first phase is depicted by stage 1 in which the certainty increased significantly at each stage. The second phase is depicted by stage 2, 3 and 4: the certainty was consistently low and differed significantly from the certainty expressed in the stages 5, 6, 7, 8. The third phase is depicted by stages 5, to 8 in which the certainty increase significantly at each stage.

There was almost significant interaction between stage x group [F (7, 406) = 3.384 p=0.07]. We obtained a significant difference between believers vs. non-believers groups at stages 1(Mean=1.99, SD=0.483; Mean=1.71 SD=0.43 p<.005), 2(Mean=2.35, SD=0.822; Mean=1.93, SD=0.422, p<.005), 4(Mean=2.84, SD=0.564; Mean=2.46, SD=0.536: p<.005) and 5(Mean=3.22, SD=0.583; Mean=2.82, SD= 0.59: p<.005). Believers showed more confidence in these stages than non-believers. See Figure 1.

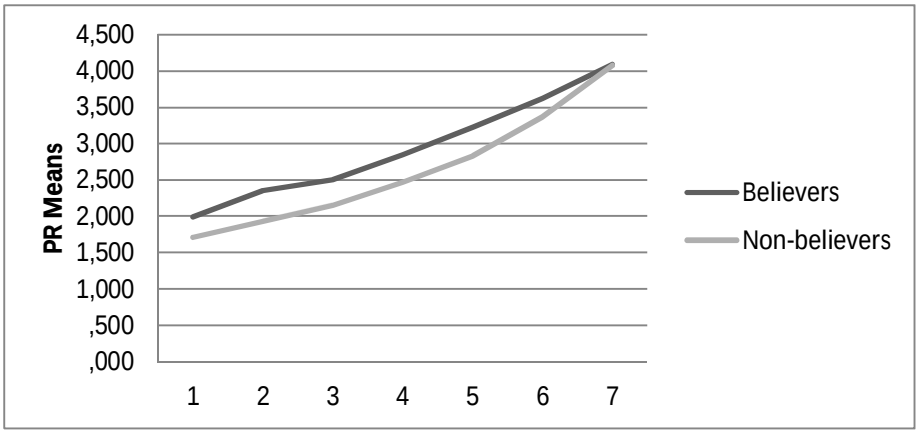


*Figure 1.* Plausibility Rating (PR): comparison between the means of the certainty of the two groups (believers and non-believers) for each stage (1-8).

3.2.2. Draws to Decisions

There was a significant effect of cue [F (1, 58)=75.710 p<0.001]: Participants expressed maximum safety before in the cued condition (5.71 vs.6.92). There was a significant main effect of group [F (1, 58)=8.414 p=0.05, see Figure 2]: believers showed maximum security before than non-believers (5.98 vs. 6.65). There was not a significant cue x group interaction.

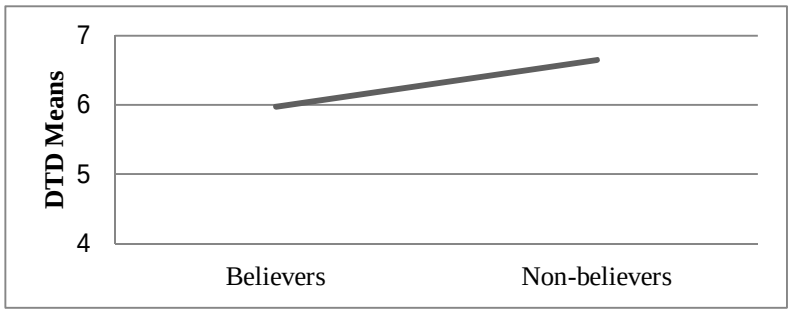


*Figure 2.* Drawing to Decision (DTD) means for the two groups (believers and non-believers): Number of stages necessary to take the final decision.

3.2.3 Number of correct answers at the stage 8

There was a significant effect of cue [F (1, 58) = 24.262, p <0.001]: participants had higher scores in the cued condition (4.68 vs. 4.05). There was not a significant main effect of group (F<1) or cue x group interaction. However, we found that the believers did show significant differences between cued and uncued condition (Mean=4.70 (SD=0.534); Mean=3.86 (SD=0.776), p=.000) and non-believers did not (Mean=4.67 (SD=0.546); Mean=4.23 (SD=0.678), p=.020).

3.2.4 Feedback sensitivity

There was a significant effect of cue [F (1, 58) = 184,523 p <0.001]: in the cued condition feedback was more used than in the condition without cue (5.47 vs. 10.77).There was not a significant effect of group, F<1. There was not a significant group x cue interaction. In the two conditions there was not an apparent difference between the groups in the use of feedback.

3.2.5. Bias Against Disconfirmatory Evidence (BADE)

The analyses about BADE was collapsed ratings from cued and uncued trials, as Trial Type (cued, uncued) did not yield any significant interaction with Group when entered as an additional within-subject factor. See Figure 3 with Bias Against Disconfirmatory Evidence (BADE): change scores (initial stage to subsequent stages) averaged over uncued and cued trials. Believers decreased their plausibility scores like non-believers individuals across time, what means similar BADE for both groups .

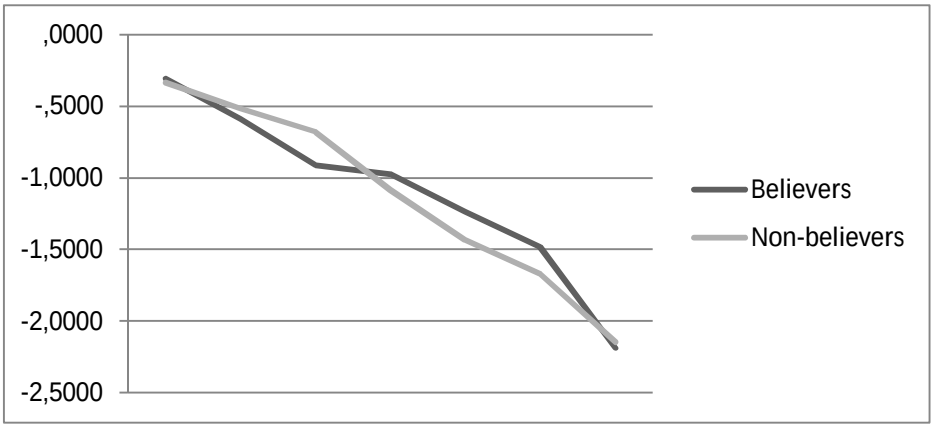


*Figure 3*. Bias Against Disconfirmatory Evidence (BADE) — change Scores in stages 2 to 8, following Moritz and Woodward (2006), figure 1.

3.2.6. Bias Against confirmatory Evidence (BACE)

The analyses about BACE was collapsed ratings from cued and uncued trials, as Trial Type (cued, uncued) did not yield any significant interaction with Group when entered as an additional within-subject factor. Believers showed a similar PR scores increment in the correct responses, what means similar BACE than non-believers. See Figure 4.

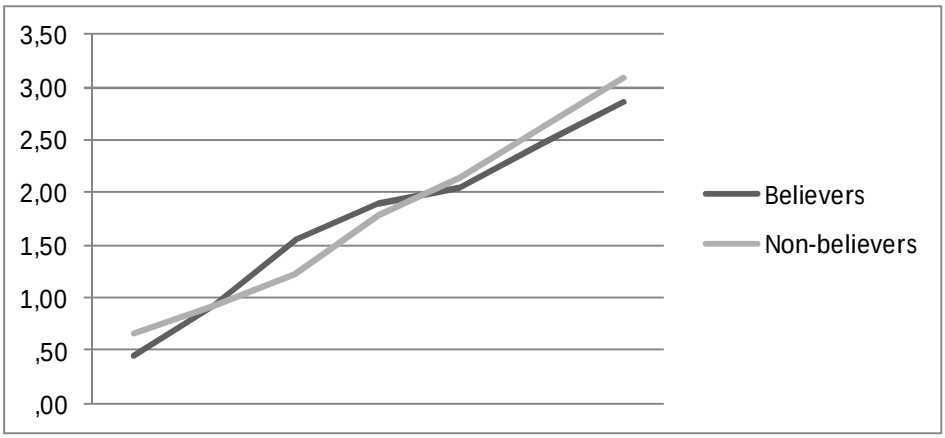


*Figure 4*. Bias Against Confirmatory Evidence (BACE) — change Scores in stages 2 to 8, following Moritz and Woodward (2006), figure 2.

3.2.5. Correlational analyses.

The correlations show that [see tables 2 to 4 in Appendix 1 (JTC bias) and Appendix 2 (BADE/BACE)]:

• In the cued condition, in the first (and intermediate part of) stages all groups showed negative correlations between PR and DTD, what means JTC bias.

• Believers showed positive correlations between number of correct answer and PR at first three stages, so that accuracy was related to PR. For all groups, accuracy was not linked to DTD. Non-believers evidenced a negative association between accuracy and feedback sensitivity.

• In the uncued condition (difficult version of the task) only believers showed negative correlations between PR at the first four stages and DTD, that is, a strong confidence in their interpretations at the beginning of the decision-making process, that lead to need fewer stages to arrive at a final decision, that is, they displayed the JTC bias from the beginning.

• Believers showed negative associations between accuracy and PR at stage 4 (and a positive association at stage 8). In addition, only believers had a positive association between accuracy and DTD. Non-believers showed positive associations between accuracy with PR at stages 7 and 8. The accuracy was related to PR and DTD in the believers group but only to PR in non-believers group. All groups showed negative correlations between accuracy and feedback sensitivity. The Feedback sensitivity index seems to be not related to JTC bias.

•There were negative significant correlations between BADE and PR at the first stage and positive correlations at the last stage in all groups. For BACE, there were negative significant correlations with PR and positive with DTD in the two groups. Non-

believers showed negative associations between accuracy and BACE in the intermediate changes. Also, we found negative associations between BACE and FS in believers only. BADE and BACE showed negative associations between them in all groups.

## 4. Discussion

The results of our study suggest that individuals with a religious belief displayed a greater tendency to Jump to Conclusions than non-believers (higher PR at first stages and lower DTD for both conditions –cued and uncued; but overall for the difficult version of the task, uncued condition). They made decisions with a high level of confidence when there is little evidence to do this. The expected pattern in people with JTC bias is a negative correlation between PR and DTD at first stage and a negative correlation between PR and accuracy at first stages (in the uncued condition or difficult version of the task). In the cued condition, accuracy normally is not affected by JTC bias. In general, believers were more confident in their hypothesis at the beginning of the decision-making process (higher PR at the first stage) than non-believers. Also, in general, believers were absolute security before than non-believers (lower DTD). Accuracy is related to PR at first stages and DTD in the uncued condition only for believers. These results point to a Jumping to Conclusions bias that may be related to overestimating the conviction in their choices at the beginning of the decision-making process (high PR at first stages). Lower Draws to Decision results associated to errors may be considered as evidence of a reasoning bias, involving a failure to integrate new evidence when strong initial beliefs exist. In relation to accuracy and feedback sensitivity, we did not find differences between groups, in fact the correlation analyses showed a fixed pattern between them (a negative correlation). Accuracy is related to PR and DTD in the two conditions only for the believers group (but in different directions).

Only in the uncued condition accuracy is related to PR for the non-believers group (a positive correlation in the last stage: that must be expected because the drawing is completed). For BADE/BACE, we did not find differences between samples, so religious belief seems to be not linked to these biases.

The previous results supported the hypothesis that religious beliefs (believers vs. non-believers) can be related to cognitive styles (Amodio et al., 2007; Inzlicht et al., 2009) and that these cognitive tendencies probably were previous to religion (Boyer, 2003) because the JTC bias is unconscious and related to personality traits (Mckay et al., 2006; Lincoln et al., 2010).

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## Appendix 1.

Table 2. Results of Pearson's correlation between the parameters of the Picture Decision Task in the two conditions conduct on believers and non-believers group.

| | JTC (Cued Trial) | | | | | | JTC (Uncued Trial) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Believers | | | Non-Believers | | | Believers | | | Non-Believers | | |
| | DTD | Acc | FS | DTD | Acc | FS | DTD | Acc | FS | DTD | Acc | FS |
| PR1 | -,277 | **,394*** | -,120 | -,226 | -,028 | ,279 | **-,554**** | -,083 | ,177 | ,259 | ,243 | ,022 |
| PR2 | **-,556**** | **,524**** | -,047 | **-,397*** | -,157 | **,512**** | **-,731**** | -,251 | ,257 | ,082 | ,266 | -,059 |
| PR3 | **-,709**** | **,441*** | -,055 | -,169 | ,066 | ,028 | **-,763**** | -,240 | ,303 | -,182 | ,101 | -,013 |
| PR4 | **-,607**** | ,098 | ,295 | **-,572**** | -,130 | ,213 | **-,788**** | **-,457*** | **,462*** | -,268 | ,198 | -,167 |
| PR5 | **-,662**** | ,322 | ,125 | **-,609**** | -,018 | ,143 | **-,835**** | -,301 | ,232 | -,315 | ,277 | -,209 |
| PR6 | **-,696**** | ,148 | ,034 | **-,642**** | ,154 | ,151 | **-,747**** | ,009 | -,114 | **-,384*** | ,304 | -,245 |
| PR7 | -,253 | ,065 | -,103 | -,318 | ,230 | -,309 | **-,730**** | ,003 | -,086 | -,233 | **,432*** | **-,384*** |
| PR8 | -,225 | ,324 | -,254 | -,254 | ,231 | ,114 | -,151 | **,408*** | -,282 | -,176 | **,553**** | **-,394*** |
| DTD | 1 | -,328 | -,055 | 1 | ,048 | -,175 | 1 | **,364*** | -,283 | 1 | ,132 | ,078 |
| ACC | -,328 | 1 | -,362 | ,048 | 1 | **-,527**** | **,364*** | 1 | **-,761**** | ,132 | 1 | **-,504**** |
| FS | -,055 | -,362 | 1 | -,175 | **-,527**** | 1 | -,283 | **-,761**** | 1 | ,078 | **-,504**** | 1 |

* $p < 0.05$; **$p < 0.001$

**Appendix 2.**

Table 3. Results of Pearson's correlation between the parameters of the Picture Decision Task and BADE in the two conditions conduct on believers and non-believers group.

| | **Believers** | | | | | | | **Non-believers** | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **BADE** | | | | | | | **BADE** | | | | | | |
| **Change** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **2** | **3** | **4** | **5** | **6** | **7** | **8** |
| **PR1** | ,033 | ,167 | ,319 | ,216 | ,186 | ,341 | ,356 | -,203 | -,100 | -,068 | -,107 | -,024 | -,037 | -,346 |
| **PR2** | **-,433*** | -,284 | -,111 | -,098 | -,107 | ,196 | ,172 | **-,459*** | -,192 | -,241 | -,251 | -,199 | -,197 | -,329 |
| **PR3** | -,349 | -,362 | -,084 | -,153 | -,232 | ,153 | ,099 | -,254 | -,229 | -,119 | -,089 | -,168 | -,024 | -,242 |
| **PR4** | -,275 | -,264 | -,199 | -,129 | -,138 | -,001 | -,040 | -,305 | -,258 | -,356 | -,279 | -,372 | -,284 | -,307 |
| **PR5** | -,356 | **-,416*** | -,174 | -,255 | -,317 | ,000 | -,101 | -,190 | -,176 | -,276 | -,357 | **-,446*** | -,346 | **-,468*** |
| **PR6** | -,202 | -,427* | -,137 | -,255 | **-,451*** | -,053 | -,155 | -,186 | -,137 | -,170 | **-,442*** | **-,555**** | **-,512**** | **-,536**** |
| **PR7** | -,214 | -,287 | -,098 | -,097 | -,184 | -,296 | -,192 | -,037 | -,015 | -,059 | -,380 | **-,470*** | **-,617**** | **-,492*** |
| **PR8** | -,338 | **-,482*** | -,158 | -,290 | **-,381*** | -,283 | **-,486*** | -,245 | -,185 | -,186 | -,372 | -,339 | **-,411*** | **-,551**** |
| **DTD** | ,282 | **,556**** | ,344 | ,331 | **,463*** | ,163 | ,161 | ,184 | ,123 | ,059 | ,151 | ,298 | ,147 | **,436*** |
| **Acc** | ,079 | -,020 | ,252 | ,011 | -,221 | -,016 | -,250 | -,240 | -,191 | -,230 | **-,424*** | **-,413*** | -,380 | -,285 |
| **FS** | ,045 | ,059 | **-,382*** | -,260 | -,016 | -,145 | -,284 | ,007 | ,066 | ,032 | ,194 | ,130 | ,269 | ,035 |

* $p < 0.05$; ** $p < 0.001$

Table 4. Results of Pearson's correlation between the parameters of the Picture Decision Task and BACE in the two conditions conduct on believers and non-believers group.

| | **Believers** | | | | | | **Non-believers** | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **BACE** | | | | | | | **BACE** | | | | | | |
| **Change** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **2** | **3** | **4** | **5** | **6** | **7** | **8** |
| **PR1** | ,008 | -,025 | **-,586**$^{**}$ | -,350 | -,294 | **-,426**$^{*}$ | **-,693**$^{**}$ | -,388 | **-,466**$^{*}$ | -,328 | -,370 | -,368 | **-,392**$^{*}$ | -,106 |
| **PR2** | ,297 | -,026 | -,438$^{*}$ | -,348 | -,243 | -,226 | **-,557**$^{**}$ | -,315 | -,429 | -,290 | -,284 | -,304 | **-,454**$^{*}$ | -,102 |
| **PR3** | ,129 | ,047 | -,277 | -,194 | -,104 | -,130 | **-,512**$^{**}$ | -,273 | -,210 | -,077 | -,232 | -,253 | -,270 | ,077 |
| **PR4** | ,026 | -,134 | -,148 | -,223 | ,086 | ,006 | **-,387**$^{*}$ | -,286 | -,220 | ,087 | -,110 | -,128 | -,229 | ,143 |
| **PR5** | ,030 | ,009 | -,272 | -,053 | ,094 | ,049 | -,293 | -,342 | -,242 | ,193 | ,040 | ,011 | -,167 | ,106 |
| **PR6** | -,064 | ,176 | -,117 | ,019 | **,443**$^{*}$ | ,278 | -,073 | **-,595**$^{*}$ | -,183 | ,197 | ,072 | ,233 | ,051 | ,228 |
| **PR7** | ,272 | -,013 | ,076 | -,024 | ,359 | **,531**$^{**}$ | ,140 | **-,689**$^{**}$ | -,036 | ,284 | ,214 | ,362 | ,223 | ,357 |
| **PR8** | ,254 | ,130 | ,209 | ,223 | ,385$^{*}$ | **,590**$^{**}$ | **,475**$^{*}$ | -,459 | ,143 | ,363 | ,290 | **,398**$^{*}$ | ,105 | **,468**$^{*}$ |
| **DTD** | -,012 | -,161 | -,008 | ,078 | -,328 | -,261 | ,132 | -,013 | -,169 | -,170 | -,060 | -,212 | -,114 | -,326 |
| **Acc** | ,071 | ,297 | -,116 | ,233 | **,379**$^{*}$ | ,359 | ,177 | ,034 | ,043 | ,142 | ,326 | **,386**$^{*}$ | ,357 | ,332 |
| **FS** | -,184 | -,127 | ,100 | -,106 | -,059 | -,131 | -,296 | ,010 | -,203 | -,207 | -,358 | -,226 | -,238 | -,168 |

* $p < 0.05$; **$p < 0.001$

# Capítulo 5: The inner voice of the brain


## Abstract

This study aims to determine if cerebral activation when talking to one's self (self-talk task) is the same activation as when listening to an external voice or recorded voice of the same gender (external voice task) or while reading silently (inner voice but external input). Our results showed that in all tasks, brain language processing (speech perception and production) occurred, and the Wernicke´s and Broca´s areas were activated. Moreover, in the external voice task (listening) there was a greater activation of the bilateral Wernicke's area. In self-talk there was a greater activation of the left Broca´s area, left orbitofrontal gyrus and higher bilateral activation of the Supplementary Motor Area (SMA) and of the left visual cortex. We interpret this to be due to higher speech planning and speech motor programming during self-talk. We also used a reading task as a control condition between the self-talk task and the listening task. For the reading task, we found lower bilateral activation of the SMA and of the middle cingulate cortex, higher right temporal and bilateral visual activation but similar Broca´s area activation with respect to the self-talk task. However, with respect to the listening task, the reading task showed lower bilateral temporal activation but higher activation of the bilateral SMA, left Broca´s area and bilateral visual cortex (similar to the comparison between self-talk and listening). The origin of the voice (inner in self-talk and reading or external in listening) is related to SMA activation or to a network for inner speech ownership (bilateral SMA, left visual cortex and left Broca´s area higher activation). In the silent reading, the voice is internal, but there is not a sense of ownership of the thoughts as one's own; therefore, the main difference between reading silently and self-talk (in the representation of the thought ownership) would consist of a parietal-frontal network activation (Left Basal ganglia, bilateral SMA, bilateral middle

cingulated cortex and left superior and middle frontal gyrus, left angular and supramarginal and left orbitofrontal gyrus but lower right temporal and right dorsolateral prefrontal cortex activation) related to verbal creativity, sentence generation and initiation, maintenance and suppression of voluntary inner speech without prosody.

## 1.Introduction

When we asked 200 university students to listen to their own inner voice and to indicate whether it is similar or different in regard to some aspects (age, gender, pitch, speed…) of their external voice, 42% believed that both the internal and external voices are the same voice. But the rest (58%) considered both voices to be different in several aspects. Overall, 100% of participants considered the inner voice to be his/her own voice. Frequently if the external voice had a local accent (Andalucian or Canarian), the internal voice did not (in other words, the inner voice had a perfect Castilian Spanish accent); some participants considered the inner voice to be more severe, less infantile, have a different speed (quicker or slower) and a different intensity (heard at a whisper), and also to be more chaotic. These participants also believed the inner voice could carry on more than one conversation at a time, was sometimes without gender distinction, tone, more fluid and friendly, and without prosody. The majority of participants in our studies (90%) considered their own voice heard from an outside source (a recording of their voice played back to them) to be different from their own voice although they still recognized the voice they heard as their own. The majority (95%) also had the subjective sensation of hearing their inner voice. In other words, they claimed to hear their inner voice as if there were an inner listener in the brain, or a cerebral “me” that listens. This is similar to the sensation of having an inner observer or internal eye that sees mental photographs when imagining the face of one’s mother for example. 78% of

our students believed that they do not control the course of their thoughts. Finally, although 100% considered their inner voice in the self-talk and reading tasks to be the same, they thought that the reading task did not produce the same feeling of ownership of thought that the self-talk task did produce.

Therefore, the question is if the inner voice and the external voice are the same voice. The principle differences are the absence of metrics and greater rhythm in the inner voice. When we hear a recording of our voice, recognition of the voice as our own is activated (Kaplan, Aziz-Zadek, Uddin and Iacoboni, 2008). Would this recognition be activated for the inner voice as well? If it were, it would be a testament to the fact that both voices are the same voice. However if it were not, it is possible that the two voices actually be distinct voices or that the discrimination between the self and others is not necessary for the inner voice. In the Iliad, the gods were the ones that put the voice in Hector or Aquilies' mind. Today, however, we believe that hearing the echo of our own inner voice is a state of self-consciousness in which an individual hears oneself (Morin, 2005). According to William James (1890) we cannot talk about "the thought," but rather "my thought" because the thought always has an owner and if one loses this subjective characteristic of the inner voice, delusional thoughts or auditory hallucinations would occur (Simons, Tracy, Sanghere, O´Daly, Gillen, Domínguez, Krabbendaml and Shergill, 2010). What differentiates the inner voice from the voice while reading silently is that, despite both being heard from the inside, the feeling of ownership of thought as one's own, as James (1890) suggested, only occurs in self-talk.Representation of the self should be active in the case of "my thought," whereas the voice that the gods gave to the mind, should activate the precuneus, the brain area whose activation has been associated with adopting the point of view of others: God, one´s mother or when recognizing familiar voices(Cavanna and Trimble, 2006; Ruby

and Decety, 2004; Uddin, Kaplan, Molnar, Szakacs, Zaidec and Iacoboni, 2005; Nakamura, Kawahiwa, Suqira, Kato, Nakamura, Hatano, Naquno,Kuboti, Fukuda, Ito and Kojima, 2001; Schjoedt, Stodkilde-Jorgensn, Geertz and Roepstrorff,2009). We also know (Perrone-Bertolotti, Kujula, Vidal, Hamame, Ossandon, Bertrand, Minotti, Kahane, Jerbi and Lachaux , 2012) that silent reading activates areas of linguistic comprehension. Written words produce an auditory experience, or a case of synaesthesia in non-synesthetes (Milán, Iborra, de Córdoba, Juarez-Ramos, Artacho and Rubio, 2013).

Some authors relate the recognition of one's own voice and the representation of the self with greater activation in certain parts of the right hemisphere of the brain. For example, Morin and Hamper (2012) relate activation on the left side of the inferior frontal gyrus with inner voice and self-reflection, while activation of the right side of the inferior frontal gyrus is associated with the recognition of one's own external voice (Kaplan, Aziz-Zadek, Uddin and Iacoboni, 2008). Studies of persons with schizophrenia who experience auditory hallucinations indicate a malfunction of the right temporal and parietal cortices, the right parahipppocampal gyrus and the right cerebellum (Shergill, Brammer, Fukuda, Williams, Murray and McCuire, 2003).

Therefore, the questions that remain are as follows: If the external voice is heard by the auditory brain system, who actually listens to the inner voice? Is it the self in the brain? Where is the inner voice produced and perceived? Are there differences in brain activation between listening to a voice and following the inner voice speech? To our knowledge, this question has not been studied among a population of people without mental disorders until now.

## 2.Method

**2.1. Participants**. Ten women between the ages of 22 and 29. (The study has also been replicated with ten new right handed participants. See Appendix 5a and 5b). All participants were right handed and had no psychiatric or neurologic record; their vision was normal or corrected during the experiment. They all provided written consent upon signing the "Informed consent for participation in the cerebral study of inner voice" form provided by the department of Experimental Psychology, CIMCYC as well as an informed consent form provided by the clinic Centro de Diagnóstico Granada SA, where the experiment was performed. None of them received monetary compensation for their participation.

**2.2. Procedure.** The following text was read to the participants: You will see different instructions on the screen that you must follow. The instructions may be different:

1-**Self-talk**: You will see the words "Encourage yourself" projected on the screen and we ask that you say phrases to yourself as though you were about to do something important and you were encouraging yourself. For example, "Everything will be just fine, you are the best, you can do it" regarding an important event for you: Looking for a job, new love relationships, exams...

**2. Listening to a positive self-help text**. In a previous pilot study positive self-talk was recorded for each participant. Then, they listened to a similar discourse as the recording of their own voice, but this time with a voice of the same gender as that of the participant.

**3. Reading task**. Participants read a positive text similar to their own self-talk which consisted of written words of similar content but which was not produced by the participant herself.

All the instructions must be performed until the next instructions appear on the screen. Do you understand? Do you have any questions? Then if you're ready let's begin. All the participants received the instructions in random order. Each instruction lasted 20 seconds and was repeated 4 times. Between instructions there was a white cross in the center of the screen (fixation point condition or base line). All the tasks were performed in silence, with no movement of the mouth. We presented an automatic task (Listening and reading) against a controlled task or more active task (encouraging oneself), where inner voice is used for motivation, planning, petition or decision making.

### 2.3.Design

fMRI Task. The stimuli were presented through fMRI-suitable glasses and liquid crystal screens apt for fMRI work (Resonance Technology, Northridge, California, USA). The experiment was programmed in E-Prime2 (Schneider, Eschman, & Zuccolotto, 2002). During the experiment, each condition was shown four times.

### Imaging data acquisition and preprocessing

The imaging was conducted on a 3.0 T clinical MRI scanner, equipped with an eight-channel phased-array head coil (InteraAchieva, Philips Medical Systems, Eindhoven, The Netherlands). Twenty-three gradient-echo planar images (EPIs), sensitive to blood oxygen level dependent (BOLD) contrast, were acquired. The EPIs were acquired with the following parameters, (repetition time: TR = 2000 ms, echo time: TE = 35 ms, flip angle = 90º, field of view: FOV = 230 x 230 mm, 96 x 96 matrix,

slice thickness = 4mm, gap = 1mm). A sagittal three-dimensional T1-weighted turbo-gradient-echo sequence (3D-TFE) (160 slices, TR = 8.3 ms, TE = 3.8 ms, flip angle = 8°, FOV = 240 x 240, 1 mm3 voxels) was obtained in the same experimental session for anatomical reference.

**fMRI Analysis**

The functional images were analyzed using the Statistical Parametric Map (SM8) software package (Wellcome Department of Cognitive Neurology, Institute of Neurology, Queen Square, London, UK), running under Matlab 6.5 (MathWorks, Natick, MA, USA). Preprocessing included slice timing correction, reslicing to the first image of the time series, normalization, using affine and smoothly nonlinear transformations, to an EPI template in the Montreal Neurological Institute (MNI) space, and spatial smoothing by convolution with a 3D Gaussian kernel (full width at half maximum FWHM= 8 mm). The BOLD response at each voxel was convolved with the SPM8 canonical hemodynamic response function (using a 128-s high-pass filter).

According to the objectives of the study, the contrasts of interest were defined combining base line (fixation point) and condition (task). Statistical parametric maps of the t-statistic (SPM{t}) were generated for each subject. One sample t-tests were conducted to assess intra-group activation in each of the contrasts. In these tests, the statistical threshold was set at $P < 0.005$ (uncorrected; KE= 10 voxels), which is optimal to achieve an appropriate balance between the risk of error Type I and II (Lieberman & Cunningham, 2009).

**3.Results**

All the participants confirmed being able to follow the instructions, to encourage themselves in the self-talk task about next exams, fears, anxiety or phobias, love or familiar relationships or looking for a job. When talking to themselves the majority said "You can do it, smile you're worth it. You can do anything you set my mind to. You can do it, breathe and stay calm. Let's do this, everything's going to turn out well and I can achieve anything I set my mind to." See Appendix 1 (tasks versus Fixation Point) and 2, 3 and 4 (Self-talk versus Listening; Listening versus Reading and Self-talk versus Reading, respectively).

Our main Conclusions from the comparison between Self-talk and listening are:

-Activation of left Wernicke´s and Broca´s areas (related to speech comprehension and speech motor programming respectively) during both tasks (external voice and inner voice).

-Higher bilateral activation of Wernicke´s areas and lower activation of left Broca´s area in the listening task (higher auditory speech comprehension) with respect to self-talk task (with higher motor speech programming).

-Higher bilateral activation of Supplementary Motor Area in the inner voice task. Higher left Broca's area activation. Higher left Orbitofrontal cortex activation during self-talk. All of these areas (BA 6, BA44-45 and BA47) are related to a extended activation system of anatomically adyacent areas for speech motor programming (language initiation and maintenance of voluntary speech production, internally

specified word generation, phonological and semantic processing, reasoning, internal rehearsal of the information, internal verbalization, selective attention to speech and emotional function in these verbal related functions and language rithm) .

For the inner voice task, higher activation of left Putamen, Caudate and Globus pallidus. We must consider the connections of these basal ganglia areas with SMA, Orbitofrontal cortex and Broca´s area (Ullman, 2006; Lieberman, 2010), in relation to the retrieval of knowledge of declarative memory, self-knowledge, empathy, and the activation of the reward circuitry related to pleasantness. The caudate nucleus probably generates some of the automatic thoughts that are later sequenced to generate internal discourse (Saxena and Rauch, 2000; Baars and Frankling, 2003).

-Higher activation of the left visual cortex in the inner voice task. Here the visual cortex can perform overall language processing (processing of phonological properties of words: Diez, Jones, Gareau, Zeffiro and Eden, 2005). It is possible that the internal discourse is accompanied by mental images.

In the listening task, activation of right BA40 is related to auditory attention (McDermott, Petersen, Watson and Ojermann, 2003). Activation of the right BA 9 and BA 46 areas of the brain are associated with attention to positive emotions (Kerestes, Ladoucer, Meda, Nathan, Blumberg, Maloney, Ruf, Saricicek, Peralson, Bhagwagar and Phillips, 2012) and activation of the right BA 47 (together with right BA21-22) area is associated with affective prosody (Wildgruber, Riecker, Hertrich, Erb, Grodd, Ethofer and Ackermann, 2002). It is interesting to highlight the fact that the activation of the areas of the right side of the brain, most especially the right BA 47 area, focuses on the aspects that differentiate the inner voice from the external voice, having prosody, or metrics. Meanwhile, activation of the left BA 47 (together with left BA 45) in the inner

voice is associated with the rhythm of language ( Vuust, Wallentin, Mouridsen, Ostergaard and Roepstorff, 2011; Brown, Martínez and Parsons, 2006). Therefore, the two main differences between the inner voice and the external voice are rhythm and prosody. Taking into account the general pattern of differences in brain activations between both tasks, there was higher speech planning and speech motor programming during the positive self-talk task, but less speech perception.

There was not a differential agent or self-activation for inner speech but higher activation of the visual cortex (then, there is no evidence of a brain-homunculus - internal eye or internal ear –different from brain areas for visual or auditory processing) unless we consider SMA activation in language production (Alario, Charnag, Leherecy and Cohen, 2006) related to the sense of agency (Haggard, 2005). Chaminade and Decety (2002) associated the sense of action agency with the supplementary motor area and the right inferior parietal cortex. We can consider SMA associated to the sense of inner speech agency (together with left visual cortex and left Broca´s area (BA6, 44-45, 47) and left Globus Pallidus, Caudate and Putamen the source of inner input for inner speech. The balance between the activation of speech motor programming areas and speech comprehension areas seems to be the key factor to know the origin (inner or external) of the voice. Prosody plays a larger role for the external voice. The rhythm of language plays a larger role in the inner voice.

Main conclusions from the Reading task (in which the input is external but the voice is internal and there is no feeling of the ownership of thought):

- Inner voice (Reading and self-talk) versus external voice (Listening) involves greater activation of the left Broca's area, greater left visual and bilateral activation of the supplementary motor area, and less bilateral activation of the temporal lobe.

- Thought ownership (Self-talk versus Reading ) involves higher bilateral activation of SMA , bilateral activation of Middle cingulated cortex (MCC, BA 32) and greater left activation of BA9-10, left BA39-40 and left BA 47 (see appendix 5 b). Reading silently a text is more similar to self-talk task than listening to the same text. Bilateral activation of the MCC can be related to verbal initiation and suppresion (Nathaniel-James, Fletcher and Frith, 1997) but also to executive function, working memory, memory retrieval and self-reflections; bilateral SMA activation can also be related to voluntary speech initiation and maintenance, executive function and self-reflections. The left middle and superior frontal gyrus (BA 9 and 10) activation is associated with sentence generation (Brown, Martínez and Parsons, 2006). Left angular and supramarginal (BA 39 and 40) activation is associated with generating phrases and verbal creativity (Bechtereva, Korotkov, Pakhomov, Roudas, starchenko and Medvedev, 2004; Brown, Martínez and Parsons, 2006) in language processing. Left BA 47 (Orbitofrontal) activation is associated with the rhythm of language (Vuust, wallentin, Mouridsen, Ostergaaarad and roepstorff, 2011).

- Inner input (Self-talk) versus external input (listening and Reading) involves higher activation of left Basal ganglia, left BA9-10, left BA39-40, left BA 47, bilateral SMA and lower right BA21-22 and right BA 9-46. See appendix 5.a.

- However, for reading versus self-talk, it is found greater bilateral visual cortex activation, greater bilateral thalamus activation, greater temporal and of the right superior parietal lobe activation. All areas related to spatial attention, visual input processing and language comprehension.

- Greater activation of the hippocampus in the reading task versus the listening task(Squire, 1992)implies that the consolidation of declarative and/or spatial memory

plays a larger role.- Both, in Reading and listening, there was greater activation of right temporal cortex (BA21-22, related to prosody processing) and right dorsolateral prefrontal cortex (BA 9-46), related to attention to positive emotions (Kerestes, Ladouceur, Meda, Nathan, Blumberg, Moloney, Ruf, saricicek, Pearlson, Bhagwagar and Phillips, 2012).

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**4.Discussion**

In conclusion, the three tasks activated the cerebral centers for the planning, production and comprehension of language. Therefore, thinking and, and to a greater degree, reading silently, both activate the auditory centers of the brain and we listen in order to understand our own thought. The centers for linguistic comprehension were more activated by listening to a voice. Reading, however, activated the visual system more than the self-talk did. Thus, sensory input activated the sensory areas to a greater extent than the inner voice did (overall in right hemisphere). The reading and self-talk tasks activated the centers for planning and linguistic production more than the listening task. The motor linguistics programming was similar for reading and for the inner voice; however, it may have been greater in the reading task due to the greater activation of the left BA6 area (precentral gyrus), which is associated with linguistic production. The self-talk task was differentiated from the external forms of input such as listening by the greater activation of the supplementary motor area which may be related to feelings of speech agency or at least to differentiating the source as internal or external (together with left visual cortex and left Broca´s area) and also by a lower activation of right temporal lobe related to prosody processing. The SMA was activated in both the reading and self-talk tasks, although to different degrees. Ultimately, the

feeling of ownership of thought(the “warm and intimate feeling of the ownership of thought”) was associated with the activation of a parietal-frontal network: Bilateral SMA, bilateral middle cingulate cortex, left BA9-10, left BA45-47, left BA 39-40, related to voluntary inner speech initiation, maintenance and suppresion . In both the reading and self-talk tasks the voice was perceived as internal, but it only subjectively belonged to the individual in the self-talk task.

In the listening task versus the inner voice, greater activation of certain areas of the right hemisphere (BA 40, BA 9-46 , BA 21-22 and BA 47) was linked to emotional processing, sensorial attention and prosody for listening, whereas the greater activation of left BA 47 (and BA 45) was linked to the rhythm of discourse in the inner voice. Prosody and rhythm are the principle subjective differences between the inner and external voices. It appears that the inner input, in comparison with the external inputs (both visual and auditory) is associated with activation of left globus pallidus, caudate and putamen. The inner voice also involves a general activation of the left hemisphere (in the occipital, temporal, parietal and frontal lobes). The only right hemisphere areas associated with the inner voice are right SMA and right MCC.

According to Ferri, Frassinetti, Ardizzi, Constatini & Gallese (2012) there is a sensorimotor network for action ownership: the Supplementary Motor Area (SMA), the anterior insula and the occipital cortex, activated bilaterally. We found also a bilateral network (SMA, MCC) for inner speech and thought ownership (overall SMA). According to Van der Meer, Costafreda, Aleman and Davis (2010) Cingulate Cortex is involved in self-processing as well as in other-reflective processing, although the fact that it is activated in the comparison of self versus other indicates that this area is more active in self-processing than in other-reflective processing and that the degree of activation in CC might be an indicator of self-specificity. Self- specify is higher in self-

talk task (inner voice, inner input and the feeling of ownership of thought) than in reading silently (inner voice, external input and absent sense of thought ownership). In relationship to inner input, overall left Basal ganglia and left BA47 (but also left BA 9-10 and left BA39-40) must be added and considered as part of the inner-speech network.

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**Appendix 1:**

a) Inner voice (or Self-task) versus Base Line condition (look at Fixation Point)

| Region | Side | BA | MNI coordinates | | | Volume ($mm^3$) | T |
|---|---|---|---|---|---|---|---|
| | | | X | Y | Z | | |
| Middle Occipital Gyrus | L | 18,19 | -42 | -70 | -18 | 1960 | 9,09 |
| Supplementary Motor Area | R/L | 6 | -10 | 18 | 58 | 4648 | 8,32 |
| PrecentralGyrus | L | 6 | -36 | 12 | 44 | 2408 | 7,28 |
| Middle Occipital Gyrus | R | 18,19 | 30 | -76 | 2 | 3760 | 6,24 |
| IFG(Broca) | L | 44,45 | -50 | 26 | 6 | 600 | 6,14 |
| Cerebellum | R | | 30 | -84 | -30 | 1816 | 5,88 |
| Middle Temporal Gyrus | L | 21,22 | -56 | -30 | -6 | 792 | 5,48 |
| Amygdala | L | 28 | -18 | -4 | -14 | 208 | 5,33 |

b) Listening versus Fixation Point

| Region | Side | BA | MNI coordinates | | | Volume ($mm^3$) | T |
|---|---|---|---|---|---|---|---|
| | | | X | Y | Z | | |
| Temporal Lobe | R | 21,22 | 60 | -14 | -14 | 14088 | 13,18 |
| Temporal Lobe | L | 21,22 | -62 | -20 | -4 | 10536 | 11,87 |
| Dorsolateral Prefontal Gyrus | R | 9,46 | 46 | 22 | 26 | 1064 | 4,62 |
| Inferior Frontal Gyrus (IFG) | R | 47 | 46 | 26 | 0 | 224 | 4,27 |
| IFG (Broca) | L | 44,45 | -50 | 16 | 20 | 144 | 3,82 |

c) Reading versus Fixation Point

| Region | Side | BA | MNI coordinates | | | Volume | T |
|---|---|---|---|---|---|---|---|
| | | | X | Y | Z | ($mm^3$) | |
| Occipital Lobe | R/L | 17,18,19 | 16 | -102 | 12 | 118992 | 21,75 |
| Hippocampus | L | | -26 | -28 | -2 | 1368 | 10,22 |
| Hippocampus | R | | 26 | -26 | -8 | 1968 | 9,07 |
| Precentral gyrus | L | 6 | -46 | -6 | 58 | 3936 | 8,11 |
| Middle Temporal Gyrus | R | 21,22 | 56 | -34 | 0 | 472 | 7,14 |
| Precentral gyrus | R | 6 | 54 | 0 | 40 | 1576 | 6,23 |
| Sup. Temp. Gyrus(Wernicke) | L | 21,22 | -56 | -20 | -12 | 1760 | 5,63 |
| Supplementary Motor Area | R/L | 6 | -6 | 6 | 58 | 568 | 5,53 |
| IFG (Broca) | L | 44,45 | -52 | 16 | 22 | 808 | 4,95 |

**Appendix 2:**

Inner Voice versus Listening

| Region | Side | BA | MNI coordinates | | | Volume | T |
|---|---|---|---|---|---|---|---|
| | | | x | Y | Z | ($mm^3$) | |
| Supplementary Motor Area | R/L | 6 | -4 | 16 | 62 | 6800 | 6,80 |
| Putamen & Caudate | L | | -16 | 12 | 4 | 1368 | 6,58 |
| Orbitofrontal Cortex | L | 47 | -42 | 40 | -10 | 2104 | 5,09 |
| Middle Occipital Gyrus | L | 17,18,19 | -30 | -86 | 10 | 2840 | 4,83 |
| IFG (Broca) | L | 44,45 | -52 | 16 | 20 | 848 | 5,95 |
| Lateral Globus Pallidus | L | | -18 | -6 | 8 | 392 | 4,64 |

Listening versus Inner Voice

| Region | Side | BA | MNI coordinates | | | Volume | T |
|---|---|---|---|---|---|---|---|
| | | | X | Y | Z | ($mm^3$) | |
| Temporal Lobe | L | 21,22,41 | -54 | -14 | -8 | 15704 | 14,43 |
| Temporal Lobe | R | 21,22,41 | 64 | -22 | -2 | 29568 | 12,32 |
| Inferior Parietal Lobule | R | 40 | 38 | -42 | 54 | 1224 | 5,01 |

**Appendix 3**

Reading vs. Listening

| Region | Side | BA | MNI coordinates | | | Volume | T |
|---|---|---|---|---|---|---|---|
| | | | x | Y | Z | ($mm^3$) | |
| Occipital Lobe | R/L | 17,18,19 | 30 | -72 | 40 | 103720 | 21,93 |
| Hippocampus | L | | -26 | -28 | -2 | 1128 | 9,48 |
| Hippocampus | R | | 28 | -28 | -4 | 584 | 8,50 |
| Precentral Gyrus | L | 6 | -46 | -6 | 44 | 1776 | 6,94 |
| Superior Parietal Lobule | L | 7 | -22 | -44 | 48 | 1016 | 5,87 |
| Supplementary Motor Area | R/L | 6 | 2 | 4 | 64 | 608 | 5,00 |
| IFG (Broca) | L | 44 | -46 | 12 | 20 | 864 | 4,16 |

Listening vs. Reading

| Region | Side | BA | MNI coordinates | | | Volume | T |
|---|---|---|---|---|---|---|---|
| | | | x | Y | Z | ($mm^3$) | |
| Temporal Lobe | L | 21,22,41 | -54 | -16 | -4 | 18544 | 29,98 |
| Temporal Lobe | R | 21,22,41 | 64 | -24 | 2 | 19288 | 10,66 |
| Amygdala | R | 34 | 18 | -10 | -20 | 448 | 4,87 |

**Appendix 4:**

Inner voice versus Reading

| Region | Side | BA | MNI coordinates | | | Volume | T |
|---|---|---|---|---|---|---|---|
| | | | X | Y | Z | ($mm^3$) | |
| Middle Cingulate Gyrus | R/L | 32 | -4 | 28 | 40 | 3392 | 8,51 |
| Sup.& Middle Frontal Gyrus | L | 9,10 | -14 | 56 | 28 | 10150 | 7,90 |
| Supplementary Motor Area | R/L | 6 | -2 | 2 | 74 | 4932 | 7,67 |
| Angular & Supramarginal | L | 39,40 | -52 | -70 | 16 | 4602 | 6,13 |
| Orbitofrontal Gyrus | L | 47 | -56 | 36 | 0 | 1080 | 5,30 |
| Thalamus Anterior | L | | -14 | -18 | 10 | 740 | 4,86 |
| Putamen | L | | -28 | -6 | 14 | 655 | 4,14 |

Reading versus Inner voice

| Region | Side | BA | MNI coordinates | | | Volume | T |
|---|---|---|---|---|---|---|---|
| | | | X | Y | Z | ($mm^3$) | |
| Occipital Lobe | R/L | 17,18,19 | 2 | -98 | 14 | 54408 | 16,44 |
| Superior Parietal Lobule | R | 7 | 12 | -74 | 40 | 5704 | 13,89 |
| Middle Temporal Gyrus | R | 21,22 | 66 | -38 | 4 | 1640 | 7,97 |
| Precentral Gyrus | L | 6 | -50 | -4 | 24 | 1466 | 5,99 |
| Thalamus | R | | 20 | -22 | -8 | 796 | 6,89 |
| Thalamus | L | | -24 | -28 | 4 | 854 | 7,18 |

**Appendix 5**: Replication of Experiment 1

**Appendix 5 a) Inner voice vs. Listening**

| Region | Side | BA | MNI coordinates | | | Volume | T |
|---|---|---|---|---|---|---|---|
| | | | X | Y | Z | ($mm^3$) | |
| Occipital Lobe | L | 17,18,19 | -30 | -82 | -8 | 41584 | 15,36 |
| Angular & Supramarginal | L | 39,40 | -50 | -66 | 36 | 5008 | 10,72 |
| Sup.& Middle Frontal Gyrus | L | 9,10 | -26 | 28 | 46 | 15056 | 7,87 |
| Supplementary Motor Area | R/L | 6,8 | 4 | 20 | 58 | 3152 | 7,49 |
| Caudate | L | | -14 | 12 | 6 | 1472 | 6,90 |
| Orbitofrontal Gyrus | L | 47 | -46 | 38 | -12 | 976 | 5,51 |
| Pulvinar (Thalamus) | L | | -20 | -30 | 8 | 392 | 4,97 |
| Lateral Globus Pallidus | L | | -20 | -8 | 2 | 456 | 4,74 |
| IFG (Broca) | L | 45 | -52 | 26 | 12 | 904 | 4,60 |
| Caudate | R | | 12 | 12 | 10 | 240 | 4,06 |

Listening versus Inner Voice

| Region | Side | BA | MNI coordinates | | | Volume | T |
|---|---|---|---|---|---|---|---|
| | | | X | Y | Z | ($mm^3$) | |
| Temporal Lobe | L | 21,22,41 | -56 | -12 | -4 | 6936 | 13,25 |
| Dorsolateral Prefrotal Cortex | R | 9,46 | 48 | 26 | 30 | 12896 | 11,42 |
| Temporal Lobe | R | 21,22,41 | 64 | -24 | -2 | 10152 | 10,63 |

**Appendix 5 b)**

Inner voice versus Reading

| Region | Side | BA | MNI coordinates | | | Volume | T |
|---|---|---|---|---|---|---|---|
| | | | X | Y | Z | ($mm^3$) | |
| Sup.& Middle Frontal Gyrus | L | 9,10 | -26 | 28 | 46 | 17578 | 12,64 |
| Angular & Supramarginal | L | 39,40 | -50 | -66 | 36 | 10553 | 8,43 |
| Supplementary Motor Area | R/L | 6 | -8 | 20 | 58 | 4613 | 6,81 |
| Orbitofrontal Gyrus | L | 47 | -42 | 40 | -12 | 1090 | 6,40 |
| Middle Cingulate Gyrus | R/L | 32 | -4 | 24 | 40 | 1472 | 5,80 |

Reading versus Inner Voice

| Region | Side | BA | MNI coordinates | | | Volume | T |
|---|---|---|---|---|---|---|---|
| | | | X | Y | Z | ($mm^3$) | |
| Occipital Lobe | R/L | 17,18,19 | 2 | -100 | 12 | 37440 | 16,62 |
| Dorsolateral Prefrotal Cortex | R | 9,46 | 46 | 28 | 36 | 6043 | 11,09 |
| Temporal Lobe | R | 21,22,41 | 64 | -24 | 2 | 8936 | 6,19 |
| Precentral Gyrus | L | 6 | -38 | -8 | 44 | 1048 | 4,93 |

# Capítulo 6: Who talks to himself hopes to one day talk to God

**Abstract**

This study aims to explore the phrase from the poet Antonio Machado: He who talks to himself hopes to one day talk to God. In other words, it aims to determine if cerebral activation when talking to one's self is the same activation as when talking to God. For example, we could expect higher self-activation when talking to one´s self. In fact we run three tasks: Lord´prayer, personal praying and positive self-talk. Our results showed that in all tasks social cognition is activated, that being the mirror neurons human system, but when talking to God there is additional activation of the bilateral visual cortex, the Precuneus, and the posterior cingulate cortex in believers. Moreover, there was a greater activation of Wernicke's area and the Temporal Gyrus. We interpret this to be due to the believer listening more while adopting a third person perspective about himself when talking to God. In any case, talk to God (or to other) with the inner voice is different than talking to oneself .The main difference in brain activation between passive (Lord´s Prayer) and active tasks (personal praying) happened in higher SMA activation and lower Dorsolateral prefrontal cortex activation for active tasks.

Keywords: Talk to God, talk to yourself, brain, social cognition

## 1.Introdution

The title of this article is a poem from Antonio Machado. This study aims to explore the phrase from the poet Antonio Machado: He who talks to himself hopes to one day talk to God. In other words, it aims to determine if cerebral activation when talking to one's self is the same activation as when talking to God. For example, we could expect higher self-activation when talking to one´s self (Lieberman, 2010). However, it is possible that the discrimination between the self and others is not necessary for the inner voice. In the Iliad, the gods were the ones that put the voice in Hector or Aquilies' mind. Today, however, we believe that hearing the echo of our own inner voice is a state of self-consciousness in which an individual hears oneself (Morin, 2005).

Boyer (2003) postulates that religious beliefs emerge from mental categories and cognitive tendencies that are previous to religion. Recently, religious beliefs have begun to be studied from cognitive neuroscience and try localizing its basis in the brain (Inzlicht et al., 2009; Kapogiannis et al., 2009; Asp et al., 2012). For example, Asp, Ramachandran and Tranel (2012) found that patients with focal damage to the ventromedial prefrontal cortex (vmPFC) expressed higher levels of authoritarianism and religious fundamentalism that increased in specific religious beliefs following their brain injury. Previous studies focused the main distinction between religious and non religious experience in the right dorsolateral and dorsomedial prefrontal cortex (Azari et al., 2001). The other interesting studio has been realized by Inzlicht et al., (2009) who obtained that religious conviction is marked by reduced reactivity (to uncertainty and error ) in the anterior cingulate cortex (ACC). Kapogiannis, Barbey, Su, Krueger and Grafman (2009) related the middle temporal cortex with experiencing an intimate

relationship with God, right precuneus with doubting God´s existence and left precuneus with fear of God.

Beauregard and Paquete (2006) used FMRI to study Carmelite nuns in a mystical state of union with God against a control condition where the participants were to relive the most intense state of union with another human being. They found a bigger activation of the Insula in the nuns in mystical state. The insula is related to integration of visceral stimuli, face recognition, empathy, theory of mind or feelings or uncertainty (Singer, Critchley and Preuschoff, 2009; Keyser and Gazzola, 2007). The question is if we would find a bigger activation of the insula for everyday religious experiences (personal praying) in normal religious persons (university students). In this line, Schjoedt, Stodkilde-Jorgensn, Geertz and Roepstrorff (2009) showed that religious people activate areas of social cognition during personal daily prayer (not making reference to mystic experiences). In other words, talking to God seems like a conversation (activation of the temporal-polar region, the medial prefrontal cortex and the union of the temporal-parietal lobe and the precuneus, all of which are areas of social cognition or linked to the theory of the mind in the left hemisphere). We aim to evaluate Machado's phrase to see if talking to one's self is similar to talking to God, though talking to God is something else altogether.

In other words, our main goal is to compare the brain activation under religious (Lord´s prayer and personal praying- petition to God-, like Schjoedt et al. did) and a non religious tasks (self-task -encouraging one's self) in believers.

## 2.Method

**2.1. Participants**. Ten people, female Spanish Catholics between the ages of 21 and 25, who perform individual prayer to God almost daily (Lord´s prayer) before going to bed

and personal praying only in special occasions (conflicts, before exams, difficult life events…) with a mean frequency of 3.2 (SD=1.4) per week. They are not practicing Catholics, or rather they do not attend church every Sunday, though they are believers. They are university students with good average score of the grades from the courses (mean= 7.8, SD= 1.1) and their final exams are in one to two weeks from the time of the study. They demonstrate signs of worry about the coming exams and they are diligent students. Then, all participants confront the same situation: The final period of exams in order to make sense to the tasks (ecological validity).

All the participants were right handed and had no psychiatric or neurologic record; their vision was normal or corrected during the experiment. They all provided written consent upon signing the "Informed consent for participation in the cerebral study of religious experience" form provided by the department of Experimental Psychology, as well as an informed consent form provided by the clinic *Centro de Diagnóstico Granada SA*, where the experiment was performed. None of them received monetary compensation for their participation.

**2.2. Procedure**.The following text was read to the participants: You will see different instructions on the screen that you must follow. The instructions can be different:

*1-Self-talk*: You will see "Encourage yourself" and we ask that you say phrases to yourself as though you were about to do something important and you were encouraging yourself. For example, "Everything will be just fine, you are the best, you can" regarding the exams.

*2- You will be asked to "talk to God" on an individual level*, as though asking him for something you need. For example, "Please give my family good health," or whatever you wish for, especially passing the course.

*3. Lord´s prayer* to pass the course

All the instructions must be performed until the next instructions appear on the screen. Do you understand? Do you have any questions? Then if you're ready "let's begin". All the participants received the instructions in random order. Each instruction lasted 20 seconds and was repeated 4 times. Between instructions there was a white cross in the center of the screen (fixation point condition or baseline).

All the tasks (talking to God, encouraging one's self, Lord´s prayer) must be performed in silence (no mouth movement). The tasks of talking to God and Lord´s prayer are religious and encouraging one's self is a non-religious task. For religious tasks we present an automatic task and more passive task (Lord´s prayer) against a controlled task or more active task (personal praying), where inner voice is used for motivation, planning, petition or decision making. Self-talk task can also be considered an active non religious task.

**2.3.Design**

fMRI Task. The stimuli were presented through fMRI-suitable glasses and liquid crystal screens apt for fMRI work (Resonance Technology, Northridge, California, USA).
The experiment was programmed in E-Prime2 (Schneider, Eschman, & Zuccolotto, 2002). During the experiment, each condition was shown four times.

*Imaging data acquisition and preprocessing*

The imaging was conducted on a 3.0 T clinical MRI scanner, equipped with an eight-channel phased-array head coil (InteraAchieva, Philips Medical Systems, Eindhoven, The Netherlands). Twenty-three gradient-echo planar images (EPIs), sensitive to blood oxygen level dependent (BOLD) contrast, were acquired. The EPIs were acquired with the following parameters, (repetition time: TR = 2000 ms, echo time: TE = 35 ms, flip angle = 90º, field of view: FOV = 230 x 230 mm, 96 x 96 matrix, slice thickness = 4mm, gap = 1mm). A sagittal three-dimensional T1-weighted turbo-gradient-echo sequence (3D-TFE) (160 slices, TR = 8.3 ms, TE = 3.8 ms, flip angle = 8°, FOV = 240 x 240, 1 mm3 voxels) was obtained in the same experimental session for anatomical reference.

*fMRI Analysis*

The functional images were analyzed using the Statistical Parametric Map (SM8) software package (Wellcome Department of Cognitive Neurology, Institute of Neurology, Queen Square, London, UK), running under Matlab 6.5 (MathWorks, Natick, MA, USA). Preprocessing included slice timing correction, reslicing to the first image of the time series, normalization, using affine and smoothly nonlinear transformations, to an EPI template in the Montreal Neurological Institute (MNI) space, and spatial smoothing by convolution with a 3D Gaussian kernel (full width at half maximum FWHM= 8 mm). The BOLD response at each voxel was convolved with the SPM8 canonical hemodynamic response function (using a 128-s high-pass filter).

According to the objectives of the study, the contrasts of interest were defined combining base line (fixation point) and condition (task). We also perform the comparisons between religious tasks (Lord´s prayer or religious passive task versus personal praying or religious active task) and also between religious versus non

religious tasks and between active tasks (Personal praying and self-talk). To test the poet sentence the key comparison is: Talk to God (petition) versus talking to one's self. Statistical parametric maps of the t-statistic (SPM{t}) were generated for each subject.

One sample t-tests were conducted to assess intra-group activation in each of the contrasts. In these tests, the statistical threshold was set at $P < 0.005$ (uncorrected; KE = 10 voxels), which is optimal to achieve an appropriate balance between the risk of error Type I and II (Lieberman & Cunningham, 2009).

**3.Results**

All the participants confirmed to be able to follow the instructions. When talking to themselves the majority said "You can do it, smile you're worth it. You can do anything you set my mind to. You can do it, breathe and stay calm. Let's do this, everything's going to turn out well and I can achieve anything I set my mind to." In petitions to God, the participants asked him to let them pass the course and for personal help in family matters like asking that their sister's baby is born safely or that their parents be healthy, happy, etc.

First, following Antonio Machado, we focused in the comparison between Personal praying and self-talk. See Table 1. For the comparison between religious tasks see appendix 1. For the comparison between self-talk and Lord´s prayer see appendix 2. For the comparison between tasks versus baseline (look at fixation point), see appendix 4.

**Comparison between the two active tasks: Personal praying and self-talk**

We found that in the comparison between asking God for something (religious task) and encouraging one's self (non-religious task), there were more cerebral areas activated when talking to God than when talking to one's self; specifically the bilateral

occipital lobe, the bilateral Precuneus and the bilateral Posterior Cingulate Cortex, the bilateral Temporal Lobe and bilateral Superior Frontal Gyrus. See Table 1.

Table 1.Asking God for something vs. Encouraging one's self

| Region | Side | BA | MNI coordinates | | | Volume ($mm^3$) | T |
|---|---|---|---|---|---|---|---|
| | | | X | Y | Z | | |
| Posterior Thalamus | L | | -18 | -30 | 8 | 496 | 8,75 |
| Occipital Lobe | R/L | 17,18,19 | -4 | -90 | 2 | 8888 | 6,99 |
| Precuneus | R/L | 7, 31 | 6 | -62 | 24 | 9048 | 7,36 |
| Posterior Cingulate Cortex | R/L | 23,30,31 | 18 | -54 | 4 | 6184 | 7,02 |
| Insula Medial-Posterior | R | 13 | 38 | -22 | 16 | 1112 | 6,81 |
| Temporal Gyrus | L | 20,21 | -60 | -12 | -8 | 4256 | 6,69 |
| Temporal Gyrus | R | 20,21 | 58 | 4 | -26 | 2480 | 5,32 |
| Sup. Temp. Gyrus (Wernicke) | L | 41, 42 | -46 | -36 | 8 | 1712 | 4,81 |
| Superior Frontal Gyrus | R/L | 10 | -4 | 64 | 24 | 424 | 4,26 |

Encouraging one's self vs. Asking God for something

| Region | Side | BA | MNI coordinates | | | Volume | T |
|---|---|---|---|---|---|---|---|
| | | | X | Y | Z | ($mm^3$) | |
| NOTHING | | | | | | | |

If we compare the results of Schjoedt et al. (2009) in the comparison between personal praying (a task related to a real being for religious adults : God) vs. making wishes to Santa Claus (a task related to an imaginary person for religious adults) with our results in personal praying vs. positive self talk for religious participants, they are similar but we found bilateral activation of precuneus (BA7,31) , temporal region

(BA20-21, 41, 42) and prefrontal cortex (BA10) instead of lateralized left areas. Schjoedt et al. also found left activation of BA39. In any case, talk to God (or to other) with the inner voice is different than talking to oneself: More brain areas are activated in personal praying overall the Precuneus. It also stands to mention the activation of the occipital cortex despite the verbal and inner nature of both tasks. But also higher activation of left Wernicke´s area (related to speech comprehension). The higher activation of bilateral temporal lobe can be related to experiencing an intimate relationship with God (Kapogiannis et al., 2009).

**Comparison between the two religious tasks. See Appendix 1.**

Our results are different from Schjoedt et al. (2009) for the same comparison between Personal praying and Lord´s prayer. We found higher bilateral activation of temporal cortex, occipital lobe, Caudate, Precuneus&Post.Cingulate and SMA. They found lower left activation of BA21, BA7and BA6. They also found activation of BA9 and BA39.

Our results are also different from Schjoedt et al. (2009) for the same inverted comparison between Lord´s prayer and Personal praying. We found similar right activation of BA40, higher right activation of dorsolateral prefrontal cortex and frontal gyrus. They found activation for leftBA5-BA7, right BA20-BA31 and cerebellum. See Appendix 1.B. The differential brain activations for Lord´s prayer are lateralized to the right hemisphere in our case overall for the Medium and Superior Frontal Gyrus against its left activation in personal praying. We also found higher right parietal activation in Lord´s prayer.

However, we do not discuss that most of the areas activated can be related to mirror neurons and social cognition. Our main conclusion, by the moment, it is that Personal

praying implies bilateral temporal cortex (specially left Wernicke´s area), bilateral visual cortex, bilateral precuneus and left (or bilateral) frontal gyrus activation in all comparisons (including Lord´s Prayer and self-task -see main text, Table 1.). We also found higher bilateral SMA activation and lower right prefrontal cortex (overall BA9 and BA 46) and lower parietal activation (BA39, BA40) for active tasks (religious or not: personal praying and self-talk) against passive tasks (Lord´s Prayer). See appendix 1 and appendix 2 –Self talk versus Lord´s Prayer-).

**4.Discussion**

In both tasks (talking to one´s self and talking to God), when compared to the baseline there was a greater activation in believers of the bilateral Occipital cortex, left Temporal activation (Wernicke's area), left activation of Broca's area, the Putamen, and bilateral activation of the Supplementary Motor Area. In other words, in both cases there is visualization or visual imagination, the speaker listens more and there is more cover linguistic production and pleasure experienced (partial activation of the pleasure circuit) and action preparation. This deals with areas linked to mirror neurons, the ToM system and social cognition (Pineda, 2009; Salazar-López, 2012). In other words, the idea proposed by Schjoedt et al. (2009) is confirmed in believers.

Clearly, Machado was right that talking to God is more than talking to one's self (in terms of cerebral activation), as shown through findings indicating that no cerebral area is more activated when talking to one's self than when talking to God. Nonetheless, when talking to God there is a greater activation of the bilateral temporal lobe (specially left Wernicke´s area) –related to speech comprehension and to experience an intimate relationship with God-, bilateral visual cortex and a greater activation of the precuneus and posterior cingulate cortex. It is as though when talking to God, a third person

perspective of one's self is adopted and the speaker listens more. The Posterior Cingulate Cortex is linked to emotional processing as well as seeing one's self in third person (Ruby and Decety, 2004).But during Lord´s Prayer (an automatic task) there was not third person perspective (Precuneus activation) or planning (SMA activation).However, during self-talk task we found a similar bilateral SMA activation (like in personal praying). In Lord´s Prayer we found higher right parietal-frontal activation (BA 39, 40; BA8, 9, 11, 46). These areas have been related to religious experience (Azari, Nickel, Wunderlich, Niedeggen, Hefler, Tellman, Herzog, Stoerig, Irnbachen and Seitz, 2001) but also to different functions like focused auditory attention, memory retrieval, attention to positive emotions or self-reflections. What is clear is that self-reflections were not higher during self-talk task but the self-other brain discrimination was activated during personal praying to God.

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**Appendix 1.**Comparison between Personal praying and the passive task (Lord´s prayer).

1. A. Personal praying vs. The Lord´s prayer

| Region | Side | BA | MNI coordinates | | | Volume ($mm^3$) | T |
|---|---|---|---|---|---|---|---|
| | | | X | Y | Z | | |
| Caudate | L | | -24 | 10 | 20 | 1608 | 12,21 |
| Caudate | R | | 12 | 6 | 22 | 776 | 8,02 |
| Occipital Lobe | R | 17,18,19 | 14 | -84 | 8 | 7472 | 7,59 |
| Sup. Temp.Gyrus (Wernicke) | L | 21,22,41 | -52 | -38 | -8 | 4248 | 6,61 |
| Occipital Lobe | L | 17,18,19 | -8 | -92 | 2 | 9072 | 6,45 |
| Superior Frontal Gyrus | L | 10 | -10 | 54 | 6 | 864 | 6,26 |
| Middle Temporal Gyrus | R | 21,22,41 | 58 | -8 | -18 | 3864 | 5,96 |
| Precuneus& Post. Cingulate | R/L | 7,23,31 | -8 | -58 | 28 | 3840 | 4,38 |
| Supplementary Motor Area | R/L | 6 | -12 | 10 | 54 | 1784 | 4,35 |

1. B. The Lord´s prayer vs. Personal praying

| Region | Side | BA | MNI coordinates | | | Volume ($mm^3$) | T |
|---|---|---|---|---|---|---|---|
| | | | X | Y | Z | | |
| Dorsolateral Prefrontal Gyrus | R | 9,46 | 46 | 38 | 36 | 1048 | 4,93 |
| Middle Frontal Gyrus | R | 11 | 30 | 50 | -14 | 528 | 4,65 |
| SupramarginalGyrus | R | 40 | 44 | -44 | 42 | 1088 | 4,60 |
| Superior Frontal Gyrus | R | 8 | 38 | 18 | 56 | 408 | 4,35 |

**Appendix 2**. Comparison between Positive self-talk and the passive task: Lord´s prayer.

2.A. Self-task vs. Lord´s prayer

| Region | Side | BA | MNI coordinates | | | Volume ($mm^3$) | T |
|---|---|---|---|---|---|---|---|
| | | | X | Y | Z | | |
| Lingual Gyrus | R | 17 | 18 | -84 | 0 | 632 | 7,71 |
| Caudate | L | | -14 | 10 | 20 | 1968 | 6,35 |
| Supplementary Motor Area | R | 6 | 14 | -4 | 60 | 360 | 5,92 |
| Supplementary Motor Area | L | 6 | -6 | 18 | 56 | 2152 | 4,35 |

2.B. Lord´s prayer vs. Self-task

| Region | Side | BA | MNI coordinates | | | Volume($mm^3$) | T |
|---|---|---|---|---|---|---|---|
| | | | X | Y | Z | | |
| Angular &SupramarginalGyrus | R | 39,49 | 38 | -68 | 42 | 4128 | 8,15 |
| Superior Frontal Gyrus | R | 8,9 | 40 | 18 | 52 | 4464 | 5,96 |
| Middle Frontal Gyrus | R | 46 | 50 | 44 | 16 | 352 | 4,96 |
| Orbitofrontal Gyrus | | 11, 47 | 26 | 32 | -20 | 352 | 4,13 |

**Appendix 3. Tasks vs. Base line (Look at fixation point)**

3.A. Lord´s prayer vs. Looking at Fixation Point

| Region | Side | BA | MNI coordinates | | | Volume ($mm^3$) | T |
|---|---|---|---|---|---|---|---|
| | | | X | Y | Z | | |
| Middle Occipital Gyrus | L | 18 | -20 | -100 | 10 | 280 | 5,47 |
| Putamen | L | | -18 | 4 | 0 | 320 | 5,25 |
| Precentral gyrus | R | 6,8 | 58 | 2 | 42 | 488 | 5,04 |
| Putamen | R | | 12 | 8 | -8 | 248 | 4,99 |
| Middle Occipital Gyrus | R | 17,18 | 28 | -90 | -16 | 752 | 3,50 |

3. B. Personal praying vs. Fixation Point.

| Region | Side | BA | MNI coordinates | | | Volume ($mm^3$) | T |
|---|---|---|---|---|---|---|---|
| | | | X | Y | Z | | |
| Occipital Lobe | R/L | 17,18,19 | 22 | -94 | 16 | 67456 | 9,80 |
| Posterior Cingulate Cortex (Precuneus) | R/L | 7,31 | 4 | -68 | 34 | 5744 | 10,84 |
| Supplementary Motor Area | R/L | 6,8 | -8 | 20 | 70 | 3928 | 6,39 |
| Thalamus Posterior | L | | -22 | -32 | -2 | 640 | 5,85 |
| Precentral gyrus | L | 6 | -40 | 2 | 54 | 2464 | 5,73 |
| Sup. Temp. Gyrus(Wernicke) | L | 21,22 | -54 | -42 | 6 | 6480 | 5,52 |
| Cerebellum | R/L | | 10 | -52 | -12 | 592 | 5,17 |
| Inferior Temporal Gyrus | R | 21 | 64 | -8 | -18 | 432 | 4,95 |
| OrbitoFrontal Gyrus | L | 47 | -42 | 30 | -14 | 1112 | 4,76 |
| Superior Frontal Gyrus | L | 9 | -10 | 52 | 34 | 904 | 4,38 |
| IFG (Broca) | L | 44,45 | -46 | 18 | 16 | 160 | 3,90 |
| Putamen | L | | -22 | 6 | 0 | 184 | 3,74 |

3.C . Self-talk vs. Fixation Point.

| Region | Side | BA | MNI coordinates | | | Volume ($mm^3$) | T |
|---|---|---|---|---|---|---|---|
| | | | X | Y | Z | | |
| Precentral gyrus | R | 6 | -38 | 12 | 46 | 2080 | 7,68 |
| Supplementary Motor Area | R/L | 6 | -6 | 20 | 60 | 3880 | 7,60 |
| IFG (Broca) | L | 44,45 | -56 | 18 | 4 | 2792 | 7,42 |
| Middle Occipital Gyrus | L | 17,18,19 | -40 | -70 | -18 | 7200 | 7,34 |
| Middle Occipital Gyrus | R | 17,18,19 | 30 | -76 | 2 | 6920 | 6,33 |
| Cerebellum | R | | 26 | -84 | -32 | 5320 | 5,82 |
| Sup. Temp. Gyrus(Wernicke) | L | 21,22 | -42 | -48 | 2 | 2200 | 5,17 |
| Putamen | L | | -20 | 6 | 2 | 192 | 3,83 |

# Capítulo 7: Decision making and feedback sensitivity: A comparison between older and younger adults


## Abstract

This study investigated decision making and feedback sensitivity in healthy older adults with a new task: the Pictures Decision Task. The study examined: (1) if older adults were cautious in their decisions or tended to immediately jump to a conclusion; (2) if older adults were able to integrate the new information they received to change their implausible interpretations (Feedback Sensitivity); (3) the role of context, more or less ambiguous, on decision making processes; (4) the specificity of the Pictures Decision Task with respect to the Iowa Gambling Task (IGT), and the Wisconsin Card Sorting Test (WCST). The study was conducted on 27 older (aged 64-88) and 26 younger adults (aged 25-57) matched for years of education. The IGT results confirmed that older adults learned with more difficulties an advantageous strategy, while the WCST results showed the production of more perseverative errors. The Pictures Decision Task showed that older adults were cautious on their decisions, as younger adults, and did not show the Jumping to Conclusions bias. Older adults, compared to younger adults, were less susceptible to feedback in the more ambiguous condition (the uncued condition), whereas were equally susceptible to feedback in the less ambiguous condition (the cued condition). These results showed that older adults had difficulty learning from feedback only when the context is ambiguous and not when they were given aid or interpretive information that decrease ambiguity. The Pictures Decision Task, with respect to IGT and WCST, allowed to assess decision making and feedback sensitivity in highly ambiguous conditions and therefore might add new insight into the reasoning processing of older people.

## 1. Introduction

Older adults require complex decision making abilities in order to accomplish various, and at times, difficult situations. For example, they need to resolve issues such as health care for themselves and their spouse and make decisions regarding financial matters. These situations require the ability to gather information needed to compare different alternatives and assess the risk and benefit ratio of each choice. Thus, there is a need to better understand the how older adults synthesis a multitude of information to make decisions.

Age-related decline in cognitive performance can be found in a variety of different tasks (Wild-Wall, Hohnsbein, & Falkenstein, 2007). In particular, older adults show decreased performance on tasks mediated by the frontal lobe areas (Park, Gutchess, Meade, & Stine-Morrow, 2007). Such tasks include the Wisconsin Card Sorting Test (WCST; Berg, 1948; Grant & Berg; 1948) and the Iowa Gambling Task (IGT; Bechara, Damasio, Damasio, & Anderson, 1994). On the WCST, participants are required to sort a series of cards based on an unkown rule that changes during the test through use of feedback from the examiner. When a category shift occurs, older adults frequently continue to incorrectly sort the cards even if the examiner expressed that their response was incorrect. Such a patter or incorrect response is indicative of perseverative behavior and lack of cognitive flexibility (Duncan, 1995). Studies conducted with the WCST to investigate cognitive flexibility in older adults found that participants showed lower accuracy (global score) and more perseverative responses compared to younger adults (West, 1996). Axelrod and Henry (1992) found a higher number of perseverative responses in participants aged 50, while those who were 60 years old had a lower global score. The authors suggested that perseverative errors may be particularly affected by age and therefore were a sensitive index to investigate cognitive flexibility (Axelrod &

Henry, 1992; Rhodes, 2004) Some authors have interpreted those results to suggest that there are age-related differences in the use of feedback. Such differences may be mediated by age differences in working memory, which are in turn mediated by age-related reductions in processing speed (Fristoe, Salthouse, & Woodard, 1997). Some authors have indicated that perseverative errors result from a deficit in set-shifting (Ridderinkhof, Span, & van der Molen, 2002), while others have suggested that it results from reduced working memory capacity (Hartman, Bolton, & Fehnel, 2001). A more recent study conducted by Ashendorf and McCaffrey (2008) found two interesting pattern of responses in older relative to younger adults: (1) responses to a category, despite previous negative feedback given regarding that category, and (2) shifts in set despite receiving positive feedback for the decision made on the previous trial. These pattern are noteworthy because they demonstrated that the poorer performance observed in those participants was attributable to reduced feedback utilization efficiency. The results implicated poor set shifting and set maintenance, consistent with reduced efficiency of feedback utilization, as the primary cause for age-related decline on the WCST (Ashendorf & McCaffrey, 2008).

Studies conducted with IGT to examine decision making with older adults showed that the older, relative to younger adults, prefer the advantageous decks (Denburg et al., 2007; Denburg, Rechnor, Tranel, & Bechara, 2006; Denburg, Tranel, & Bechara, 2005; Fein, McGillivray, & Finn, 2007). Despite that preference, it has been observed that younger adults show a constant linear positive learning trend of the win strategy, whereas older adults show a more flat trend. This pattern was due to the fact that almost all younger participants performed the task in an advantageous manner, while in the older adults group there was a substantial subgroup defined as "impaired" that failed the task due to inability to implement the win strategy. These studies showed that the ability

to make advantageous choices decreased with age (Fein et al., 2007). Denburg et al. (2007) measured the electrodermal response and found that older adults with good decision making skills (perfect performance on the IGT) had an anticipatory skin conductance response (SCR) with respect to younger adults. The latter showed the SRC before choosing disadvantageous decks, while the older adults showed it before choosing an advantageous deck. In older adults, the positive rather than negative somatic markers have a role in modulating decision making. Older adults with poor decision making, in contrast, show no such differentiation on electrodermal response. The feature that seems to differentiate older adults compared to younger adults in decision making processes is the search for emotional satisfaction rather than the the acquisition of new information and achievement of objectives (Carstensen & Mikels, 2005). Emotional regulation and decline of executive functions may therefore play a role in the tendency of older adults to seek less information than younger adults when making decisions. Other significant differences between older and younger adults on the IGT were found regarding the effects of feedback on changes in strategy. Older adults showed less stability of advantageous choices (leave the advantageous strategy) and less flexibility (e.g., not change the strategy after negative feedback) (Zamarian, Sinz, Bonatti, Gamboz, & Delazer, 2008).

There is evidence that the reward system (dopamine) is affected by both structural and functional changes during healthy aging. These changes form the basis of an impoverished stimulus-reinforcement association learning and adaptability to new situations, making older adults slower in learning and to be more conservative (Marschner et al., 2005). Taken together these results suggested that older adults used different strategies from those used by younger adults when carrying out high demanding tasks. However, the decline in cognitive functions in older adults is not

uniform. Some cognitive abilities, such as implicit memory, verbal skills and crystallized intelligence, remain stable with aging, while others, such as working memory, episodic memory, inhibition and speed of processing decrease (Ballesteros, Nilsson, & Lemaire, 2009).

Given the different decision making and cognitive flexibility characteristics in older and younger adults, we wondered if older adults, when faced with an ambiguous situation, collect sufficient information to correctly judge the situation or if they jump to conclusions. We wondered also if older adults, after judging that their interpretation is plausible, are willing to abandon it after they receive conflicting information information.

For this purpose, we used a modified version of the Pictures Decision Task, a task designed by Moritz and Woodward (2006) to investigate a particular reasoning bias in patients with schizophrenia called Jumping to Conclusions (JTC). The JTC bias is the making of quick decisions based on limited information. Several explanations have been proposed for the mechanisms underlying this bias. The first hypothesis explained it as a bias in data collection (data-gathering bias) (Garety, Hemsley, & Wessely, 1991). A second hypothesis has been named “hypothesis of liberal acceptance” and it assumed that JTC is due to a low threshold for acceptance (Moritz & Woodward, 2004). With the concept of liberal acceptance, Moritz and Woodward refered to the possibility of accepting different interpretations of the same situation. Normally the threshold of acceptance is exceeding by those hypotheses that get more confirmation, and that were assessed by the participant as the most plausible and therefore accepted with greater confidence. According to this hypothesis, patients with schizophrenia have a reduced acceptance threshold and consider plausible interpretations supported by limited information, while healthy participants are more selective and exclude interpretations

with little evidence. In other words, in patients with schizophrenia an implausible hypothesis can exceed the acceptance threshold more easily and do not require additional information to be accepted with confidence (Rubio et al., 2011).

The purpose of this study was to investigate decision making, cognitive flexibility and feedback sensitivity in older adults using the modified version of the Pictures Decision Task. The Pictures Decision Task may highlight other aspects of decision making and feedback sensitivity that are not measured by tasks (i.e., IGT, WCST) commonly reported in literature. This task allowed for the analysis of behaviour in older adults when they are faced with a situation of ambiguous or difficult interpretation, because supported by limited information. Unlike the IGT, the Pictures Decision Task does not assess decision making in risky situation, but rather assesses whether individuals show a judgment bias in their decisions. This task assessed whether the participant, in a situation with limited information, immediately jumped to a conclusion (JTC) providing high safety ratings.

The Pictures Decision Task also differs from the WCST. While the latter provides explicit feedback on the correct/wrong answer, the former provides no direct feedback, but rather the examiner checks if the participant is able to organize the information he/she receives to change the incorrect answer. The Pictures Decision Task allows for the evaluation of whether older adults are cautious in their plausibility judgments and seek sufficient information before confirming their decision, or if, on the contrary, tend to immediately make a conclusion. We plan to also test the sensitivity to feedback of older adults by assessing their ability to reorganize additional information to get the correct interpretation.

We hypothesized that (1) older and younger adults would show similar levels of JTC bias, (2) older adults would be less sensitive to feedback and have more difficulty in

changing their misinterpretation, (3) performance differences between older and younger adults would be greater in the condition in which there were no aids for interpretation, and (4) the Pictures Decision Task may highlight different decision making components than those examined by IGT and WCST.

## 2. Method

### 2.1 Participants

Two groups of healthy volunteers participated in the study. The younger group comprised of 26 participants (M = 10; F = 16) aged between 25 and 57 (M = 38.7 years, *SD* = 9.0). The older group comprised of 27 participants (M =13; F = 14) aged between 64 and 88 (M = 73.5 years, *SD* = 6.4). There was no difference between groups on level of education, (younger: M = 10.8, *SD* = 3.1; Older: M = 9.9, *SD* = 3.8; $p = 0.32$). We screened for cognitive impairment in older adults with the Mini Mental State Examination (MMSE) (cut-off > 23/30; Measso et al., 1993). The aveage MMSE score was 26.7 (*SD* = 1.15) and suggested that the older adults had intact global cognitive functions. Exclusion criteria for participation in the study were pre-existing neurological, psychiatric, or developmental disorders, or a history of alcohol and/or substance abuse. All participants provided written informed consent to participate in the study, which was conducted in line with the guidelines provided by the Department of General Psychology, Padova, Italy.

### 2.2 Materials and Procedure

Participants were tested individually in one experimental session that lasted approximately 90 minutes. Testing was conducted in a distraction free, quiet room and breaks were provided as needed between tasks. All participants performed the

experimental protocol in a fixed order: Pictures Decision Task, IGT, and WCST. Each task was preceded by a practice phase and all participants understood the instructions. The Pictures Decision Task and IGT were presented on a 15-inch PC computer monitor, and each participant was seated at a distance of approximately 60 cm from the screen. E-Prime® 1.0 was used to program and run the Pictures Decision Task and IGT.

### *2.2.1 Pictures Decision Task*

The Pictures Decision Task was a modified version of the task designed by Moritz and Woodward (2006). Stimuli included line drawings in black and white background of objects and animals. Each drawing was fragmented into eight stages. In the first stage, the drawing was ambiguous and composed of few details. In the later stages, the drawing became less ambiguous with the addition of new elements. Finally, in the eighth stage, the drawing was complete (see Figure 1).

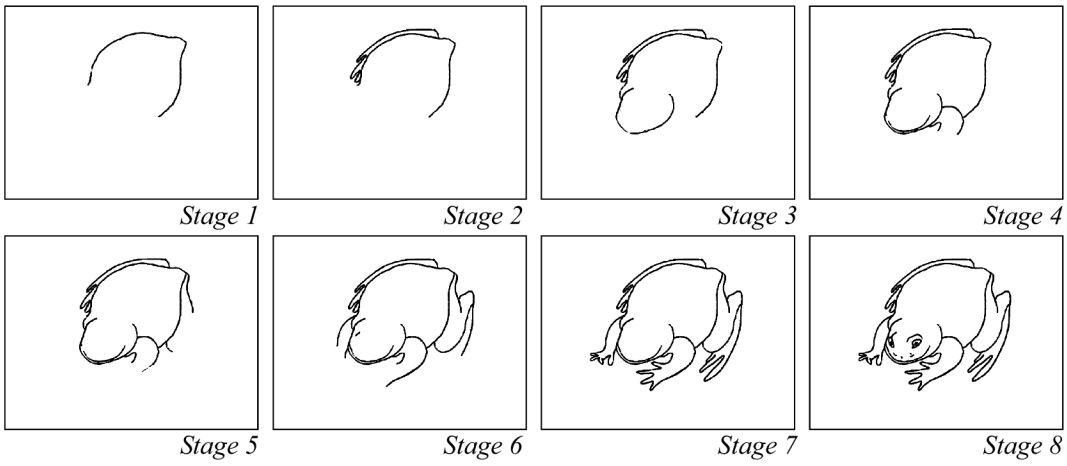


**Figure 1.** Pictures Decision Task: Example of one of the 10 drawings. The drawing is decomposed into a sequence of 8 stages, ranging from the more ambiguous drawing (stage 1) to the complete drawing (stage 8). This example shows the drawing of a "frog".

For the purposes of this study, we adapted the task by Moritz and Woodward's (2006) task. First, we increased the number of drawing from six to ten. Second, we conceptually divided the task into two parts. The first part consisted of the first four stages and the second part consisted of the remaining four stages. In the first four stages, in fact, it was unclear the thematic representation, but ambiguous elements (i.e. circles, lines, etc) of the figures were predominate and so the participant could only develop interpretative hypotheses. Over the last four stages, the theme was incrementally outlined, and addition of new elements acted as feedback on prior responses. We created a feedback sensitivity index that investigated how much the participant, in the last four stages, used the new information to change his/her answer (see the Statistical Analyses section). Third, in Moritz and Woodward's task, the presentation of the elements was interrupted at any stage if the participant's rated confidence was at the maximum level (=5) (Moritz & Woodward, 2006). As we were interested in exploring decision making and feedback sensitivity, we decided to not interrupt the presentation of the stages that make up the drawing, even when the participant evaluated his decision with maximum confidence.

The revised Pictures Decision Task as used in this study consisted of two practice trials and ten experimental trials (five were presented in a cued condition and five in an uncued condition). The order of presentation was fixed, alternating with a cued drawing and an uncued drawing. The practice trials consisted of a cued guitar and an uncued raft. The experimental trials were presented in the following order: coach, castle, elephant, mill, house, girl, pig, bat, frog, and fish.

In the cued condition, the drawings were accompanied by a list of six possible interpretations (cues) and the participants were asked to choose an answer and assess the plausibility of their choice on a 5-point Likert scale 1 = not sure, 2 = unsure, 3 =

fairly sure, 4 = very confident, 5 = very safe). In the uncued condition, participants were asked to produce an interpretation at each stage and to assess, as for the cued condition, the plausibility of their responses. Participants were instructed to interpret the drawing at each stage and make a judgment on the certainty of each interpretation. The task was untimed, so the drawing remained available to the participant until the provision of a response. No feedback was provide about an erroneous interpretation. The critical feedback was provided by the subsequent stages of the drawing.

### *2.2.2. Iowa Gambling Task*

The IGT was developed to assess real-world decision making in a laboratory (Bechara et al., 1994). Participants were administered a computerized version of the IGT (Bechara, Tranel, & Damasio, 2000). In the test session, four card decks appeared face down on the computer screen. Participants interfaced with the task by use of a mouse to select cards from one of the decks. Starting capital was fixed at $2000 of fictive money "borrowed" from the examiner. Participants were told to maximize profit by selecting cards from one of the four decks. The decks were stacked such that A and B produced higher winnings and higher losses, whereas C and D produced more modest winnings but smaller losses. After each selection, the amount won appeared on the screen, followed by the amount lost, if any. Over time, C and D yielded the highest overall winnings. The test continued until 100 cards had been drawn. Participants were neither instructed about the rules of the task, nor did they know the number of trials until completion of the task.

*2.2.3 Wisconsin Card Sorting Test*

The WCST (Heaton, Chelune, Talley, Kay, & Curtiss, 1993; Laicona, Inzaghi, De Tanti, & Capitani, 2000) was designed to assess the reasoning ability and set shifting cognitive strategies. The standard WCST materials included four stimulus cards and two identical decks of 64 fixed sequence response cards. Each card presented a certain number of figures of the same form and colour. Four stimulus cards were placed in front of each participant displaying, respectively: one red triangle, two green stars, three yellow crosses, and four blue circles (from left to right). Each participant was provided the two decks of response cards and instructed to match each consecutive card with one of the stimulus cards. There were three possible sorting categories: form (crosses, circles, triangles or stars), colour (red, blue, yellow or green) and number (one, two, three or four). The participants were notified only whether the responses were right or wrong, without mention of the underlying sorting criterion (known only to the examiner, in sequence: colour, form, number, colour, form, number). Once a participant had made 10 consecutive correct matches, the sorting criterion was changed, without warning. The test was discontinued when a participant achieved all six sorting categories or had sorted both card decks.

## 3. Results

### 3.1 Statistical analyses

The Pictures Decision Task was analyzed in terms of Plausibility Rating, Draws to Decisions, Number of Correct Responses, and Feedback Sensitivity. The *Plausibility Rating* indicated for each drawing the mean certainty (safety range from 1 to 5) that the participant expressed at each stage (from 1 to 8). This index was used to measure

the level of conviction that participants expressed for their interpretations of the drawing. This index showed the acceptance threshold of an interpretative hypothesis. The participants had a low acceptance threshold if they expressed maximum security in the early stages (when the design was very ambiguous). The *Draws to Decisions* represented the stage in which the participants attributed for the first time to their decision, the value of "maximum confidence" (= 5). This index indicated the average number of stages required by the participants to evaluate their decision with maximum security. This index assessed whether participants tended to draw conclusions based on limited information (e.g., the JTC bias). The *Number of Correct Responses* at the last stage (max: 5) represented a global cognitive efficiency index. The *Feedback Sensitivity* related the number of errors vs. the number of wrong guesses made in the last four stages. This index checked whether participants realized they were wrong and tried to change the interpretation of the drawing by use of new information (at each stage), or if they were anchored to the previous wrong answer. To calculate this index, we added to the number of errors (E) and the inverse of the number of wrong guesses (C): $\sum E + ( 1/ \sum C)$;  E = number of errors, taking into account the repetitions; C = number of different wrong conjectures. Participants were sensitive to feedback if they realized that they made a mistake and tried to change their interpretation based on the new information. Participants were insensitive to feedback when they continued to make mistakes by maintaining the same misinterpretation even in the next stage, which suggsetd that they did not incorporate new information (see Figure 2 for an example).

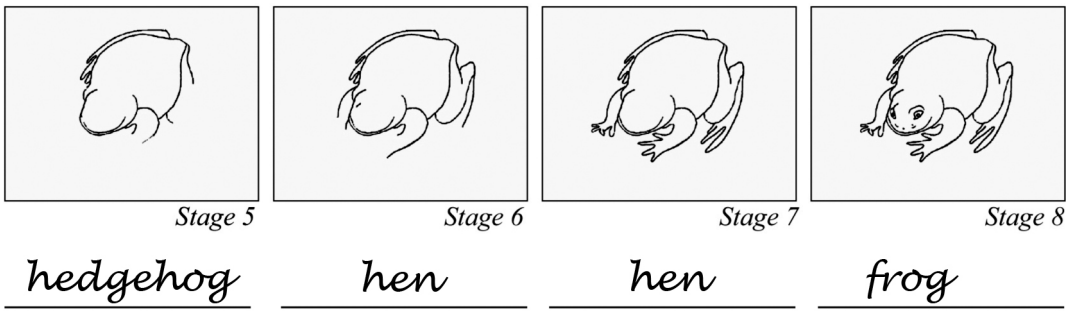


**Figure 2.** Pictures Decision Task: The drawing of the frog at stages 5, 6, 7, and 8 and examples of participants' responses. The participant made three errors (hedgehog, hen, hen) and produced two wrong guesses (hedgehog, hen). It may be noted that the participant was sensitive to feedback in the transition from stage 5 to stage 6, but was not in the transition from stage 6 to stage 7.

The feedback sensitivity index can be represented along a continuum: greater feedback sensitivity when participants made fewer mistakes and produced more conjectures; lowest feedback sensitivity when participants made more mistakes and produced less conjectures.

Separate analyses of variance were conducted on the various dependent variables of the Pictures Decision Task. Data on Plausibility Rating were included into mixed-model analysis of variance (ANOVA) with between factor of group (older vs. younger adults) and within factors of condition (cued vs. uncued) and stage ($1^{st}$ to $8^{th}$ stage). Data on Draws to Decisions, Number of Correct Responses and Feedback Sensitivity were included in separate mixed-model ANOVAs with between factor of group (older vs. younger adults) and within factor of condition (cued vs. uncued). The significance level for these and all the subsequent analyses was $p < .05$. Post hoc analyses were performed with the Bonferroni correction.

IGT performance was calculated by dividing the 100 trials in five blocks of 20 trials and for each block was calculated the difference between the frequency in the choice of the advantageous decks (C + D) and the frequency in the choice of disadvantageous decks

(A + B). Data were included into a mixed-model ANOVA with between factor of group (older vs. younger adults) and within factor of block (1 to 5).

WCST performance was analyzed in term of global score and number of perseverative errors. The global score estimated how many cards the participant actually used in excess of the minimum necessary to achieve the six categories. The global score was computed by subtractions from the total number of administered trials and the number of categories completed multiplied by ten. The number of perseverative errors was calculated following the scoring and recording procedures suggested by Heaton and colleagues (1993). Separate independent *t*- test were carried out on these scores.

We also computed separate, two-tailed Pearson correlations for younger and older adults between Pictures Decision Task, IGT and WCST to investigate the relationship between these tasks and highlight the processing differences between younger and older adults. In particular we investigated if participants with lower cognitive flexibility at Pictures Decision Task would also present lower cognitive ability and lower cognitive flexibility as indexed by the traditional tasks investigating these processes, such as IGT and WCST. To better understand the differences between older and younger adults, we also compared the two correlation analyses (z Fisher), for which we will only report those results that are significant.

## 3.2 Pictures Decision Task

### 3.2.1 Plausibility Rating

Results showed significant effects of condition [$F(1, 51) = 138.55$, $p < .001$; $\eta^2_p = .73$] and stage [$F(7, 357) = 382.31$, $p < .001$; $\eta^2_p = .88$]. Participants were more confident on their interpretations in the cued than in the uncued conditions (3.26 vs.

2.77); moreover, the effect of stage showed that the level of certainty increased significantly at all 8 stages (2.08, 2.28, 2.41, 2.59, 2.98, 3.30, 3.88 and 4.62, respectively). Interestingly the condition × stage interaction was also significant [$F(7, 357) = 23.83$, $p < .001$; $\eta^2_p = .32$]. Post hoc analysis showed that from stage 1 to stage 7, participants expressed greater certainty in the cued condition with respect to the uncued condition, while at the last stage, when the drawing was complete, the certainty expressed was equivalent in the two conditions. Also, certainty was steadily increased and was significantly different at each stage only in the cued condition.

We found no effect of group ($p>.05$), but group significantly interacted with condition [$F(1, 51) = 10.05$, $p < .001$; $\eta^2_p = .17$], indicating that even if both groups expressed greater certainty of judgment in the cued condition, the younger adults showed a greater difference in the rating between the cued and uncued conditions. There was also a significant group × stage interaction [$F(7, 357) = 2.200$, $p < .05$; $\eta^2_p = .04$], which may be explained in light of the group × condition × stage interaction [$F(7, 357) = 2.32$, $p < .05$; $\eta^2_p = .04$] (see Figure 3).

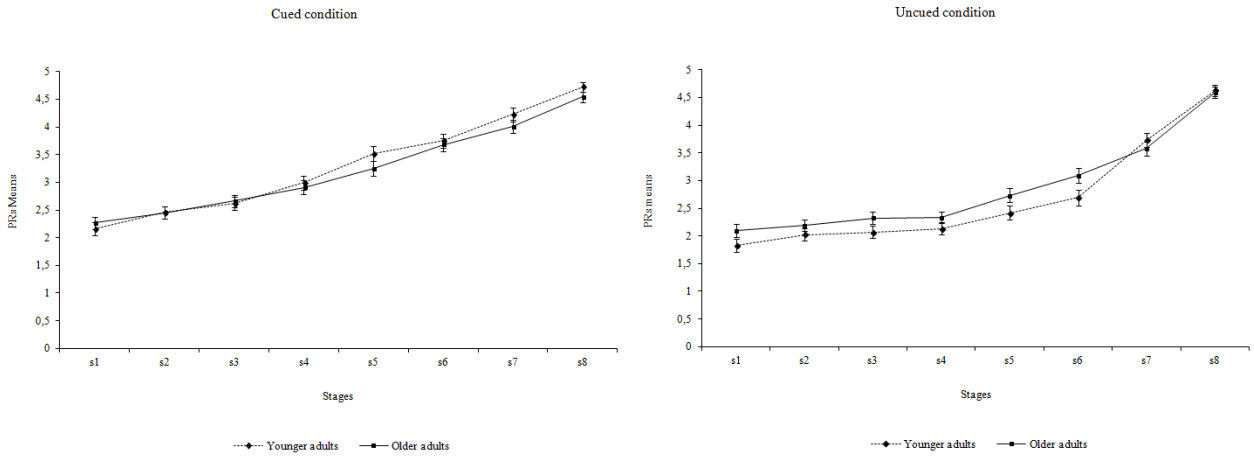

**Figure 3.** Pictures Decision Task: (a) Group x stage x condition interaction on the Plausibility Rating (PR) index, (b) comparison between the certainty score of the two groups (older and younger adults) in the two conditions (cued and uncued) for stages 1 to 8.In the cued condition, younger and older adults showed the same level of certainty, but in the uncued condition, younger and older adults showed different levels of certainty. In particular, the difference trended towards significance at stage 5 ($p$ = .08) and reached significance at stage 6 ($p$ < .05), indicating that older adults showed higher levels of certainty in the intermediate stages (stages 5 and 6).

3.2.2 Draws to Decisions

Results showed a significant effect of condition [$F(1, 51) = 30.30$, $p < .001$; $\eta^2_p$ = .37], indicating that participants required more stages to make a decision with maximum certainty (6.79 vs. 5.72) when they performed the task in the uncued relative to the cue condition. No significant effect of group or interactions were found ($p > .05$).

3.2.3 Number of Correct Responses at the last stage

Results showed a significant effect of group [$F(1, 51) = 5.0$, $p < .05$; $\eta^2_p = .090$], indicating that older adults identified fewer number of drawings compared to younger adults (4.40 vs. 4.78). The numbers of older adults who did not recognize the drawing at stage 8 was 9 out of 27, while the number of controls was 3 of 26.

3.2.4 Feedback Sensitivity

Results showed the significant effects of group [$F(1, 51) = 4.74$, $p < .05$; $\eta^2_p = .09$] and condition [$F(1, 51) = 6.72$, $p < .05$; $\eta^2_p = .12$]. Older adults used the feedback to a lesser extent than younger adults (8.63 vs. 7.19); moreover, the feedback sensitivity was greater in the cued than in the uncued condition (7.39 vs. 8.43). There was also a significant group × condition interaction [$F(1, 51) = 4.72$, $p < .05$; $\eta^2_p = .09$]. Post-hoc

analysis showed that older adults had less feedback sensitivity in the uncued with respect to the cued condition (9.60 vs. 7.66), but the younger adults showed no difference in the use of feedback between the two conditions (7.27 vs. 7.11). In the uncued condition, we found a significant difference between groups. Older adults were significantly less sensitive to feedback than younger adults. However, in the cued condition, there was no significant difference between the older and younger adult group with regard to feedback sensitivity.

### 3.3. Iowa Gambling Task

Results showed significant effects of group [$F(1, 51) = 7.76$, $p < .001$; $\eta^2_p = .13$] and block [$F(4, 204) = 23.46$, $p < .001$; $\eta^2_p = .32$]. Older releative to younger adults tended to make fewer advantageous choices (2.01 vs. 5.04). The significant effect of block indicated a learning effect. That is, the number of advantageous choices increased with the progression of the game (-1.39, 1.82, 5.57, 5.36 and 6.28). Interestingly, there was also a significant group × block interaction [$F(4, 204) = 3.68$, $p < .001$; $\eta^2_p = .07$]. A significant difference between younger and older adults in the number of advantageous choices emerged in the last two blocks (blocks 4 and 5; see Figure 4). Older adults, while adopting a win strategy in the last two blocks, selected less advantageous cards than the younger adults. For the younger group, there was a significant difference between block 1 and 2 and both blocks are significantly worse than all the other blocks. The number of advantageous choices was not significantly different for blocks 3 - 5. The difference between advantageous and disadvantageous choices was significantly greater in block 3 than in the first two blocks. This difference was consistent across the last two blocks. For the older group, the only significant difference was between block 1 and 3.

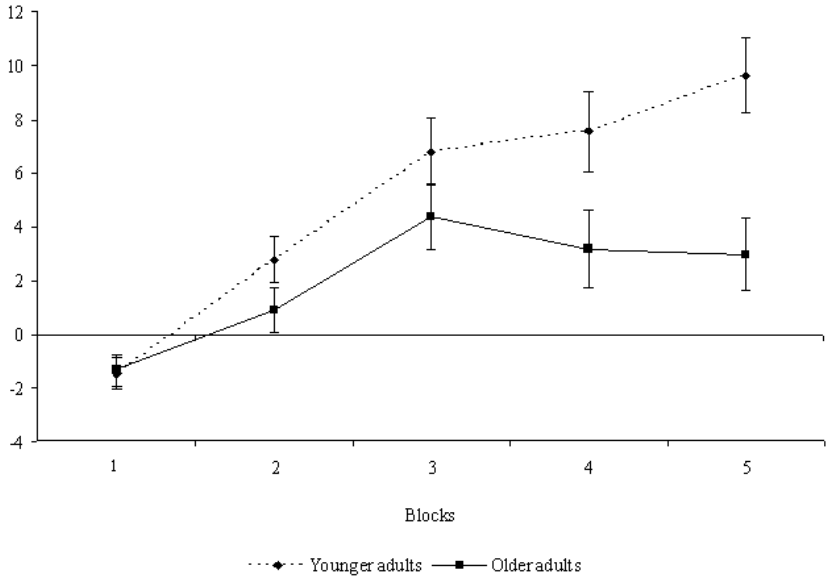


**Figure 4¡** Iowa Gambling Task: Interaction of group (older and younger adults) x block (1 to 5) in advantageous choices. For each block, we calculated the difference between the frequency in the choice of the advantageous decks (C + D) and the frequency in the choice of disadvantageous decks (A + B).

3.4. Wisconsin Card Sorting Test

Results showed a significant difference between groups for the global score [$t(51) = 4.04$, $p < .001$; $d = 1.13$] and the number of perseverative errors [$t(51) = 2.04$, $p < .001$, $d = .57$]. Analysis on the global score found that older adults required a higher number of cards to achieve the six categories (62.78 vs. 37.15). Analysis on perseverative errors showed that older adults made more errors compared to younger adults (22.15 vs. 14.04).

3.5. Correlations on Pictures Decision Task, Iowa Gambling Task and Wisconsin Card Sorting Test

Correlation analyses were conducted on the uncued condition of the Pictures

Decision Task, IGT (block 3, 4 and 5), and the WCST. The uncued condition of the Pictures Decision Task, compared with the cued condition, required more stages to make a decision with maximum certainty (see the Draws to Decisions results) and showed a significant difference between groups on Plausibility Rating and Feedback Sensitivity indexes. Therefore, the uncued condition was more suited to highlight the processing differences between older and younger adults. We restricted the analysis of the IGT task at block 3, 4 and 5 considering the results obtained; the difference between advantageous and disadvantageous choices became significant at Block 3 and then remained constant over the last two blocks. Thus, it was at block 3 (from 41° to 60° choices) that began the learning of the advantageous strategy. This decision was also supported by various studies. Bechara, Damasio, Tranel, & Damasio (1997) divided the IGT performance in four stages: 1) the pre-punishment stage, where participants do not show SCR and prefer the disadvantageous decks, because they give more consistent winnings; 2) the pre-hunch stage, where participants start to show anticipatory SCR when they select the disadvantageous decks; 3) the hunch stage, which is approximately after the 50° choice, where participants begin to express the feeling that decks A and B are more risky; 4) the conceptual stage, which is approximately the 80° choice, where participants express an understanding about the reason why the decks A and B are disadvantageous and the decks C and D are advantageous.

Table 1 shows the separate, two-tailed Pearson correlations conducted between the Pictures Decision Task, IGT and WCST. The Pictures Decision Task was analyzed in terms of Plausibility Rating for each stage, Draws to Decisions, Number of Correct Responses at the last stage, Feedback Sensitivity. The IGT was analyzed in terms of the difference between the frequency in the choice of the advantageous decks (C + D) and

the frequency in the choice of disadvantageous decks (A + B) for each block. The WCST was analyzed in terms of Global Score and Perseverative errors.

For older adults significant negative correlations were found between IGT at block 3 and Plausibility Rating at the first 5 stages of the Pictures Decision Task. Block 3 at IGT task was considered the critical stage to learn a strategy; higher score at IGT indicated an accurate use of strategies. The less older adults put in place an advantageous strategy to block 3 most expressed high certainty ratings in the early stages (1-5 stages) of the Pictures Decision Task. This showed that older adults with low acceptance threshold were less able to implement advantageous strategies.

Younger adults showed significant positive correlations between blocks 3 and 4 of the IGT and Plausibility Rating at the $7^{th}$ stage of the Pictures Decision Task. This suggested that younger participants with higher acceptance threshold at stage 7, when the drawing in the Pictures Decision Task was almost complete, were more able to engage and maintain advantage strategies over time. Moreover, IGT task at block 3 and 4 negatively correlated with Feedback Sensitivity of the Pictures Decision Task. This suggested that younger adults with lower ability to engage advantage strategies at IGT task showed lower sensitivity to the feedback at Pictures Decision Task. IGT task at block 4 positively correlated with number of correct responses at the last stage of the Pictures Decision Task. As such, the more younger adults put in place an advantageous strategy to block 4 of the IGT, i.e. when learning of the win strategy was well established, the more accurate they were at the last stage of the Pictures Decision Task.

**Table 1.** Results of two-tailed Pearson's r correlation coefficients between Pictures Decision Task (uncued condition), Iowa Gambling Task (IGT; Blocks 3 to 5) and Wisconsin Card Sorting Test (WCST). The Pictures Decision Task was analyzed in terms of Plausibility Rating for each stage (PR1 to PR8), Draws to Decisions (DTD), Number of Correct Responses at the last stage (CR), and Feedback Sensitivity (FS). The IGT was analyzed in terms of the difference between the frequency in the choice of the advantageous decks (C + D) and the frequency in the choice of disadvantageous decks (A + B) for each block. The WCST was analyzed in terms of Global Score and Perseverative errors.

| | **Older adults** | | | | | **Younger adults** | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **IGT** | | | **WCST** | | **IGT** | | | **WCST** | |
| | Block 3 | Block 4 | Block 5 | Global score | Perseverative errors | Block 3 | Block 4 | Block 5 | Global score | Perseverative errors |
| PR1 | **-.622**** | -.171 | -.225 | .064 | .227 | .080 | -.028 | .083 | .081 | -.041 |
| PR2 | **-.504**** | -.061 | -.032 | -.081 | .029 | .267 | .194 | .219 | -.029 | -.152 |
| PR3 | **-.442*** | .030 | .034 | -.120 | .069 | .110 | .098 | .102 | .040 | -.110 |
| PR4 | **-.505**** | -.068 | -.097 | .017 | .320 | .084 | .158 | -.004 | .107 | -.010 |
| PR5 | **-.448*** | .126 | .083 | -.081 | .187 | .127 | .075 | .079 | .156 | .035 |
| PR6 | -.300 | .173 | .034 | -.029 | .085 | .233 | .356 | .163 | .158 | .100 |
| PR7 | -.187 | .127 | .070 | -.244 | -.211 | **.389*** | **.392*** | .196 | .002 | -.009 |
| PR8 | .001 | .046 | .037 | -.309 | -.266 | .142 | .268 | -.045 | .373 | .367 |
| DTD | .301 | .013 | .146 | -.122 | -.189 | -.024 | .282 | -.168 | .014 | .130 |
| CR | .079 | .129 | .189 | **-.473*** | **-.436*** | .157 | **.391*** | .070 | -.065 | .010 |
| FS | -.222 | -.127 | -.192 | **.450*** | **.436*** | **-.394*** | **-.437*** | -.252 | .033 | -.051 |

* $p < 0.05$; ** $p < 0.001$

Significant correlations were also found between WCST number of correct responses at the last stage and feedback sensitivity of the Pictures Decision Task in older adults. The more perseverations errors on the WCST participants committed, the less sensitive they were to feedback and less correctly identified the drawing in Stage 8

of the Pictures Decision Task. Analyses of z Fisher conducted between younger and older participants showed that Plausibility Rating at stage 1 to 7 of the Pictures Decision Task differentially correlated with block 3 of IGT: z=-.-2.8; z=-2.87; -2.03; z=-2.22; z=-2.11; z=-1.89; and z=-2.08. Moreover, Plausibility Rating of the Pictures Decision Task at stage 8 differentially correlated with the WCST global score (z=-2.46) and perseverative errors z=-2.28.

## 4. Discussion

The present study was designed to investigate decision making and feedback sensitivity in older adults with the Pictures Decision Task. This novel task was created to measure critical decision making abilities. Imporantly, this task allowed for the assessment of decision making in an ambiguous context, because supported by limited information, assessed the presence of judgements bias and allowed to measure feedback. Specifically we hypothesized that: (1) older adults did not show a JTC bias. In fact we expect that older adults would present the same level of confidence on their decisions as for younger adults. People should judge with less confidence in the first stages and wait the last stages to engage the maximum confidence; (2) older adults were less sensitive to feedback and therefore showed more difficulty changing their misinterpretation; (3) higher differences between older and younger adults in the condition in which there were no aids for interpretation; (4) the Pictures Decision Task allowed to assess different decision making aspects with respect to the Iowa Gambling Task (IGT), and the Wisconsin Card Sorting Test (WCST).

With respect to the first point, regarding the decision making processes, evaluated with the Picture Decision Task, older adults do not differ from younger adults in

experiencing certainty about their decisions. In addition, they did not need a smaller number of stages to make a decision with maximum certainty. Older adults were cautious as younger adults in decision making and therefore they did not show the JTC bias. The Picture Decision Task showed that the errors in the decision making processes of older adults were not due to a reduced search for information and/or to a low threshold of acceptance, even though in the condition without cue there was a greater certainty in the intermediate phase. Despite this, in the decision making processes investigated with IGT, older adults adopted a less advantageous strategy, showing a flater learning trend than younger adults, especially in the last two trial blocks. As evidenced by the literature (Denburg et al., 2007, 2006, 2005; Fein et al., 2007) younger adults showed a linear learning trend of the advantageous strategy, while older adults show a more flatter learning trend.

The Pictures Decision Task also highlighted a greater difficulty in the older adult group in identifying the figure when it is complete (stage 8). This difficulty and the lower ability to adopt an advantageous strategy, as evidenced by the IGT, did not reflect a Jumping to Conclusions bias, but may have reflected a greater challenge of older adults to learn from feedback.

In fact, we confirmed our prediction (second point) that older adults have a lower level of feedback sensitivity than younger adults. Older adults were unable to change their misinterpretation with the addition of new information that suggested their initial choice was incorrect. These inabilities arised only in the uncued condition when there were no interpretive aids; however, in the cued condition when such aid was provided, older adults showed a similar pattern as the younger adults. Therefore, the cue served as a facilitator for incorporation of the feedback. This result showed that older adults have difficulties learning from feedback only when the context was ambiguous, and not when

they were given aids or interpretive information that decreased ambiguity (Zamarian et al., 2008).

These considerations were also confirmed by the results obtained with the WCST task. Older adults showed less cognitive flexibility and problem solving abilities as evidenced by the need for a higher number of cards to complete the six categories. Also, older adults made more perseverative errors compared to younger participants. These results were in line other studies and support the hypothesis of a reduced efficiency of feedback utilization, as a possible cause for age-related decline (Ashendorf & McCaffrey, 2008).

With respect to the third point, our results showed differences between older and younger adults only in the uncued condition, where no help on the interpretation was given. In the more ambiguous condition, the older adults showed more difficulty in changing their misinterpretation when new information is added. Cues facilitated older adults leading them to have a similar sensitivity to feedback to younger adults, unlike the latter were equally sensitive in the two conditions. Interestingly, only in the uncued condition, older adults differed from younger adults in their level of certainty at stages 5 and 6. These stages were crucial because defined the moment in which the drawing became less ambiguous. In fact, in the uncued condition there was a certainty pattern that may be described in three phases. The first phase is represented by stage 1: the certainty is low and differed significantly from the certainty expressed in all subsequent stages, except for stage 2. The second phase is represented by stage 2, 3 and 4: the certainty was consistently low and differed significantly from the certainty expressed in all subsequent stages. The third phase was represented by stage 5, 6, 7, 8 in which the certainty continued to significantly increase at each stage. Older adults tended to be more confident with their decision compared to younger adults; beside that older adults

did use a lower number of stages to make a decision, thus older adults were cautious as younger adults in decision making and do not show JTC bias. Therefore we can say that the cued condition was the basic (control) condition, while the uncued condition detected differences in feedback sensitivity. For this reason we decided to use the uncued condition to compare the Pictures Decision Task with the IGT and the WCST.

Correlational analysis (fourth point) showed that older adults with greater difficulties in problem solving and cognitive flexibility (as assessed by the WCST) were less sensitive to feedback and were less able to identify the picture at the last stages of the Pictures Decisions Task in the most ambiguous condition (uncued condition).

The judgment of safety showed that older adult with lower threshold of acceptance, i.e., high safety ratings already to the first four stages of the Pictures Decision Task, were less able to develop an advantageous strategy in the phase defined "hunch" at the IGT (block 3). This correlation was not showed in young adults.

Younger adults with higher acceptance threshold, i.e., with higher safety ratings only in the last stages of the Pictures Decision Task, the more they were able to develop an advantegeous strategy at the IGT.

These correlations showed that the Picture Decision Task is a suitable tool to investigate decision making processes and feedback sensitivity as the indices (Plausibility Rating, Feedback Sensitivity and Number of Correct Responses at the last stage) correlate with the IGT index (especially for block 3) and WCST indices (global score and perseveration).

In conclusion, this study found that older adults were cautious, as younger adults, expressing security judgements on their decisions and that older adults do not show the Jumping to Conclusions bias. Both older and younger adults, were equally susceptible

to feedback in a less ambiguous condition, and, but only older adults were less susceptible to feedback in a more ambiguous condition. These results suggestd that older adults had difficulty learning from feedback when the context was ambiguous, but they did benefit from interpretive information in structured conditions. Future directions should continue to invesgiate the utility of the Pictures Decision Task to investigate in adults and elderly adults, as well as clinical populations.

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# Capítulo 8: Gender Differences in Jumping to Conclusions bias and risk attitude: A men´s bias?

**Abstract**

Diverse studies especially about schizophrenia have shown a cognitive bias named "Jumping to conclusions" (JTC), defined as a decision made quickly on the basis of little evidence. The main objective of this study is to compare JTC in men versus women to understand why men show more overconfidence and take more risks than women that can lead to wrong decisions. Drawing to Decision task, a task with a probabilistic reasoning paradigm, was administrated in 30 men and 30 women. In addition to the traditional parameters of this task (Plausibility Rating and Draws to Decision), we also calculated the number a correct answers a stage 8 (accuracy). The results of the study suggest that men showed a higher tendency to jump to conclusions than women. Also it is demonstrated that men have overconfidence in their choices, using less information to take a final decision what produce more mistakes in difficult task-situations. The JTC bias is related to risk attitude in the financial domain.

Keywords: jumping to conclusions, pictures to decision task, women, men, risk

Abbreviations: JTC= Jumping to conclusions, DTD= drawing to decision, PR= Plausibility Rating. Acc= Number of correct answers at stage 8. Risk Attitude: RA.

## 1. Introduction

According to Furby and Beyth-Marom (1992), behaviors can be appropriately defined as risky even when the person performing these actions is unaware of possible negative consequences. Numerous studies have demonstrated that there are gender differences in the perception of risk; in particular, it was found that men are more likely to take risks (Byrnes et al., 1999). For example, Harris, Jenkins and Glaser (2006) conducted a study about risk activities related to the gambling, health, recreation and social domains, where participants should report their perceptions of the likelihood of negative consequences, the severity of these consequences and enjoyment expected. The results showed that women were less likely to choose riskier options in each domain least in the social, where there were not gender differences. According to the authors a partial explanation could be that women perceive a greater risk of negative consequences and a lower expectation of enjoyment. In another economic study by Mittal and Vyas (2011) was observed gender differences in attitudes and preferences of risk while investing. Men engaged in more risk taking and were more overconfident than women. Women tend to put in their funds in low risk – low return investments.

Following this line of research, the main goal of our study is to investigate the cognitive bias called jumping to conclusions and see if there are differences of gender. The "Jumping to Conclusions" cognitive bias occurs when there is a tendency to take decisions with a high level of haste, even taking into account, that there is little evidence for this. Although, the "Jump to Conclusions" bias has been studied classically in schizophrenic patients with delusions (Moritz et al, 2007; Speechley et al., 2010) it has been also studied in “normal” populations (Warman and Martín, 2006, Mckay et al.,2006, Lincoln et al., 2010, Lincoln et al., 2011, Lee et al., 2011). At the present time

there are two different hypotheses to explain this cognitive bias (Averbeck et al., 2011). The first hypothesis, proposed by Moritz and Woodward (2004), has been named "The hypothesis of Liberal Acceptation". The authors assume that the JTC bias is due to a low threshold for acceptance, that is, needless information to take a decision, (Moritz et al., 2009; Veckenstedt et al., 2011). The second hypothesis maintains that participants that JTC overestimate the conviction in their choices at the beginning of the decision process (Hulq et al., 1988, Lincoln et al., 2010; Speechley et al., 2010).

To get our goal, we used a new version of Drawing to Decision task, previously used in other studies (Moritz et al., 2006, Rubio et al., 2011). In this new version, we have introduced a new parameter: Number of correct answers at stage 8, in order to clarify why this cognitive bias happens. The analysis of accuracy lets us know whether JTC is related or not to efficiency. Like in the previous versions of the tasks, the principal dependent measures were the Plausibility Rating of each stimulus presented at all stages and the number of stimulus necessary to reach a final decision about their identity. These measures were analyzed in two kinds of trial ("cued" and "uncued"; that is, with and without interpretative cues or easy and difficult version of the task). This last characteristic allows us to analyze the effect of the context in which the decisions are taken.

Our hypothesis (JTC like a general bias against hypothesis contrast) is that men have overconfident in their choices, so a lower acceptance threshold, what will produce a Jumping to Conclusion bias. Following this line, JTC means taking more risks and commit more mistakes.

## 2. Method

### 2.1. Participants

A total of 60 people participated in this experiment. We used a group of 30 men, and another group of 30 women. The mean age of the men was 23.27 (SD= 3.619 range=18-33) and the mean age of the women was 22.73 (SD= 3.676 range= 18-36). Participants recruited via adverts, were students of faculty of psychology at the University of Granada.

### 2.2. Procedure

Participants were tested individually for an hour experimental session in distraction-free quiet room. The Drawing to Decision task was administrated. We also used the Domain-Specific Risk-Taking (DOSPERT) Scale developed by Weber, Blais, and Betz (2002) to assess self-report risk attitudes (defined as the reported level of risk taking, from 1-extremaly unlikely to 7-extremaly likely) and perceived-risk attitudes (defined as the willingness to engage in a risky activity as a function of its perceived riskiness, from 1-Not at all risky to 7-extremely risky) in five domains: ethical, financial health/safety, social and recreational decisions.

#### 2.2.1. The Pictures Decision Task

Our experimental procedure is a version of the picture task created by Moritz & Woodward (2007). Ten experimental trials, following two practice trials, were presented. Each trial consisted in a sequence of eight stages, each showing a common object that was increasingly disambiguated by decreasing degrees of visual fragmentation: New object features were added to each new picture until, eventually, the entire object was displayed in the final stage. The objects were depicted as post-edit simple black and white drawings. Instructions and trials were presented using a computer. There were two types of trials (cued and “uncued”). In the cued trials, the drawings were accompanied by a list of six possible interpretations (cues) and the

participants were asked to choose an answer and assess the plausibility of their choice on a 5-point Likert scale. In the uncued trials no interpretative cues were provided and the participants were instructed to derive their own interpretations. The practice trials are a guitar with cue and a raft without cue. The experimental trials were run in a fixed order and fully counterbalanced. In all these trials their plausibility was then rated using a five-point Likert scale (1= dismissed, 2= unlikely, 3= possible, 4= likely, 5= positive decision). Examples of the task can be seen in Appendices 2 (cued trial) and 3 (uncued trial). During this new version of this task the presentation of the stages was not interrupted until the participants finish up the drawing, even when the participants evaluated their decision with maximum security before the last stage. We also conceptually divided the task into two parts (the first part consisting of four stages and the last part consisting of four stages). In the first four stages, in the pictures formal elements of the drawing predominated (circles, lines, etc…) and so the subject could only develop interpretative hypothesis. Throughout the last four stages the pictures begin to be outlined, and the addition of new elements acted as a feedback on the previous response.

In this new version of the task, different new parameters can be calculated and then used to provide further insight into the underlying mechanisms of JTC bias. Specifically, three parameters were calculated (two old ones and a new one): Plausibility Rating (PR) and Draws To Decision (DTD) as the old ones, Number of correct answers (Acc) as the new one.

**The Plausibility Rating (PR)** was defined as the mean to plausibility rating at the eight stages for cued and uncued trials (range 1 to 5). This parameter is used to measure the level of conviction that the subject expresses for his interpretations of the drawing

**The Draws To Decision (DTD)** was defined as the mean to number of stages for cued and uncued trials necessary for the participant to reach a final decision about the identity of the objects with absolute certainty (range 1 to 8; the total number of stages per trial).

**The Number of correct responses (Acc)** at the last stage (max: 5 for cued and 5 for uncued trials).

## 3. Results

Statistical analyses were carried out with SPSS Version 17.0. On the Pictures Decision Task we conducted separate analysis of variance on the different dependent variables. For all analyses, the scores were compared among the two groups. On the Plausibility Rating an ANOVA was performed with a between factor (Group: men vs. women) and two within factors: condition (with cue vs. without cue), stage (1 to $8^{th}$ stage). For the other parameters (Draws to Decision and Number of correct answers at stage 8) separate ANOVAs were calculated with a between factor (Group: men vs. women) and a within factor (condition with cue vs. without cue). Finally, correlational analyses were conducted on the entire sample between the indices of the Pictures Decision Task.

### 3.1. Drawing to decision tasks

3.1.1 Plausibility rating

There was a significant main effect of cue [$F(1, 58) = 525.540$, $p<0.0001$]: the participants were more confident about their interpretations in the cued condition with respect to the uncued condition (3.49 vs. 2.54).

The stage effect was significant [$F(7, 406) = 607.19$, $p<0.0001$]: The certainty increased significantly at all stages (1.85, 2.06, 2.3, 2.57, 3, 3.49, 4.12 and 4.72). Also the cue x stage interaction was significant [$F(7, 406) = 34.76$, $p<0.0001$]: In the cued

condition the certainty is growing steadily and significantly at different stages. In the uncued condition there was a certainty pattern that may be described in two main phases. The first phase is represented by stages 1, 2 and 3: The certainty is consistently low and differs significantly from the certainty expressed in the stages 5, 6, 7 and 8. The second phase is represented by stages 4, 5, 6, 7 and 8 in which the certainty continues to significantly increase at each stage.

There was almost significant stage x group interaction [F (7, 406) = 2.304, p=0.06, see Figure 1]. There was a significant difference between groups at stage 2 (Mean=2.21 SD=0.525 Mean=1.92 SD=0.450 $p<0.05$); stage 3 (Mean=2.42 SD=0.509 Mean=2.17 SD= 0.424 $p<0.05$); stage 4 (Mean=2.73 SD=0.604 Mean=2.43 SD= 0.484 $p<0.05$); stage 5 (Mean=3.17 SD=0.611 Mean= 2.84 SD=0.491 $p<0.05$); stage 6 (Mean= 3.70 SD= 0.569 Mean= 3.28 SD= 0.532 $p<0.05$) and stage 7 (Mean=4.26 SD=0.416 Mean=3.98 SD=0.571 $p<0.05$). The men showed more conviction in their beliefs than women at all these stages. See Figure 1.

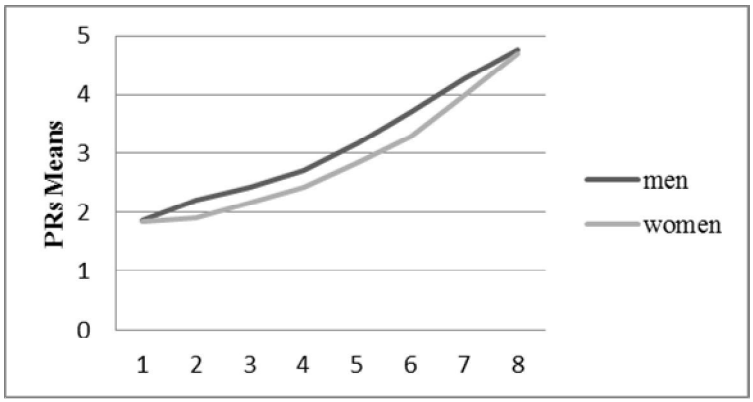


*Figure 1.* Plausibility Rating (PR): comparison between the means of the certainty of the two groups (men and women) for each stage (1-8).

3.3.2 Draws to Decisions

There was a significant main effect of cue [F (1, 58)=122.571 $p<0.0001$]: Participants

showed maximum security before in the cued condition (5.89 vs.7.11). There was a significant main effect of group [F (1, 58)=18.185 p<0.0001]: The men showed maximum security in their responses before than women (6.06 vs. 6.86). See Figure 2. There was not a significant cue x group interaction.

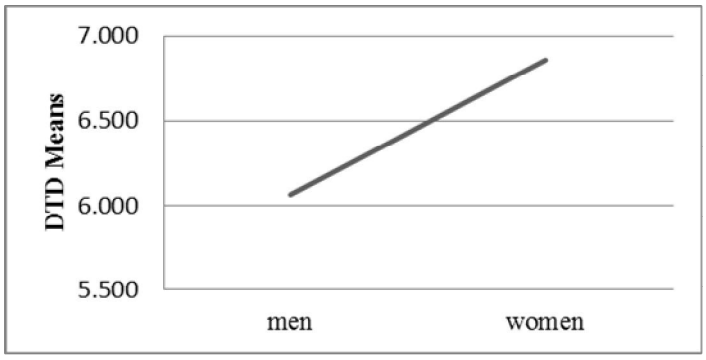


*Figure 2.* Drawing to Decision (DTD) means to the two groups (men and women): Number of stages necessary to take the final decision.

3.3.3 Number of correct answers at the stage 8

There was a significant main effect of cue [F (1, 58) = 28.563, p <0.001]. The participants had higher scores in the cued condition (4.85 vs. 4.38). Men showed differences between cued and uncued condition in accuracy (Mean=4,8 SD= 0,379 Mean=4,16 SD=0,791 p= 0.00) but women did not. There was not a difference significant between groups in accuracy in the cued condition. However, in the uncued condition, there was a significant difference in accuracy between groups (Mean=4,16 SD=0,791 Mean= 4,6 SD= 0,498 p<0.05). See Figure 3.

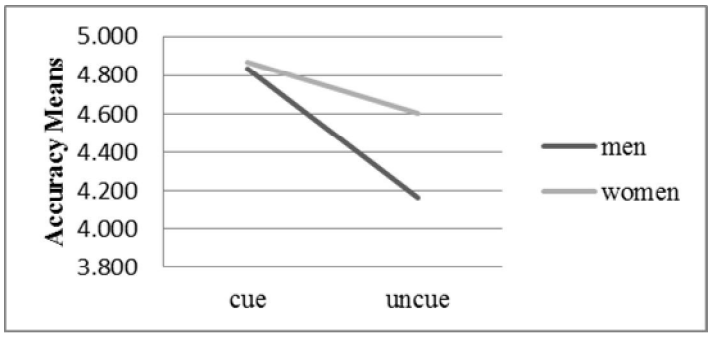


*Figure 3.* Number of correct answers at stage 8 index: Means of the two groups (men and women) in the two conditions (cued and uncued).

3.3.4. Correlational analyses.

The correlations show (see tables 1) that:

• In the cued condition, only men showed negative correlations between PR at the first two stages and DTD. In the second part of stages both groups showed negative correlations between PR and DTD.

• In addition, in the cued condition, only for the group of women, there are positive correlations between the number of correct answers and PR at the stages 5, 6, 7, 8 where use of feedback makes sense. And they also showed a negative correlation between accuracy and DTD index.

• In the uncued condition, for both groups we found a negative correlation between PR and DTD at the stage 1. There are also negative associations between PR at the stages 2, 3, 4 (first part of stages where the use of feedback makes no sense) and DTD parameters only in the group of men. In the second part of stages both groups showed negative correlations between PR and DTD.

• As in the other condition, in the uncued condition only women have negative associations between number of correct answers and DTD.

Table 1. Results of Pearson's correlation between the parameters of the Picture Decision Task in the two conditions conduct on men and women group.

| | **JTC (Cued Trial)** | | | | **JTC (Uncued Trial)** | | | |
|---|---|---|---|---|---|---|---|---|
| | **Men** | | **Women** | | **Men** | | **Women** | |
| | **DTD** | **Acc** | **DTD** | **Acc** | **DTD** | **Acc** | **DTD** | **Acc** |
| **PR1** | **-,551**** | 0,01 | -0,03 | 0,17 | **-,411*** | 0,15 | **-,374*** | 0,26 |
| **PR2** | **-,631**** | 0,08 | -0,27 | 0,15 | **-,436**** | 0,15 | -0,28 | 0,14 |
| **PR3** | **-,685**** | -0,04 | **-,566**** | 0,27 | **-,583**** | 0,15 | -0,26 | 0,08 |
| **PR4** | **-,558**** | 0,15 | **-,558**** | 0,09 | **-,564**** | 0,07 | -0,02 | -0,02 |
| **PR5** | **-,649**** | 0,21 | **-,605**** | ,307 | **-,537**** | 0,18 | -,355 | 0,11 |
| **PR6** | **-,724**** | 0,17 | **-,670**** | **,445*** | **-,544**** | 0,07 | **-,553**** | 0,3 |
| **PR7** | -0,11 | -0,02 | **-,440**** | **,387*** | **-,405*** | 0,29 | **-,799**** | **,624**** |
| **PR8** | -0,11 | 0,23 | -0,15 | ,353 | 0,05 | **,519**** | **-,552**** | **,570**** |
| **DTD** | 1 | -0,03 | 1 | **-,463*** | 1 | 0,03 | 1 | **-,730**** |
| **ACC** | -0,03 | 1 | **-,463*** | 1 | 0,03 | 1 | **-,730**** | 1 |

* $p < 0.05$; **$p < 0.001$

In general, in the uncued condition, both groups showed a negative correlation between PR at the first stage (and almost for all stages) and DTD and a positive correlation between PR and accuracy at last stage but only women showed a negative correlation between accuracy and DTD. In the uncued condition (or difficult version of the task), men showed more PR, less DTD and less accuracy than women. What means that men took more risks, they showed higher tendency to JTC related to mistakes in difficult tasks.

If the JTC bias is related to risk-taking in the DOSPERT scale we expect positive correlations between PR at first stages and risk attitude, negative correlations between

DTD and risk attitude and a negative correlation between accuracy in the picture decision task and risk attitude and/or exactly the opposite pattern for risk perception (negative correlations with PR and positive correlations with DTD and accuracy). Only for the financial domain we found this pattern of correlations. See Appendix 1: The participants showed very high positive correlations between investment risk attitude with PR at stages 3, 4 (0.96 and 0.94), a negative correlation with DTD (-0.72) and a positive correlation between investment risk perception and accuracy in the picture decision task (0.98).

Men have higher score in the five domains in the risk attitudes scale: Ethnical (Mean=2.76), healthy/safety (Mean=3.86), investing (Mean=2.13), recreational (Mean=5.09) and social (Mean=5.83) versus women: Ethnical (Mean=2.63), healthy/safety (Mean=2.90), investing (Mean=1.99), recreational (Mean=3.41) and social (Mean=5.30). In general: Risk attitude for men (Mean=3.93, SD=1.20) is higher than for women (Mean=3.24, SD=0.88): delta of Cohen (1988) =0.66 (A significant size effect).

With respect to the risk perception: Men have higher scores only in the ethnical domain (Mean=4.23) versus women ethnical (Mean=4.05). In the other domains men obtained lower scores: Healthy/safety (Mean=4.93 SD=1,10), investing (Mean=4.43 SD=0.81), recreational (Mean=3.22 SD=1,31) and social (Mean=2.16 SD=1.66) versus women healthy/safety (Mean=5 SD=1,58), investing (Mean=4.54 SD=1.71), recreational (Mean=3.89 SD=1,24) and social (Mean=3.26 SD=1.13). In general, men expressed less risk perception than women in almost all domains. In short, men had less risk perception that lead to show more risk attitudes than women.

## 4. Discussion

The most important result of this study indicates that, relative to women, men display a tendency to Jump to Conclusions, characterized by making decisions with a high level of confident when there is little evidence for this. This result confirms our first hypothesis. In concrete, we found in the cued/uncued condition, an inverse relationship between the Plausibility Rating at the first stages and Draws to Decision. The data evidence that a Jumping to Conclusions bias may be related to overestimate the conviction in their choices at the beginning of the decision process (high PR at first stages). Plausibility Rating and Draws to Decision results may be considered as evidence of a reasoning bias, involving a failure to integrate new evidence when strong initial beliefs exist. Also we have confirmed our second hypothesis: Men have more overconfidence than women at the first stages, tend to decide quickly when there is little information, and so they take more risks. Taking risks lead to make more mistakes. In the data was observed that men have higher number of wrong answers than women. Also there was a negative correlation between Draws to Decision and the number of correct answers at stage 8 only for women. This result confirms that women have less overconfidence at the first stages; they need more information to take a final decision, taking fewer risks, so they make fewer mistakes. Maybe men have a tendency to use simplifying heuristic devices to arrive at the decision quickly and women tend to be more detail-oriented, be more holistic (Meyers-Levy, 1989). In fact, both groups follow different strategies: for women a quick decision is related to mistakes and the use of feedback (or slow decisions) with accuracy. Men only take quick decisions with high confidence but lower accuracy. In general, men are more confident, quicker in taking decisions but they also make more mistakes in difficult situations. This strategy looks useful only for easy tasks. Women solve difficult and easy versions of the task in a

similar way: being less confident and with slower decisions. A strategy that looks useful only for difficult tasks. Women have less probability to make a mistake because they need more information to take a final decision. Men show a higher security at the beginning of the decision-making process than women, so they need fewer stages to arrive at a final decision: what means men prone to JTC. Also, the inverse correlation between PR and DTD, suggests that men overestimate their confident in their own choices at the beginning of the decision process, what produces a lowered threshold for making decisions so that men use less information to arrive at a decision, which leads to a higher probability to make a mistake.

To our knowledge, this study is the first one that obtains gender differences in the JTC bias. At the same time we showed that the main parameters in the picture decision task (high PR at first stages, low DTD and low accuracy) related with JTC bias are also related to a risky attitude overall in the financial domain (see again appendix 1). These results have many implications such as socioeconomic implications. For example, these results seem to support various economic studies about investment (Barber and Odean, 2001). These studies showed the need to adopt a cautious and conservative investment strategy. Overconfidence makes men comfortable with risk and drives them to take unnecessary and unjustifiable risk, resulting in wrong decisions. Women are more cautious about the risk and better calibrated long-term impacts, which leads us to ask ourselves a question: "Could women have avoided the crisis?".

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**Appendix 1.**

The Domain-Specific Risk-Taking (DOSPERT) Scale was developed by Weber, Blais, and Betz (2002) to assess self-report risk attitudes (defined as the reported level of risk taking, from 1-extremaly unlikely to 7-extremaly likely) and perceived-risk attitudes (defined as the willingness to engage in a risky activity as a function of its perceived riskiness, from 1-Not at all risky to 7-extremely risky) in five domains: ethical, financial health/safety, social, and recreational decisions.

Correlational analyses were conducted on the entire sample between the indices of the Pictures Decision Task and The Domain-Specific Risk-Taking (DOSPERT) Scale. See Table 2.

Table 2. Results of Pearson's correlation between the parameters of the Picture Decision Task in the uncued condition (difficult version of the task) and The Domain-Specific Risk-Taking Scale conduct.

| **Uncued Trials** | **PR-1 uncued** | **PR-2 uncued** | **PR-3 uncued** | **PR-4 uncued** | **PR-5 uncued** | **PR-6 uncued** | **PR-7 uncued** | **PR-8 uncued** | **DTD uncued** | **Acc uncued** |
|---|---|---|---|---|---|---|---|---|---|---|
| Ethnical_RA | -,399 | ,560 | -,458 | -,471 | -,501 | **-,764*** | -,334 | ,074 | ,532 | ,578 |
| Healthy/Safety_RA | **-,833**** | **-,803**** | -,517 | -,370 | -,599 | -,203 | -,543 | **-,794**** | -,043 | -,606 |
| Investing_RA | ,541 | ,351 | **,965**** | **,949**** | **,746*** | **,776**** | ,328 | ,076 | **-,729*** | ,137 |
| Recreational_RA | **,981**** | ,513 | **,669*** | ,530 | ,372 | ,511 | **,935**** | **,748*** | -,061 | ,538 |
| Social_RA | ,247 | ,418 | ,581 | ,626 | ,018 | **,773**** | ,485 | ,251 | ,572 | -,230 |
| Ethnical_RP | **,784**** | ,580 | **,879**** | **,795*** | **,763*** | ,628 | ,521 | ,449 | -,447 | ,367 |
| Healthy/Safety_RP | **,704*** | **,863**** | ,075 | -,100 | ,183 | -,243 | ,533 | **,953**** | ,527 | **,793**** |
| Investing_RP | ,568 | **,948**** | ,102 | -,051 | -,109 | -,288 | ,564 | **,831**** | ,526 | **,987**** |
| Recreational_RP | -,506 | -,185 | -,301 | -,229 | ,376 | -,265 | **-843*** | -,386 | -,126 | -,505 |
| Social_RP | **,662*** | ,542 | **,700*** | ,620 | **,896**** | ,465 | ,260 | ,423 | -,381 | -,215 |
| Ethnical_RA | -,399 | ,560 | -,458 | -,471 | -,501 | **-,764*** | -,334 | ,074 | ,532 | ,578 |

* $p < 0.05$; ** $p < 0.001$

In the uncued condition, there are positive correlations between PR at stages 3, 4, 5, 6 and investing dimension about risk attitudes and negative correlations between DTD and this dimension. Participants that took more investing risk were more confident in these stages and took a final decision earlier. Accuracy in the Picture decision task is positively related with investing risk perception (also with healthy/safety risk perception).

In addition, there are positive correlations between PR at stage 1,3,4,5 and etnical dimension about risk perception and negative correlations between PR-6 and etnical dimension about risk attitudes.

There are negative correlations between PR at stage 1, 2, 8 and healthy/safety dimension about risk attitudes and positive associations between these indexes about risk perception. People with high risk attitude in the healthy/safety domain are less confident at the beginning of the decision process.

Also, there are positive associations between recreational dimension about risk attitudes and PR at stage 1, 3, 7, 8. People with recreational risk attitudes were more confident in these stages. Finally, there are positive correlations between social risk perception and PR at stages 1, 3 and 5.

# Capítulo 9: The laughter of ticklishness is a Darwinian feature related to empathy in both genders: self-esteem in men and sexism in women.

**Abstract**

The theory of false alarm for laughter could explain the involuntary laugh when someone is tickled. To put this hypothesis to the test, we handed out a questionnaire (180 items) with two hundred university students. Our main results are: In women who like being tickled, we discover components related to pleasure, erotism, feeling of affection, arousal, uncontrollability, domination, sexism and Darwinian (golden ratio) and psychological traits (empathy, low schizotypy and external locus of control) that are not present in the laughter at a stumble. The relation of both types of laughter with sense of humor is also differential. In men who like being tickled, we discover components related to masturbation, sexual fantasies, erotism, arousal, domination, sexist humour and Darwinian (square chin, feeling of masculinity) and psychological traits (empathic stress, low schizotypy, external locus of control and overall self-esteem). The relationship between being tickled and self-esteem shows a double aspect in men: It is positive in men who like being tickled and negative in men who do not like being tickled. For women there is not a relationship between self-esteem and tickling. Our conclusion is that laughter of ticklishness is a Darwinian feature related to empathy.

## 1.Introduction

The theory of the false alarm of laughter maintains that an involuntary laugh implies the evaporation of a threat; that is, we laugh to release tension after its activation by a danger that turned out not to be one (Ramachandran & Blakeslee, 1998). Thus, we laugh when a clown falls over in the circus. In everyday life, we also laugh, in spite of ourselves, when someone trips up without major consequences. We are going to take the theory of false alarm and the involuntary laughter at a stumble as the reference in our investigation on the nature of ticklishness. In tickling there is also laughter, but the investigation is not clear on whether the laughter from tickling is similar to that of the stumble without consequences (Davila Ross, Owren, & Zimmermann, 2010). With imagination, the false alarm in being tickled should produce an involuntary laugh on realising that no real threat exists, that it is a simulated attack, a game or, in a speculative interpretation characteristic of evolutionary psychology: what could be a harmful insect turns out to be the fingertips of your partner. However, in tickling, other ingredients appear to play a part: it has been affirmed that it has erotic value (feet tickling), that it forms part of the play between partners and of emotional dominance (it is easier for a grandfather to tickle his grandchild than the reverse). For this reason perhaps, heterosexual men do not tickle each other too much. Whatever the case, it seems that in this simulated struggle there is a winner (the one who tickles) and a loser (the one who is dying of unavoidable laughter). That is to say, a priori, we can differentiate three potential components in tickling: the false alarm, the seduction or sexual-erotic component and the domination or power motive. In any event, the question is whether the laughter from tickling and the laughter at another person's stumble, both involuntary, have something in common and if this common factor is the

false alarm (a potential danger averted or that isn't one) and/or its hedonic value (does the false alarm produce physical or mental pleasure?).

Another of our aims in this study is to establish whether ticklishness is more a mental than a body trait, viceversa or both. For example, before we do mental arithmetic we count with fingers. But maybe physical flexibility doesn't correlate with cognitive flexibility: Does ticklishness belong to the world of laugh? Does it keep more relation to basic forms of laugh (as laughing for a stumble) or to more sophisticated ways (as irony)? If some of these hypotheses were true, the intensity of laughter from being tickled and the inability not to laugh when someone tripped would correlate. Does ticklishness depend on a person's physical or psychological traits? Is it more related to the Darwinian or the Popperian mind? (Dennett, 1987). Is it more related to biological traits, such as secondary sexual characteristics (as, for example, what happens with beauty-Platek and Singh, 2010; Feng, 2002; Tovee and Cornelissen, 1998-) or to empathy and the theory of mind (Singer, 2006) – for example, empathy develops much earlier than mentalizing abilities-?

## 2. Method

To put this hypothesis to the test, we handed out a questionnaire of 180 questions with two hundred university students aged between 18 and 45, of whom 110 were men and 90 women. The anonymity of the participants was preserved. The questions were combined randomly. All the questions had to be answered on a scale of 0 to 10 but without the option of responding with a 5. The key question was: 1) level of intensity of the laughter from being tickled.

The remaining questions make reference to:

A) The personality of the person who laughs when tickled. Also on Darwinian characteristics (secondary sexual characteristics).

B) The sense of humor.

C) Items related to the possible main components of ticklishness: sexuality, domination and false alarm mostly.

We explain each section of the questionnaire in detail:

**A-1) Personality traits** (you are envious, fearful, a cry-baby, perfectionist, egocentric, ambitious, naïve, irresponsible, distrustful, level of self-esteem, level of self-confidence, affectionate, nice, boring, level of energy, nostalgic, consistent, a procrastinator, intelligent, obsessive, shy, impulsive, happy, a liar, from 0 to 10 I'm the number…). Attempting to cover a large number of traits but focusing on those that have something to do with stimulation, fear and security, such as I'm fearful, I'm brave, I'm usually stimulated, security matters to me, I look for strong sensations, I like risk, danger attracts me… As we said each sentence was evaluated from zero to ten.

To complement this information, standardized questionnaires were run to our sample; questionnaires of empathy -the empathy scale TECA (López Pérez, Fernández Pinto, & Abad, 2008); Schizotypy -the CAPE scale (Stefanis, et al., 2002), locus of control-the locus of control questionnaire of Rotter (1966), Self-esteem (Rosenberg, 1989) and a questionnaire of sexism (Campbell, Schellenberg and Senn, 1997: Neosexism Scale). The aim is to determine whether ticklish people are more or less empathetic, schizotypal, with external locus of control, whether they are or not "macho" and their level of self-esteem compared to those who are not ticklish, complementing the rest of the information provided by the questionnaires.

**A-2) A questionnaire of masculinity for men and a questionnaire of femininity for women** based on the Darwinian characteristics. Asymmetry between the

index and ring fingers were measured in men (Bailey and Huud, 2005). Then their secondary sexual characteristics were recorded from zero to ten by four trained judge observers: level of facial hair, square jaw, and arm and leg length, level of baldness, deep voice and muscular development. The average of masculinity calculated, just as their subjective assessment (from zero to ten) of how masculine they consider themselves and if they consider themselves as an alpha male. Women run a questionnaire of femininity. Their golden ratio was measured in different forms: Waist to hip ratio (WHR=0.70) – Platek and Singh, 2010; facial divine ratio like height of face divided by distance from eyes to mouth (=36%); the canonical proportion (1:1.618) and breast, waist and hip direct measures (90:60:90 like reference) –we took these measures also for men. A visual analysis of their faces was also performed: full lips, small nose, big eyes, high cheekbones, facial symmetry. Each item is rated from zero to ten by four trained judge observers. The asymmetry between the index and ring fingers is also measured in women.

**B) Questionnaire on types of humor,** with explanation of the type of humor and examples: If I can't avoid laughing when someone stumbles (level of intensity of the laughter). Churches and priests jokes, sexist jokes (macho and feminist), black humor, white humor, sex jokes, political jokes and absurdities. Examples of irony and sarcasm. They value on a scale from zero to ten how much they like a type of humor or joke.

**C-1) Sex life** referred to different components of sexuality with the aim of determining if there is a sexual component in ticklishness, for example: ease of reaching orgasm, frequency of masturbation, level of sexual knowledge, frequency of daily thoughts about sex, frequency of sexual fantasies, frequency of intercourse, presence of

sexual problems, importance of pleasure, I miss an ex, my current relationship is satisfactory, I don't forgive physical infidelity, I don't forgive emotional infidelity...

The questionnaire also included questions about the meaning of ticklishness: being tickled is erotic. It arouses me. Ticklishness involves emotional relationship with the other person. It is pleasant. Each item is valued on a scale from zero to ten.

**C-2) Questions about domination and ticklishness**, for example**:** "I like people of the opposite sex to tickle me", "I think that tickling has an element of domination", "I'm a sexist", "I'm a xenophobic", "I'm a racist", "Tickling seems to me an act of violence", "I like people of the same sex to tickle me", "I like tickling people of the opposite sex", "I like tickling people of the same sex", "I don't like being tickled". "Being tickled bothers me", "Ticklishness is uncontrollable", "I use to tickle people who are smaller or less burly than me", "I use to tickle people burlier than me", "Ticklishness seems uncontrollable to me", "I feel superior when I tickle", "I feel inferior when I'm tickled"...

**C-3) Questions concerning the response of the false alarm,** such as: "I laugh when I get scared", "I laugh in uncomfortable situations", "I laugh when I make a mistake in front of other people", "I have hysterical laughter quite often", "I get scared easily", "I laugh when I'm criticized", "I laugh when I feel I dodged a hazard" (for example, "I almost stumble"), "I smile when someone is unfriendly with me", "I startle easily" ... Items are valued, as usual, on a scale from zero to ten.

## 3.Results

We analyzed every part of the questionnaire and the subtests contained therein. We did an analysis of correlations and declared significant all correlations with p value $<0.05$. In pilot studies, we found that to obtain these associations, the intensity of ticklishness

variable was more important than the body map of the ticklishness (where you are ticklish) and that there is an almost perfect correlation between the subjective intensity of ticklishness, the involuntary laugh at a stumble and the evaluation by judges of these two aspects. In order to prove it, we took ten people and tickled them with a feather and fingers, two independent judges evaluated the intensity of their laughter from the tickling (the correlation was $r$ = 0.82 and $r$ = 0.73, respectively). We did the same with another ten people and an independent judge evaluated the magnitude and duration of their laughter when watching videos showing people falling over (the correlation was $r$ = 0.78).

Subsequently we observed that the pattern of correlations was completely different according to gender. That is, women and men show different relationships between these phenomena. The mean and typical deviation for the key question (ticklishness (T)) were for women: for T, 6.77 (2.73). For men, the results were: for T, 4.09 (2.10). That is, there were significant gender differences in the intensity of the laughter from tickling, Cohen's (1988) delta being =1.1.

ANALYSIS FOR WOMEN

**Secondary sexual characteristics and personality traits**

The intensity of the ticklishness correlates with facial symmetry ($r$ = .45) and with the average score on the questionnaire of Darwinian femininity ($r$ = .56). As a curiosity, WHR correlates with the asymmetry index-ring fingers in women ($r$ = .39) and waist size correlates with empathy total score ($r$ = .49). Self-esteem correlated positively with breast size ($r$ = .44) and with WHR ($r$ = .42). For women, self-esteem correlated negatively with the depressive dimension of the CAPE ($r$ = -.44).

For women ticklishness intensity correlated with schizotypy ($r$ = -.41) in CAPE total. CAPE total score also correlated with the consideration that tickling is violence ($r$ = .68). Tickling people of the same sex correlated with empathy ($r$ = .73). Locus of control correlates with being good at tickling ($r$ = .55).

However, the majority of correlations with ticklishness occur when the woman has traits like the following: with I am obedient ($r$ = .40). Also when the subject has the traits: being responsible ($r$ = .42), being sensitive ($r$ = .45) and falling in love easily ($r$ = .44). Women also laugh when tickled when someone is nice to them ($r$ = .38), in uncomfortable situations ($r$ = .41) but not when they commit a fault ($r$ = -.37). The intensity of laughter when tickled correlates with its uncontrollability ($r$ = .70) and with being sexist ($r$ = .49). Sexism correlates with tickling often ($r$ = .88) and with being tickled often ($r$ = .50) and it correlates negatively with "I don't like being tickled" ($r$ = -.47).

**Sense of humor**

The correlation between ticklishness and laughter at a stumble was not significant ($r$ = .17). Moreover, the common cases, where both occur in conjunction, appear to be due to a mediating variable, which is the item 'I laugh easily at anything' that correlates with laughing at a stumble ($r$ = .48) and laughter from tickling ($r$ = .62). Other common factors are to laugh when scared ($r$ = .44 and $r$ = .53) for ticklishness and laughing at a stumble respectively. For women, no other common factor exists between ticklishness and laughter at a stumble. To laugh at a stumble correlates with black humor in women ($r$ = .36), with hysterical laughter ($r$ = .46) and with "I like cruel jokes" ($r$ = .44). Ticklish women are considered funny ($r$ = .38).

For women, self-esteem correlates negatively with laugh when frightened ($r$ = -.36), with laugh at a stumble ($r$ = -.38), with hysterical laughter ($r$ = -.46) and with laugh at others' defects ($r$ = -.44) and it correlates positively with being funny ($r$ = .52).

**Sexual component**

If we analyse the specific correlations with ticklishness in women, the results show there is no correlation with ease of reaching orgasm ($r$ = -.08) or other sexual variables but it exists a correlation with seeking pleasure ($r$ = .44). "I like the opposite sex to tickle me" correlates with "I think that tickling has an erotic component" ($r$ = .48). "Tickling is linked to feelings of affection" correlates with "Being tickled arouses me" ($r$ = .51). "Tickling is erotic" with "Being tickled arouses me" ($r$ = .64) and with "Tickling imply affection" ($r$ = .58). The total score on empathy correlates with "Being tickled arouses me" ($r$ = .59), especially with empathic understanding ($r$ = .59) and with empathic stress ($r$ = .64). "I like men to tickle me" with "Tickling is affective" ($r$ = .66). "I'm very ticklish" with "Tickling imply feelings" ($r$ = .67), "Being tickled arouses me" ($r$ = .55), "I would never let a stranger tickle me" ($r$ = .47), "I laugh a lot when tickled" ($r$ = .52) and "Ticklishness is uncontrollable" ($r$ = .59). "Tickling involves feelings" with "I laugh a lot when tickled" ($r$ = .74) and with "Ticklishness is uncontrollable" ($r$ = .72).

**Domination**

The correlations found are: "I don't like being tickled" with "I'm good tickling" ($r$ = -.46). "I'm very ticklish" with "Ticklishness is uncontrollable" ($r$ = .52). "Tickling seems to me an act of violence" with locus of control ($r$ = .51) and $r$ = .49 with the subscale A of the depressive component of CAPE. "I laugh out loud when I'm tickled" with "Ticklishness is uncontrollable to me" ($r$ = .65). "When I'm tickled I feel inferior" with the subscale A of the CAPE positive ($r$ = .58). "When I tickle I feel superior" with "I'm

very ticklish" ($r$ = .39). The total score on empathy correlate negatively with "I don't like being tickled" ($r$ = -.64) and "I feel inferior when tickled" ($r$ = -.57). "I'm more ticklish in my sole" with "I feel inferior when I'm tickled" ($r$ = .50). "I like being tickled by people of the same sex" with "I feel superior when I tickle" ($r$ = .50) and with "Tickling is violent" ($r$ = .51). "I feel superior when I tickle" with "Tickling is violent"( $r$ = .64) and "I'm good at tickling" with "I feel inferior when I'm tickled" ($r$ = .58).

**Discussion (on the role of the false alarm)**

To sum up, these two phenomena (ticklishness and laughter at a stumble) seem to be independent in women, except that they laugh at anything and that appears to be also a close relationship of both phenomenons with false alarm (laugh after being frightened).

With regard to ticklishness, pleasure and male domination are related in women who are responsible, sensitive, obedient, and who fall in love easily. Ticklishness correlate positively with the secondary sexual characteristics (breast size or WHR) and the secondary sexual characteristics correlate positively with self-esteem and empathy. Female ticklishness is above all related to sexism, high empathy, low schizotypy and external locus of control. Self-esteem doesn't seem to play a direct role in tickling.

With respect to involuntary laughter at a stumble, there does appear to be a clear relationship with false alarm: the taste for making cruel jokes, black humour and being strange... Highlight its negative correlations with self-esteem and empathy.

To summarise, in ticklishness (in women who like being tickled), we discover components related to pleasure, erotism, feeling of affection, arousal, uncontrollability, domination, sexism and Darwinian (golden ratio) and psychological traits (empathy) that are not present in the laughter at a stumble. The relation of both types of laughter with a sense of humor is also differential.

ANALYSIS FOR MEN

**Secondary sexual characteristics and personality traits**

Differentiating by gender, for men, Intensity of ticklishness correlates with total empathy ($r$ = .33) and with empathic stress ($r$ = .40). Locus of control correlates with being very ticklish ($r$ = .64). "I'm tickled often" correlates with total CAPE ($r$ = -.75). The correlation of the intensity of tickling with self-esteem ($r$ = .35) was significant, as well as between ticklishness and feeling masculine (0.50) or feeling like an alpha male ($r$ = .48) and with square chin ($r$ = .41). Feeling masculine correlates with facial hair ($r$ = .36), with muscular development ($r$ = .56) with square chin ($r$ = .44) and with average of male secondary sexual characteristics ($r$ = .41).

Tickling someone burlier correlates with empathy ($r$ = .67) and self-esteem ($r$ = .62). We also find correlation between self-esteem and masculinity ($r$ = .49) and feeling like an alpha male ($r$ = .60). Self-esteem correlates with negative ($r$ = -.63) and depressive dimension ($r$ = -.69) of CAPE and with total score on empathy ($r$ = .77). The score in sexism correlates negatively with total empathy ($r$ = -.68).

**Sense of humor**

Ticklishness and involuntary laughter at a stumble don't correlate in men ($r$ = .32).

Specific correlations for ticklishness and sense of humor are: with sexist humor ($r$ = .53), laugh at others' defects ($r$ = .56), laugh to hurt ($r$ = .76) and being happy ($r$ = .52).

Regarding involuntary laughter at a stumble and sense of humor: Positive correlations specific to this involuntary laughter occur with hysterical laughter ($r$ = .47).

For men, self-esteem correlates as well with laughing out loud ($r$ = .62), laughing or saying something funny in uncomfortable or tense situations ($r$ = .57), smiling if someone is unfriendly with you ($r$ = .57) and with being funny ($r$ = .54) .

**Sexuality**

Positive correlations specific to ticklishness are: masturbating a lot ($r$ = .71) and having sexual fantasies ($r$ = .37). "I like to tickling the opposite sex" with "Being tickled arouses me" ($r$ = .69), "Tickling is erotic" ($r$ = .78), "I'm good at tickling" ($r$ = .65), "I'm tickled often" ($r$ = .61) and "Being tickled bothers me" ($r$ = -.71).

The negative correlations specific to involuntary laughter at a stumble occur with: level of energy ($r$ = -.74) and thinking about sex ($r$ = -.90).

**Domination**

For this variable, the main correlations found are: "I like to tickle the opposite sex" with "Tickling is violent" ($r$ = -.66) and "I feel inferior when I'm tickled" ($r$ = -.67). "I tickle burlier people" with "I feel inferior when I'm tickled" ($r$ = .68) and "I do not like Being tickled " with "I feel inferior" ($r$ = .64). "I feel inferior when I'm tickled" with self-esteem ($r$ = -.58). "Tickling is violent" with locus of control ($r$ = .49).

**Discussion for men**

To summarise, in ticklishness (in men who like being tickled), we discover components related to masturbation, sexual fantasies, erotism, arousal, domination, sexism humour and Darwinian (square chin, feeling of masculinity) and psychological traits (high empathy, low schizotypy, external locus of control and self-esteem). The relationship with self-esteem is double: positive with men who like being tickled and negative with men who do not like being tickled.

## 4.GENERAL DISCUSSION

With regard to the associations between involuntary laughter at a stumble and the laughter from tickling, in women they only occur in conjunction in those women who laugh at anything or laugh more after being frightened. The conclusion is that the

laughter from tickling and the laughter at a stumble are not directly related. There could be women who laugh when tickled and do not laugh at a stumble and viceversa. In ticklishness we did find factors associated sense of humour, with hedonism and sexuality that are not present in the laughter at a stumble. To summarise, false alarm does not appear to provide a full explanation for these phenomena.

The specific traits of ticklishness in women are its relationship with pleasure and obedience. Ticklishness in men has a strong, specifically sexual (masturbation and fantasy) and hedonic (relationship with being happy) component and is associated with being masculine, with self-esteem. Ticklish men, it seems, are the men by whom women like to be tickled. Ticklish women are sensitive and fall in love easily; ticklish men not. The sexual component is in male ticklishness; female ticklishness is linked with love, arousal, affection and pleasure but not explicitly with sex. In ticklishness, men are not concerned about security and do not consider themselves boring. Ticklish women are fearful but they like risk, security and men who are sure of themselves, that is, they seek the pleasure of domination. Nevertheless, we must consider the differences between them according to personality traits and gender. Ticklishness appears to primarily reflect empathy and Darwinian femininity overall, as well as sexism in women and self-esteem in men (high if being tickled is pleasant and low if being tickled is unpleasant), sexual fantasies and subjective masculinity. In both genders, tickling is associated to empathy or ability to share emotions and sensations that develops much earlier than mentalizing abilities.

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# Capítulo 10: Jumping to Conclusions bias, BADE and Feedback Sensitivity in Schizophrenia and Schizotypy


## Abstract

Several studies about schizophrenia have shown a cognitive bias named "Jumping to conclusions" (JTC), defined as a decision made quickly on the basis of little evidence that occurs in these patients when performing probabilistic reasoning paradigms. The main objective of this study is to compare JTC bias and BADE (Bias Against Disconfirmatory Evidence) in patients with schizophrenia versus participants with high/low schizotypy to understand the underlying mechanism of these cognitive biases. Probabilistic reasoning was assessed using a modified version of Drawing to Decision task. In addition to the traditional parameters of this task (Plausibility Rating (PR), Draws to Decision (DTD), BADE) we also calculated new parameters, overall accuracy and one named Feedback Sensitivity (FS) which lower scores shows greater use of feedback. The results of the study suggest that patients with schizophrenia were less sensitive to feedback than the two groups of high/low schizotypy participants. In the cued condition, the control groups made better use of feedback and showed more plausibility and accuracy in the last stages. In the uncued condition, we found JTC bias at stage 1 only for patients and high schizotypy participants. At the same time, PR at first stages (1 to 4) related positively with Feedback Sensitivity and negatively with accuracy for patients and high schizotypy participants (high confidence is associated with worse performance and lower feedback use). BADE seems unrelated to JTC bias and FS. The results are discussed in terms of JTC like as a clinical bias and whether patients with schizophrenia are less able to use feedback.

## 1. Introduction

Schizophrenia onset is associated with gene–environment interplay (Van Os, Kenis & Rutten, 2010). Heritability, as an index of genetic influence, must be viewed in the context of interaction with environmental, social and cognitive effects. Schizophrenia research has demonstrated a cognitive bias that occurs when using probabilistic reasoning paradigms like the task of beads (Huq et al., 1988). This cognitive bias has been called "Jumping to Conclusions". In particular, the "Jumping to Conclusions" bias has been observed to be accentuated in patients with delusions (Huq et al. 1988; Moritz and Woodward, 2005; Moritz et al, 2007; Speechley et al., 2010). However, the JTC bias has been also studied in different populations (Broome et al., 2007, van Dael et al., 2006, Lincoln et al., 2011), especially in non-clinical samples scoring high on a schizotypy scale (Rodier et al., 2011; Freeman, 2008; Warman, 2007; Van Dael, 2006; Balzan et al., 2012).Unlike schizophrenia, schizotypy is an aspect of normal individual variation (Johns and van Os, 2001) but characterized by similar psychopathology and cognitive disorganization (Stefanis et al., 2002). This continuity forms the basis of the dimensional view of schizophrenia (Claridge and Beech, 1995; Buchy, Woodward and Liotti, 2007). In other words, schizotypy can be considered qualitatively similar but quantitatively less severe than schizophrenia (van Os et al., 2000; Verdoux and van Os, 2002). The study of schizotypy in the general population is a relevant point in schizophrenia research that can provide us with clues to the possible etiological mechanisms underlying schizophrenia spectrum disorders, and may allow us to improve the strategies for prevention and early detection of this clinical disorder (Kwapil, Barrantes Vidal, & Silvia, 2008; Lenzenweger, 2010; Raine, 2006).

The "Jumping to Conclusions" cognitive bias occurs when there is a tendency to take decisions with a high level of haste, even taking into account, that there is little evidence for this. Here, we study the JTC bias with a modified version of the Drawing to Decision Task (DDT: Moritz et al., 2006, Rubio et al., 2011) explained below, to distinguish its interpretative framework. We assume that our task (DDT) consists in an interplay between hypothesis and data (feedback) that marks the drawing interpretation (Levitan & LaBerge, 1991). In this context (the study of JTC bias with DDT in schizophrenia and schizotypy), two main specific questions for us are: 1. Does JTC bias affect task performance (accuracy)? Up until now accuracy was not computed in DDT. Probably this cognitive bias can help to solve easy questions sooner but what would happen in a more difficult version of the task? 2. Is JTC bias related with evidence (or feedback)? It may be that the cognitive bias only happens if there is little (low or null) evidence but could it happen also with a clear feedback, confirmatory or disconfirmatory, in relation to the hypothesis? These two questions are interrelated: normally higher accuracy and feedback use correlate. At the same time, these questions drove us to explore the relationship between JTC bias and the Bias Against Disconfirmatory Evidence (BADE) (Buchy, Woodward and Liotti, 2007; Moritz and Woodward, 2006). Are both cognitive biases different expressions of an underpinning factor (for example: low feedback sensitivity)? BADE has also been observed in patients with schizophrenia and in people with high schizotypy. The dimensional model of schizophrenia predicts unifying cognitive biases or that these cognitive biases may combine to contribute to the formation of the delusional aspects of psychosis (Buchy, Woodward and Liotti, 2007). New studies are necessary to investigate which combinations of such cognitive biases may be used to predict first episodes of psychosis. But until now the relationship between these two cognitive biases is still an

open and complex question: it remains unclear whether these reasoning biases are independent or share common underpinnings (Munz, 2011). Then, another goal of our study is to reproduce the JTC and BADE biases in patients with schizophrenia and in a non-clinical sample of participants with high (versus low) schizotypy trait, measured using the CAPE questionnaire (Stefanis et al., 2002). We use this questionnaire regularly (along with others) with our students of Psychology, in trials and for research, and obtain participants with high scores, whose mental health we do not doubt. Healthy people often show poorly-defined boundaries between imagination and reality without this dragging a diagnosis of schizophrenia or mental illness, in the same way that major and sub-clinical depression exists (Fonseca-Pedrero, et al., 2011). In this sense, perhaps we can find a continuum or a mental line between schizotypy and schizophrenia in relation to these cognitive biases: lower biases magnitude in low schizotypy versus high schizotypy healthy participants and higher biases magnitude in people with schizophrenia versus people scoring high on a schizotypy scale.

As we claimed, to achieve our goals, we used a new version of Drawing to Decision Task (DDT). In this new version, we have introduced new parameters as the Feedback Sensitivity and a number of correct answers, in order to clarify why JTC bias happens. The analysis of the Feedback Sensitivity will allow us to find out if this cognitive bias is only present when subjects have been instructed to derive their own interpretations (uncued trials) or when more sources of information are available and the decision-making context has been previously defined (cued trials). This last characteristic allows us to analyse the effect of the context in which the decisions are taken. The analysis of accuracy let us know whether JTC is related or not to efficacy.

In short, we have chained the following hypotheses: 1. JTC is a clinical judgment that could be useful to predict first episodes of psychosis: We expect higher

JTC bias in patients with schizophrenia followed by persons with high schizotypy and the lowest (or null) JTC bias in participants with low schizotypy 2. JTC is related negatively with accuracy but only in the difficult version of the task (uncued trials). 3. JTC is related to Feedback Sensitivity (FS) but only in the difficult version of the task (uncued trials). 4. JTC is related to BADE (we expect a high correlation between BADE and FS specially). 5. Our previous hypotheses maintain that the more JTC the less Feedback Sensitivity and accuracy. Following this line of thinking, patients with schizophrenia show higher JTC (and BADE) and are less sensitive to feedback and therefore have more difficulty changing their misinterpretation than high schizotypy subjects (lower accuracy). A similar pattern would happen for high schizotypy participants with respect to low schizotypy ones.

## 2. Method

### 2.1. Participants

A total of 45 people participated in this experiment. We used a group of 15 patients with schizophrenia, and two control groups with high (n=15) and low schizotypy (n=15). The inclusion criteria for the patients with schizophrenia were: having a diagnosis of functional psychosis according to the DSM-IV-TR (295-297-298, and 296 with psychotic codes) (APA, 1994).The presence and intensity of psychotic symptoms was assessed by means of the PANSS scale (Kay et al., 1987). The PANSS has been validated on a Spanish population of patients with schizophrenia (Peralta & Cuesta, 1994). With respect to healthy participants, 169 undergraduate students were assessed to baseline vulnerability to psychosis with the Community Assessment of Psychic Experience, CAPE (Konings et al., 2006). The inclusion criteria for the control subjects with high schizotypy got a total score higher than 1.6 but inside the range for

normal population (because the score for non-clinical populations were found to range from 1.4 to 1.8). The inclusion criteria for the control subjects with low schizotypy got a total score lower than 1.5 but inside the range for normal population. Out of the 88 subjects contacted, 42 agreed to participate. The final sample consisted in 15 high schizotypy and 15 low schizotypy individuals, as data were lost for several participants due to technical difficulties or missing values. BADE task data from five schizotypal subjects were lost because of computer crashes. Seven participants were excluded due to incomplete questionnaires. Premorbid intelligence was determined by Test de acentuación de palabras TAP-30 (González Montalvo, 1991). All participants reported an absence of cerebral damage and no clinical evidence of drug abuse during the course of the study. Also, healthy participants reported an absence of mental disorder. See Table 1.

**Table 1.** Sociodemographic and psychopathological variables

| **Variable** | **Schizophrenia(n=15)** | **High schizotypy (n=15)** | **Low schizotypy (n=15)** | **Statistics; LSD post-hoc** |
|---|---|---|---|---|
| *Sociodemographic variables* | | | | |
| Age | 39.20 (6.179) | 31.53 (2.356) | 32.27 (5.311) | $F(2,37)=4.246$ p=.022 NS |
| Gender | 7M, 8F | 6 M, 9 F | 5 M, 10 F | $\chi^2$ (2)=0.556 p=.757 NS |
| Years of formal education | 13.60(1.765) | 13.40(1.454) | 13.67(1.234) | $F(2,42)=0.128$ p=.088 NS |
| Premorbid intelligence (IQ) | 15.80 (2.512) | 16.33 (2.257) | 16.20 (2.980) | $F(2,42)=0.717$ p=.844 NS |
| *Psychopathological variables* | | | | |
| PANSS total score | 66.80 (8.402) | – | – | |

## 2.2. Procedure

Participants were tested individually in two experimental sessions; each one lasted approximately 60 minutes. Testing was conducted in a distraction-free quiet room. In the first sessions all participants were conducted with questionnaires. In the second sessions everything was screened with the Pictures Decision Task.

**Community Assessment of Psychic Experience, CAPE**

For two control groups, baseline vulnerability to psychosis was assessed with the Community Assessment of Psychic Experience, CAPE (Konings et al., 2006). This scale evaluates three basic dimensions (negative, positive and the depressive symptoms) of psychotic spectrum to assess order psychotic experiences and psychotic symptoms in the general population. The positive scale, of 18 items, comprises delusions, hallucinations, suspiciousness/ideas of persecution, unusual thought content. The 14 items of the negative scale cover flat affect, emotional withdrawal, lack of relationship, passive social withdrawal, and lack of spontaneity. The 8 items of the depressive scale included cognitive symptoms of the depression such as sadness, pessimism, hopelessness, feeling a failure or feeling guilty. The CAPE has correct psychometric behavior regarding internal consistency, temporal stability and different evidences of validity (Stefanis et al., 2002; Hanssen et al., 2003), so it would be used as a screening instrument in the general population. The CAPE has been adapted and validated on Spanish healthy population (Fonseca-Pedrero, Paino, Lemos-Giráldez, & Muñiz, 2012; Ros-Morente, Vilagra-Ruiz, Rodriguez-Hansen, Wigman, & Barrantes-Vidal, 2011).

The TAP-30 is a measure of intelligence in which the participant is instructed to read 30 words of irregular pronunciation. It is a Spanish adaptation validated through the North American Adult Reading Test (NART; Nelson, 1982).The NART was developed as a measure for estimating premorbid intelligence in patients with schizophrenia (for a review, see O'Carroll, 1995; Russell et al., 2000) and is viewed as

providing a good estimate of premorbid IQ because it: (a) predicts much of the variance in current WAIS IQ; (b) has high reliability in normal subjects (Kondel et al., 2003).

**The Pictures Decision Task**

Our experimental procedure is a version of the picture task created by Moritz & Woodward (2007). Ten experimental trials, following two practice trials, were presented. Each trial consisted in a sequence of eight stages, each showing a common object that was increasingly disambiguated by decreasing degrees of visual fragmentation: new object features were added to each new picture until, eventually, the entire object was displayed in the final stage. The objects were depicted as post-edit simple black and white drawings. Instructions and trials were presented using a computer. There are two types of trials (cued and "uncued"). In the cued trials, the drawings were accompanied by a list of six possible interpretations (cues) and the participants were asked to choose an answer and assess the plausibility of their choice on a 5-point Likert scale. In the uncued trials no interpretative cues were provided and the participants were instructed to derive their own interpretations. The practice trials are a guitar with cue and a raft without cue. The experimental trials were run in a fixed order and fully counterbalanced. In all these trials their plausibility was then rated using a five-point Likert scale (1= dismissed, 2= unlikely, 3= possible, 4= likely, 5= positive decision). Examples of the task can be seen in Appendices 4 (cued trial) and 5 (uncued trial). During this new version of this task the presentation of the stages was not interrupted until the participants finish up the drawing, even when the participants evaluated their decision with maximum security before the last stage. We also conceptually divided the task into two parts (the first part consisting of four stages and

the last consisting of four stages). In the first four stages, in the pictures formal elements of the drawing predominated (circles, lines, etc…) and so the subject could only develop interpretative hypothesis. Throughout the last four stages the pictures started to be outlined, and the addition of new elements acted as a feedback on the previous response.

In this new version of the task, different new parameters can be calculated and then used to provide further insight into the underlying mechanisms of JTC bias. Specifically, five parameters were calculated (three old ones and two new ones): Plausibility Rating (PR), BADE and Draws To Decision (DTD) as the old ones, Number of correct answers (Ac) and Feedback Sensitivity (FS) as the new ones.

**The Plausibility Rating (PR)** was defined as the means to plausibility rating at the eight stages for cued and uncued trials (range 1 to 5). This parameters is used to measure the level of conviction that the subject expresses for his interpretations of the drawing

**The Draws To Decision (DTD)** was defined as the means to number of stages for cued and uncued trials necessary for the participant to reach a final decision about the identity of the objects with absolute certainty (range 1 to 8; the total number of stages per trial).

**The Number of correct responses or accuracy (Acc)** at the last stage (stage 8) (max: 5 for cued and 5 for uncued trials).

**The Feedback Sensitivity** (**FS**) relates the number of error vs. the number of wrong guesses accomplished in the last four stages. This index checks whether the person realises if he was wrong and tries to change the interpretation of the drawing using the new information received (at each stage) or if he is anchored to the previous wrong answer. To calculate this index we add to the number of errors (E, taking into account

the repetitions) the inverse of the number of wrong guesses (C=number of different wrong conjectures). FS= ($\sum$E + 1/$\sum$C). In this index, a low score means that the feedback is more used.

**Bias Against Disconfirmatory Evidence (BADE)** is the difference score between mean plausibility ratings for incorrect interpretations at the first stage relative to the mean plausibility ratings for incorrect interpretations at later stages. The signature of a BADE effect would be a lower reduction of plausibility ratings for incorrect interpretations across stages (Moritz and Woodward, 2006).

## 3.Results

### 3.1. Sociodemographic variables

The samples did not differ on any major sociodemographic background variables (age, gender, formal school education, intelligence). Post-hoc group comparisons were more significant than P=0.1 for all parameters, even before correction for multiple comparisons (See Table 1).

### 3.2. Drawing to Decision Task

Statistical analyses were carried out with SPSS Version 17.0. On the Pictures Decision Task we conducted separate analysis of variance on the different dependent variables. For all analyses, the scores were compared among the three groups (patients with schizophrenia and two control groups-high and low schizotypy). On the Plausibility Rating an ANOVA was performed with a between factor (Group: patients with schizophrenia vs. control groups) and two within factors: condition (with cue vs. without cue), stage (1 to 8$^{th}$ stage). For the other parameters (Draws to Decision,

Accuracy, Feedback Sensitivity) separate ANOVAs were calculated with a between factor (patients with schizophrenia vs. control groups) and a within factor (condition with cue vs. without cue). The analyses about BADE were performed as ratings from cued and uncued trials collapsed. Simple mean comparisons were used to determine group differences for the BADE parameter at the different stages. Apart from this main parameter (difference score initial vs. later rating for incorrect responses), we also assessed the horizontal stability of our results to detect if they showed any evident trend, with the C statistic (Young, 1941, Suen and Ary, 1989).

Finally, correlational analyses were conducted on the entire sample between the indices of the Pictures Decision Task.

### 3.2.1 Plausibility rating

There was a significant main effect of cue, [$F(1, 42) = 121.751$, $p<0.001$]: the participants were more confident about their interpretations in the cued condition with respect to the uncued condition (3.34 vs. 2.55). There was also a significant cue x group interaction, [$F(2, 42) = 7.164$, $p<0.05$]. All groups expressed greater certainty of judgment in the cued condition. See Figure 1. The difference in PR between cued and uncued conditions was significant for all groups. For patients, (Mean=2.662 SD= 0.137, Mean=3.094 SD=0.131, p=.001). For the control groups, (Mean=2.636 SD= 0.137, Mean=3.725 SD=0.131, p=.001) and (Mean=2.351 SD= 0.137, Mean=3.205 SD=0.131, p=.001), respectively for high and low schizotypy participants. The only significant difference between patients with schizophrenia and control groups (high schizotypy and low schizotypy) in PR occurred in the cued condition, [$F(2, 42) = 6.594$, $p<0.05$] and [$F(2, 42) = 4.022$, $p<0.06$] respectively, being controls participants more confident than patients with schizophrenia.

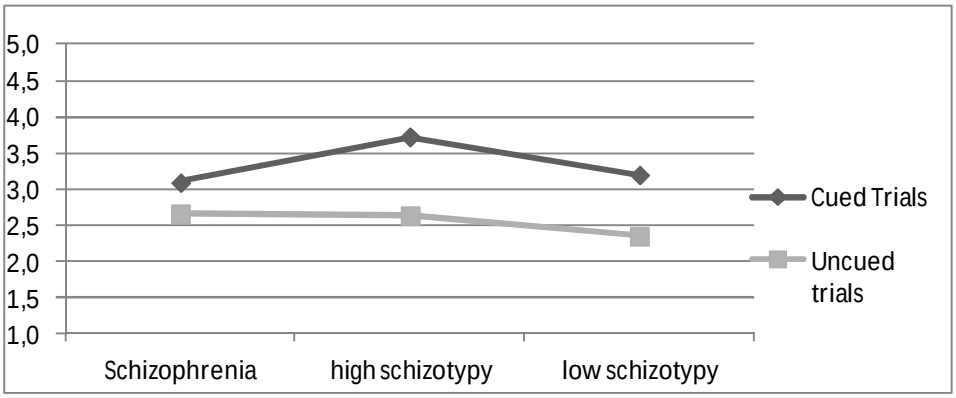


*Figure 1.* Cue x Group interaction between patients with schizophrenia, and the other two healthy groups (high and low schizotypy) in the cued and uncued condition.

The stage effect was significant [F (7, 294) = 174.138, p<0.001]: the certainty increased significantly at all stages (1.98, 2.18, 2.36, 2.59, 2.90, 3.21, 3.81, 4.50). Also the cue x stage interaction was significant [F (7, 294) = 11.901, p<0.001]. Participants expressed greater confidence in the cued condition with respect to the condition without cue at all stages. In the cued condition at stages 1, 2, the certainty differed significantly from PR in the stage 3. From the stages 3 to 8, the certainty increased significantly at each stage. But in the uncued condition, at stages 1 to 4 we found a similar PR. The certainty grows slightly but significantly from the stages 4 to 6. By stages 6 to 8 the certainty continued growing significantly again but with higher slope. See Figure 2.

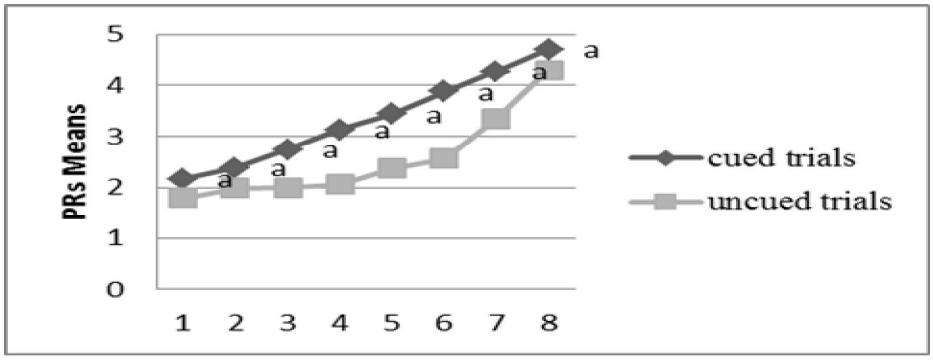


*Figure 2*. Plausibility Rating in the two conditions (cued trials and uncued trials). Vertical axis reflects the range of this parameter (1-5, the five points of plausibility rating). Horizontal axis reflects the number of stages. "a" significant difference between cued and uncued trials for each stage (from stage 1 to 8), p=.0001.

There was also a significant stage x group interaction [F (14, 294) = 4.657, p< 0.001]. There were significant differences between patients with schizophrenia vs. low schizotypy participants at stages 1 [F (2, 42) = 7.579, p<0.05], 2 [F (2, 42) = 6.722, p<0.05] and stage 8, [F (2, 42) = 5.955, p<0.05], where patients with schizophrenia showed more security. We also obtained significant differences between high schizotypy participants and patients at stages 1 [F (2, 42) = 4.855, p<0.05], 6 [F (2, 42) = 6.722, p<0.05], 7 [F (2, 42) = 7.936, p<0.05] and stage 8 [F (2, 42) = 9.637, p<0.05]. Patients with schizophrenia showed more certainty in their hypothesis at the first stage when there is less information but they showed less confidence at the last stages when there is more information. The controls participants showed more security in their hypothesis at the last stages when there is more information on disposal and less certainty at the first stages when there is less information available. No other group differences were significant, F<1. See Figure 3.

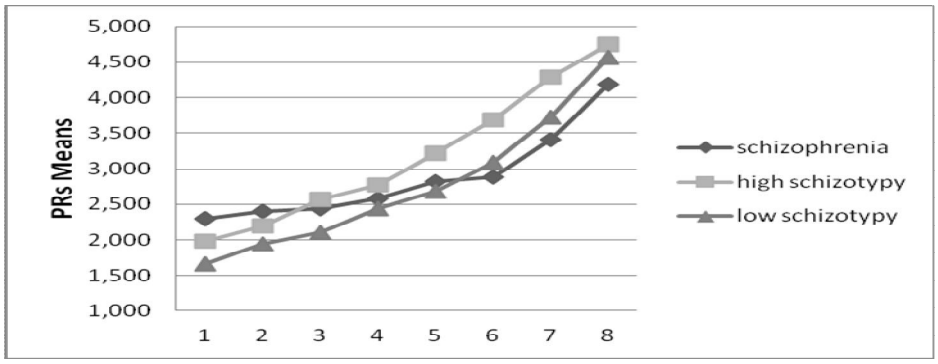


*Figure 3.* Plausibility Rating for the three groups (stage x group interaction). Vertical axis reflects the range of this parameter (1-5, the five points of plausibility rating). Horizontal axis reflects the number of stages.

3.2.2 Draws to Decisions (DTD)

There was a significant main effect of cue [F (1, 42) = 11.557, p <0.05], (5.93 vs. 6.66) with quicker responses in the cued condition. There was also a significant cue x group interaction [F (2, 42) = 7.65 p<0.05]. In fact, high and low schizotypy groups (6.74 and 7.37) showed higher DTD scores in the uncued trials than patients with schizophrenia (5.89). Only high schizotypy participants showed significant differences between cued and uncued conditions (Mean=5.800, SD=0.361; Mean= 6.743, SD= 0.334; p=.001). Two independent t-test samples were run to compare means between groups. The patients with schizophrenia showed more absolute security before than low schizotypy participants (Mean=5.891, SD=1.984; Mean= 7.373, SD= 0.736; p=.003). The patients with schizophrenia also showed more absolute security before than high schizotypy individuals (Mean=5.891, SD=1.984; Mean= 6.742, SD= 0.807; p=.006). The DTD differences between groups for the cued trials were non-significant (6.1, 5.8 and 6.3 respectively for patients and high and low schizotypy participants).

3.2.3 Number of correct answers at Stage 8.

There was a significant main effect of cue [F (1, 42) = 27.421, p <0.001]. The participants showed higher scores in the cued condition (4.55 vs. 3.82). That means that the uncued condition is a more difficult version of the task. There were no other significant effects of group or significant interactions.

3.2.4 Feedback sensitivity

There was a significant main effect of cue [F (1, 42) = 200.39, p <0.001]: In the cued condition feedback was more used than in the uncued condition (5.82 vs. 11.60). There was a significant main effect of group [F (2, 42) = 6.459, p <0.05]: the controls were more sensitive to the feedback than the patients with schizophrenia (8.12, 8.32 and 9.69 for high schizotypy participants, low schizotypy participants and patients with schizophrenia respectively).There was not a significant group x cue interaction.

3.2.5. Bias Against Disconfirmatory Evidence (BADE)

The analyses about BADE was made with collapsed ratings from cued and uncued trials, as Trial Type (cued, uncued) did not yield any significant interaction with Group (patients with schizophrenia, high schizotypy, low schizotypy) when entered as an additional within-subject factor. See Figure 4 with Bias Against Disconfirmatory Evidence (BADE): change scores (initial stage to subsequent stages) averaged over uncued and cued trials. Patients with schizophrenia decreased their plausibility scores significantly less than controls across time, being the decrement significant only for controls but not for patients (C=0.57, p=0.03; C=0.46, P=0.04 and C=0.22, p=0.20, respectively for high, low schizotypy and patients). For absolute plausibility scores, group differences no yielded significance.

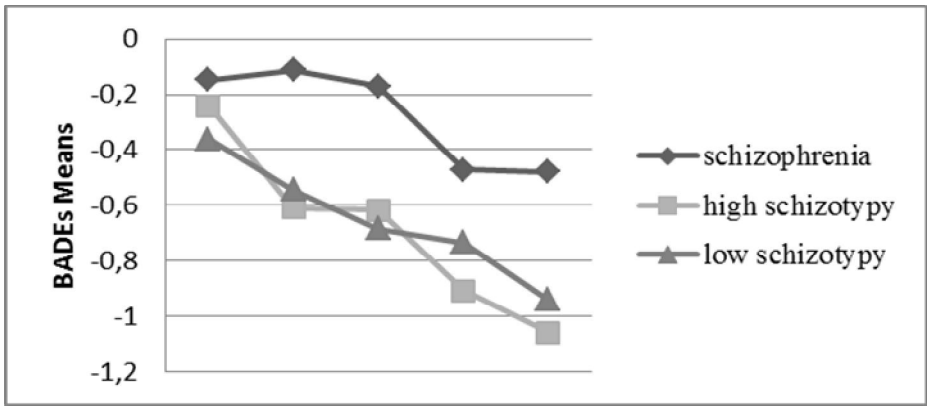


*Figure 4*. Bias Against Disconfirmatory Evidence (BADE) — change Scores in stages 2 to 6, following Moritz and Woodward (2006), figure 1.

3.2.6. Correlational analyses.

Analyses made for cued and uncued trials. The cue variable has been significant for most measures (PR, DTD, FS and Ac) what means a relevant context effect. The correlations show that [see tables in Appendix 1 (JTC bias), appendix 2 (BADE) and appendix 3 (three dimensions´ squizotypy with JTC/BADE bias)]:

-In the cued condition there were negative associations between PR and DTD in the first part of stages (stage 2) for all groups less low schizotypy. That is to say that when a strong conviction exists at the beginning of the decision-making process, fewer stages are necessary to arrive at a final decision: so JTC. However, in the group of low schizotypy participants, it was appreciated more negative associations between PR and DTD in successive stages.

-In the cued condition, there was not a clear association between DTD parameter with task accuracy that is similar for all groups.

-In the cued condition there was a negative correlation between accuracy and Feedback sensitivity in the group of high schizotypy participants only. Therefore for this control group the less of the feedback use the less accuracy to make a final decision. Only the control groups showed positive correlations between PR at last stages and accuracy (what suggest more accuracy with better confidence for these stages or vice versa). Only high schizotypy participants showed a negative correlation between PR at last stages and FS in the cued condition, what suggests more confidence with better use of feedback or vice versa. The reader can remember now that the control groups made better use of feedback and showed more plausibility, less DTD than in the uncued condition and better accuracy in the last stages. In correlations more specific (Appendix 3), it is observed that there were strong positive associations between the positive dimension of schizotypy and PR in first stages, and negative with DTD and the other way around, there were negative correlations between negative dimension of schizotypy with PR and positive with DTD in high schizotypy participants, like we expected. Also the depressive dimension had negative correlations with PR.

-In the uncued condition or more difficult version of the task, for patients and high schizotypy participants, we found evidence of JTC bias at first stage (negative correlation between PR1 and DTD). At the same time, PR at first stages (1 to 4) related positively with FS and negatively with Accuracy for both groups (confidence is associated with worse performance and lower feedback use). At the same time, FS and Acc related between them negatively for all groups. Also for both groups (patients and high schizotypy), DTD related positively with accuracy. Only for patients, we found in stage 8 a positive

correlation between PR and DTD. Only patients and low schizotypy participants showed at stage 8 a positive correlation between PR and accuracy. What means, that patients reversed the pattern of performance from stage 1 (JTC bias) to stage 8.

Also, we observed for uncued trials (Appendix 3) positive associations between PR and positive dimension in the control groups, although earlier in high schizotypy participants. In the negative and depressive dimensions there were negative correlations with PR in high schizotypy participants only.

-There were negative significant correlations between BADE and PR for all groups (except for high schizotypy participants in PR at stage 1). BADE was not related to accuracy or FS for patients and high schizotypy participants. In the case of low schizotypy participants, we found negative correlations with accuracy and FS (the bias is related with feedback use and less accuracy) but only for last stages. For the control groups (high and low schizotypy participants, overall for low ones), there was a positive correlation between BADE and DTD. Also, BADE had negative correlations with the positive dimension of CAPE only in high schizotypy individuals. For patients, the correlation between BADE and DTD is negative at early stages and positive for last stages.

## 4. Discussion

The present results evidence that a Jumping to Conclusions bias may be related to propensity to hold strong beliefs (high PR at first stages) and/or to low feedback sensitivity (FS). Previous studies have examined the relationship between JTC bias, schizophrenia and schizotypy (Speechley et al., 2010; Rodier et al., 2011). However,

our contribution is to add new parameters and analyze the relationship between BADE and JTC bias with these new parameters. We also focus in the context effect and its relationship with accuracy and JTC bias. Especially we analysed like FS may be key in the cognitive differences between schizophrenia and schizotypy. FS could be a second factor related to JTC. We found similar JTC in the cued condition for all groups (two control groups and patients) but earlier JTC in the uncued condition for patients and high schizotypy participants and higher JTC bias in the uncued condition for patients (more PR at early stages, less DTD than controls) related to less accuracy and less feedback use.

In the cued condition, patients benefit less from cues, showed similar DTD than in the uncued condition. Patients also showed less confidence at last stages and less FS but similar accuracy. What could mean that feedback sensitivity is independent of JTC bias in this context (easy version of the task with more sources of information available and the context of the decision previously defined). FS is unrelated to DTD and related to PR only in the last stages in the cued condition but only for the controls. The control groups made better use of feedback and showed more plausibility, less DTD than in the uncued condition and better accuracy in the last stages in the cued condition.

The pattern of results is different for the uncued trials or difficult version of the task (with less accuracy). For the uncued condition, we found also than the patients showed more confidence at first stage and less confidence at last stages but the control groups showed the opposite pattern. At the same time, the patients showed less DTD or quicker decisions. That is we found more JTC bias for patients in the uncued condition even if the negative correlation between PR and DTD was significant for both groups (patients and high schizotypy participants) at first stage. The patients showed also in the uncued condition less feedback sensitivity. An open question is whether JTC (higher PR

at first stage and less DTD) is related to less use of the feedback in the uncued condition for patients. The high schizotypy participants behaved like low schizotypy participants in the cued condition (better confidence, feedback use and accuracy in last stages) but like patients with schizophrenia in the uncued condition (JTC bias at first stage, less feedback use and worse accuracy with more confidence in early stages). High schizotypy participants showed an opposite pattern of relationships between FS, Acc and PR in the cued and uncued conditions. Overall, high PR at first stages was related negatively with accuracy and positively with FS (less use of feedback) in the uncued condition. For the cued condition, high PR at last stages was related negatively with FS (better use of feedback) and positively with accuracy. This difference could be considered in favor of a relationship between JTC and FS overall in the uncued condition. BADE is not related to accuracy or feedback use. Even more, BADE is related to lower PR and higher DTD, what implies that BADE is independent of JTC bias characterized by high PR and low DTD.

Our results also demonstrate that in general the patients with schizophrenia are less sensitive to the feedback compared to the control groups. The patients with schizophrenia were more reluctant to change a belief when new evidence does not confirm it. They were less able to integrate disconfirming evidence. Although, the cue serves as a facilitator in the feedback use, as can be observed in the control group who make quicker decisions in the cued condition. The patients have not benefited when there were interpretative aids. More important JTC (in the cued condition) is not related to accuracy. What means that JTC could be a good heuristic tool under certain conditions or that our task is too easy to show a relationship between accuracy and JTC. However, in the uncued condition, the negative correlations between PR at first stages and accuracy and the positive correlations between DTD and accuracy can be

considered in favour of a negative relationship between JTC bias and accuracy for difficult versions of the task. In general, Accuracy is negatively correlated with feedback sensitivity. In conclusion, JTC is a general bias also presented in non-clinical population but it happens earlier and with higher magnitude in clinical population. This bias is not related to feedback use in the cued condition but it could be related to a general bias against use of feedback in the uncued condition. We need more research to solve the incongruent results between cued and uncued conditions (context effect).

The result found in the present study should be interpreted considering the following limitations. First, there is the problem inherent to the application any type of self-report. Second, to assess the representativeness of the sample, it would have been favourable to determine additional cognitive (e.g., executive functioning, reasoning) and meta-cognitive measures. Third, the present sample was a small one. Thus, group differences may have failed to emerge due to a lack of power.

About future directions, the present findings offer potential therapeutic implications. If delusion formation and maintenance are mediated via a general JTC bias and low feedback use, cognitive therapy in schizophrenia could use tasks such as the ones employed in the present study to promote more efficient hypothesis testing through better feedback use.

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## Appendix 1

Table 2. Results of Pearson's correlation between the parameters of the Picture Decision Task in the cued condition conduct on all groups.

| | JTC (Cued Trial) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Schizophrenia | | | High schizotypy | | | Low schizotypy | | |
| | **DTD** | **Acc** | **FS** | **DTD** | **Acc** | **FS** | **DTD** | **Acc** | **FS** |
| **PR1** | .029 | -.078 | .127 | -.062 | .117 | -.101 | -,014 | ,342 | ,129 |
| **PR2** | **-.451*** | -.131 | .201 | **-.561*** | .037 | .049 | -,343 | **,545*** | ,112 |
| **PR3** | -.424 | .041 | -.041 | -.012 | .261 | -.210 | -,320 | ,046 | ,169 |
| **PR4** | **-.536*** | -.081 | .102 | -.150 | .233 | -.190 | **-,569*** | ,066 | ,425 |
| **PR5** | **-.610*** | -.284 | .084 | -.192 | .425 | -.281 | **-,537*** | ,117 | **,553*** |
| **PR6** | -.432 | .081 | .123 | **-.470*** | .325 | -.162 | **-,597*** | ,218 | ,300 |
| **PR7** | -.378 | .035 | -.024 | -.417 | **.647**** | **-.477*** | **-,600*** | ,180 | -,146 |
| **PR8** | .193 | .131 | -.365 | -.066 | .422 | **-.455*** | -,503 | ,446 | -,100 |
| **DTD** | 1 | .244 | .041 | 1 | -.176 | .027 | 1 | -,252 | -,006 |
| **ACC** | .244 | 1 | -.382 | -.176 | 1 | **-.86**** | -,252 | 1 | -,030 |
| **FS** | .029 | -,382 | 1 | .027 | **-.86**** | 1 | -,006 | -,030 | 1 |

* $p < 0.05$; ** $p < 0.001$

Table 3. Results of Pearson's correlation between the parameters of the Picture Decision Task in the uncued condition conduct on all groups.

| | JTC (Uncued Trial) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Schizophrenia | | | High schizotypy | | | Low schizotypy | | |
| | DTD | Acc | FS | DTD | Acc | FS | DTD | Acc | FS |
| **PR1** | **-.365*** | **-.535*** | **.434*** | **-.477*** | **-.337*** | **.631**** | ,272 | ,276 | -,238 |
| **PR2** | **-.409*** | **-.490*** | **.439*** | -.161 | **-.357*** | **.330*** | -,466 | ,184 | -,132 |
| **PR3** | -.187 | **-.666**** | **.486*** | -.361 | **-.454*** | .295 | **-,542*** | ,260 | -,183 |
| **PR4** | -.258 | **-.583*** | **.523*** | -.343 | **-.520*** | .296 | -,377 | ,178 | -,232 |
| **PR5** | -.414 | .409 | .172 | -.215 | -.182 | .016 | -,424 | ,243 | -,195 |
| **PR6** | -.184 | **-.481*** | .321 | -.149 | .101 | -.156 | -,448 | ,505 | -,388 |
| **PR7** | .222 | **.**177 | -.102 | -.185 | .097 | -.295 | -,369 | **,666**** | -,378 |
| **PR8** | **.750**** | **.486*** | -.386 | -.120 | .250 | -.418 | -,209 | **,648*** | -,488 |
| **DTD** | 1 | **.491*** | -.078 | 1 | **.484*** | -.457 | 1 | -,092 | -,097 |
| **ACC** | **.491*** | 1 | **-.750**** | **.484*** | 1 | **-.782*** | -,092 | 1 | **-,852**** |
| **FS** | -.078 | **-.750**** | 1 | -.457 | **-.782*** | 1 | -,097 | **-,852**** | 1 |

* $p < 0.05$; ** $p < 0.001$

**Appendix 2**

Table 4. Results of Pearson's correlation between the parameters of the Picture Decision Task and BADE (collapsing the uncued and cued conditions) conduct on patients with schizophrenia.

| | **Schizophrenia** | | | | | | |
|---|---|---|---|---|---|---|---|
| | **BADE** | | | | | | |
| **Change** | **2** | **3** | **4** | **5** | **6** | **7** | **8** |
| **PR1** | ,011 | ,164 | ,238 | ,167 | ,174 | ,313 | ,322 |
| **PR2** | **-,737**$^{**}$ | -,349 | **-,493**$^{*}$ | **-,456**$^{*}$ | -,196 | ,172 | ,326 |
| **PR3** | **-,551**$^{*}$ | **-,526**$^{*}$ | -,393 | -,274 | -,146 | ,138 | ,064 |
| **PR4** | **-,686**$^{**}$ | **-,502**$^{*}$ | **-,618**$^{**}$ | **-,648**$^{**}$ | **-,511**$^{*}$ | -,194 | ,010 |
| **PR5** | **-,671**$^{**}$ | -,395 | **-,590**$^{*}$ | **-,792**$^{**}$ | **-,608**$^{**}$ | -,250 | ,080 |
| **PR6** | -,363 | **-,487**$^{*}$ | **-,504**$^{*}$ | **-,711**$^{**}$ | **-,774**$^{**}$ | **-,543**$^{*}$ | -,297 |
| **DTD** | **,499**$^{*}$ | -,098 | ,248 | ,415 | ,057 | -,288 | **-,568**$^{*}$ |
| **Acc** | ,119 | -,137 | -,009 | -,050 | -,117 | -,310 | -,388 |
| **FS** | ,056 | -,160 | -,013 | ,128 | -,017 | ,216 | ,011 |

* $p < 0.05$; ** $p < 0.001$

Table 5. Results of Pearson's correlation between the parameters of the Picture Decision Task and BADE (collapsing the uncued and cue conditions) conduct on high schizotypy.

| High schizotypy | | | | | | | |
|---|---|---|---|---|---|---|---|
| | BADE | | | | | | |
| Change | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| PR1 | ,181 | ,212 | ,172 | **,465*** | **,658**** | **,644**** | **,539*** |
| PR2 | **-,571*** | -,148 | **-,522*** | -,178 | ,090 | ,061 | ,204 |
| PR3 | -,420 | **-,839**** | -,359 | -,125 | ,120 | ,033 | -,157 |
| PR4 | **-,466*** | -,283 | **-,614**** | -,318 | -,061 | -,110 | -,012 |
| PR5 | -,340 | -,199 | **-,501*** | -,418 | -,181 | -,203 | -,060 |
| PR6 | -,433 | ,025 | **-,466*** | **-,632**** | **-,587*** | **-,459*** | -,211 |
| DTD | ,266 | ,201 | **,571*** | ,244 | ,268 | ,373 | ,097 |
| Acc | ,111 | ,165 | ,174 | -,095 | -,315 | -,313 | ,056 |
| FS | ,175 | ,120 | ,093 | ,213 | ,397 | ,457* | ,096 |

* $p < 0.05$; ** $p < 0.001$

Table 6. Results of Pearson's correlation between the parameters of the Picture Decision Task and BADE (collapsing the uncued and cue conditions) conduct on low schizotypy.

| Low schizotypy | | | | | | | |
|---|---|---|---|---|---|---|---|
| | **BADE** | | | | | | |
| **Change** | **2** | **3** | **4** | **5** | **6** | **7** | **8** |
| **PR1** | -,148 | -,085 | ,025 | ,009 | -,172 | ,084 | -,133 |
| **PR2** | **-,744**$^{**}$ | **-,657**$^{**}$ | **-,478**$^{*}$ | **-,555**$^{*}$ | **-,684**$^{**}$ | ,097 | -,268 |
| **PR3** | **-,765**$^{**}$ | **-,776**$^{**}$ | **-,511**$^{*}$ | **-,575**$^{*}$ | **-,733**$^{**}$ | ,126 | -,255 |
| **PR4** | **-,643**$^{**}$ | **-,655**$^{**}$ | **-,781**$^{**}$ | **-,649**$^{**}$ | **-,636**$^{**}$ | -,256 | **-,692**$^{**}$ |
| **PR5** | **-,774**$^{**}$ | **-,705**$^{**}$ | **-,764**$^{**}$ | **-,759**$^{**}$ | **-,838**$^{**}$ | -,311 | **-,672**$^{**}$ |
| **PR8** | -,354 | **-,498**$^{*}$ | -,197 | -,310 | -,360 | -,300 | **-,647**$^{**}$ |
| **DTD** | **,706**$^{**}$ | **,746**$^{**}$ | ,395 | **,497**$^{*}$ | **,597**$^{**}$ | -,052 | **,485**$^{*}$ |
| **Acc** | -,280 | -,277 | -,259 | -,356 | -,291 | -,155 | **-,565**$^{*}$ |
| **FS** | ,135 | ,173 | -,219 | -,179 | -,234 | **-,491**$^{*}$ | -,163 |

* $p < 0.05$; ** $p < 0.001$

Table 7. Results of Pearson's correlation between the parameters of the Picture Decision Task with three dimensions (positive, negative and depressive) of schizotypy conduct on high schizotypy.

| | **High Schizotypy** | | | | | |
|---|---|---|---|---|---|---|
| | **Uncued Trials** | | | **Cued Trials** | | |
| | **Positive** | **Negative** | **Depressive** | **Positive** | **Negative** | **Depressive** |
| **PR1** | ,064 | -,268 | ,371 | ,069 | -,317 | **,444*** |
| **PR2** | ,320 | **-,594**** | -,260 | **,530*** | **-,596**** | ,089 |
| **PR3** | **,521*** | -,414 | -,202 | -,111 | -,032 | ,058 |
| **PR4** | **,547*** | -,408 | -,041 | ,254 | -,144 | **,508*** |
| **PR5** | **,547*** | -,282 | -,317 | ,232 | -,174 | **,569*** |
| **PR6** | **,503*** | -,301 | **-,493*** | **,466*** | -,292 | ,243 |
| **PR7** | **,510*** | -,315 | **-,527*** | **,543*** | -,165 | ,165 |
| **PR8** | -,040 | ,247 | -,338 | ,292 | -,091 | -,069 |
| **DTD** | -,426 | ,154 | -,378 | **-,695**** | **,618**** | -,158 |
| **ACC** | -,184 | ,293 | -,384 | ,432 | ,080 | ,008 |
| **FS** | ,076 | -,270 | **,499*** | -,302 | -,075 | ,256 |

Table 8. Results of Pearson's correlation between the parameters of the Picture Decision Task with three dimensions (positive, negative and depressive) of schizotypy conduct on low schizotypy.

| | **Low Schizotypy** | | | | | |
|---|---|---|---|---|---|---|
| | **Uncued Trials** | | | **Cued Trials** | | |
| | **Positive** | **Negative** | **Depressive** | **Positive** | **Negative** | **Depressive** |
| **PR1** | ,423 | ,260 | -,111 | ,406 | ,409 | ,067 |
| **PR2** | ,367 | ,139 | -,072 | ,341 | ,160 | ,268 |
| **PR3** | ,385 | ,096 | -,005 | ,438 | ,349 | ,408 |
| **PR4** | ,113 | -,115 | ,170 | ,425 | ,202 | ,269 |
| **PR5** | ,258 | ,089 | ,125 | ,437 | ,166 | ,307 |
| **PR6** | **,513*** | ,156 | -,187 | **,575*** | ,307 | ,138 |
| **PR7** | **,583*** | ,338 | -,009 | ,126 | -,167 | -,138 |
| **PR8** | **,498*** | ,247 | -,074 | ,392 | ,056 | -,304 |
| **DTD** | -,383 | -,019 | ,359 | **-,630**** | -,168 | ,116 |
| **ACC** | ,373 | ,258 | ,074 | ,289 | ,122 | -,174 |
| **FS** | -,428 | -,155 | ,030 | ,072 | ,126 | ,427 |

* $p < 0.05$; ** $p < 0.001$

Table 9. Results of Pearson's correlation between BADE (collapsing the uncued and cue conditions) with three dimensions (positive, negative and depressive) of schizotypy conduct on high/low schizotypy.

| | JTC (Cued Trial) | | | | | |
|---|---|---|---|---|---|---|
| | High schizotypy | | | Low schizotypy | | |
| **Dimension** | **Positive** | **Negative** | **Depressive** | **Positive** | **Negative** | **Depressive** |
| **BADE2** | **-,485*** | ,231 | ,405 | -,255 | ,013 | -,057 |
| **BADE3** | -,061 | -,059 | ,136 | -,349 | -,140 | -,159 |
| **BADE4** | **-,641**** | ,342 | ,114 | -,014 | ,101 | -,432 |
| **BADE5** | **-,465*** | ,084 | ,402 | -,162 | -,025 | -,318 |
| **BADE6** | -,365 | -,009 | **,448*** | -,357 | -,143 | -,308 |

* $p < 0.05$; ** $p < 0.001$

# Capítulo 11: Discusión general

Desde el punto de vista de nuestro equipo de investigación, el cerebro es un dispositivo de contrastes de hipótesis, que confronta de modo continuo el procesamiento de abajo-arriba (o entrada sensorial) con el procesamiento de arriba-abajo (expectativas previas o formulación de hipótesis). De manera que de modo continuo estas dos corrientes de información se comparan realizando un contraste de hipótesis (posiblemente no científico, o en lugar de centrado en la falsación de la hipótesis más bien con sesgo confirmatorio a partir de una evidencia menor). Por ejemplo, si estoy en mi casa por la tarde sentado viendo la televisión y escucho un ruido en la cocina, pensaré que es mi perro (expectativa más probable si vivo sólo con mi perro y éste no está en el salón), pero podría ser el gato de la vecina que ha entrado por la ventana o un ladrón. En mi casa, en mi percepción y/o cognición ha dominado el procesamiento de arriba-abajo y apenas si he verificado esta hipótesis con los datos (tan sólo con un ruido "he visto a mi perro en la cocina" en mi mente).

Algo parecido ocurre en las ensoñaciones propias de sueño REM (hipótesis variables con un umbral confirmatorio muy bajo según Hobson). El caso contrario sería el siguiente: Decido, sin previo aviso a nadie, irme a Londres y aterrizo en el aeropuerto de Heatrow. Allí me tropiezo de frente con una señora mayor y me sorprendo mirándola fijamente con las pupilas dilatadas, llama mi atención pues se ha activado en mi un sentimiento de familiaridad y al cabo de unos segundos eternos me doy cuenta de que es mi madre, que jamás ha salido del pueblo pero que sin previo aviso tuvo el mismo capricho que yo de viajar a Londres el mismo día. De manera que me ha costado reconocer a mi madre, pues su presencia está ocurriendo en un contexto de baja

probabilidad (Londres) y he tenido que recurrir a los datos, a una exploración sensorial exhaustiva, para verificar que la activación inconsciente de familiaridad, en los árboles de búsqueda de mi cerebro, me condujera a una comparación positiva entre hipótesis y datos o "matching": Hasta comprobar que los rasgos físicos se corresponde a la hipótesis "es mi madre," que no se activaba por encima del umbral de la consciencia en este contexto. Es decir, he estado a punto de no reconocer a mi madre ni ella a mí. Si ver es un contraste de hipótesis y reconocer lo es, puede que también soñar y pensar lo sean.

Puede que todo sea una decisión, por ejemplo reírse o no, consciente (es o no es apropiado hacerlo por el contexto) o incluso inconsciente, como en el caso de las cosquillas (tal vez sería mas adecuado decir decisión involuntaria aunque resulte paradójico, pues en las cosquillas como hemos visto el estallido de la risa se produce tras una evaluación por un programa automático de la relación entre quien hace cosquillas y quien las recibe). Este es nuestro planteamiento de partida o presupuesto sobre la mente humana (todo es una decisión (soñar, pensar, ver, actuar) y en las decisiones se ejecuta una comparación, contraste de hipótesis o reglas del tipo condición-acción), de modo que buscamos una tarea cognitiva que podamos manipular para hacer contraste de hipótesis y poner en juego los elementos clave: Hipótesis o expectativas, datos o feedback sensorial y contextos diversos. Según nuestro juicio, una tarea que cumple estos requisitos es la "Pictures Decision Task" modificada por nosotros, como se cuenta con detalle en los capítulos de esta tesis, y el sesgo cognitivo de salto a conclusiones.

El objetivo era mostrar que el ajuste a la realidad o la objetividad (congruencia entre interpretaciones y hechos) dista de ser perfecto en los seres humanos. Podemos clasificar a los grupos humanos en función de la magnitud de este desajuste, por eso estudiamos con esta tarea sesgos cognitivos o fallos de razonamiento en función de

variables demográficas muy generales: género, edad, creencia religiosa, ideología política o rasgos de personalidad como la esquizotipia.

Nuestra serie experimental, nos permite concluir que efectivamente podemos clasificar a los grupos humanos en función de la magnitud de este desajuste, por lo menos en los que respecta a los sesgos cognitivos aquí estudiados.

En nuestra investigación el sesgo cognitivo salto a conclusiones se ha visto relacionado con el rasgo de personalidad esquizotipia, con el sexo masculino, creer en Dios y tener una orientación política conservadora. De modo que las personas que más saltan a conclusiones o muestran más sesgos cognitivos son hombres, creyentes de la tercera edad y alta esquizotipia. El perfil mayoritario de los políticos, empresarios, médicos, científicos, jueces…Además, con respecto a los sesgos cognitivos BADE (sesgo en contra de la evidencia desconfirmatoria) y BACE (sesgo en contra de la evidencia confirmatoria) se ha podido establecer una relación entre ideología conservadora, alta esquizotipia, y la creencia en Dios.

Existen una serie de prejuicios respecto a la objetividad de los grupos humanos que vamos a someter a prueba en un futuro, así se afirma que el optimista ve la botella medio llena y el pesimista medio vacía. Esto es, un hecho (una botella llena hasta su mitad) es susceptible de dos interpretaciones opuestas (el liquido va a aumentar o va a disminuir). También se afirma que un optimista es sólo un pesimista mal informado o viceversa, esto es, que el pesimista es mas objetivo o muestra un mayor ajuste a la realidad. ¿Es esto cierto?

También se afirma que las mujeres son más subjetivas o que el diablo sabe más por viejo que por diablo (esto puede significar que el viejo es más objetivo o está más ajustado a la interacción social, donde tal vez mentir se vincula al éxito social). Ambos

prejuicios (al menos con nuestras tareas y sesgos cognitivos) se han visto desconfirmados.

Por eso el contexto es importante, no es lo mismo un ajuste hipótesis-datos físicos (juicio sobre lo que veo u oigo) que un ajuste hipótesis-datos social (lo que me conviene decir que veo u oigo en un grupo social). Es decir, otra cuestión es si estos sesgos cognitivos son adaptativos y se vinculan con la eficacia. Hemos visto, que en ocasiones, en la versión difícil de la tarea (uncued trials en inglés) se asociaban a menor exactitud de respuesta. Otra cuestión encadenada es si el éxito social tiene algo que ver con la eficacia. De modo que es posible que los sesgos cognitivos se vinculen a un rendimiento peor pero esta ineficacia se asocie a un éxito social mayor.

## Perspectivas Futuras

Otras cuestiones de interés que abordaremos en el futuro es si los científicos siguen en su práctica la filosofía de la ciencia de Popper y hacen falsación en vez de verificación de hipótesis. Una cosa es la filosofía de la ciencia y otra la ciencia real. Es posible que el contexto actual o espíritu de la época con su énfasis en el número de publicaciones como modo de prestigio científico haga muy difícil hacer ciencia con lógica falsacionista: No se publican las replicas, no se publican las confirmaciones de la hipótesis nula, el sitema de la peer review convierte a los científicos en juez y parte…

La cuestión es si la praxis nos hace mejores en el contraste de hipótesis o no. Por ejemplo, profesionales que usan la ciencia o profesionales que hacen diagnósticos, como médicos y psiquiatras, a la hora de diagnosticar muestran estos sesgos cognitivos en mayor o menor medida (como el salto a conclusiones, el sesgo de confirmación o el

sesgo contra la evidencia desconfirmatoria) y esto los hace mejores o peores profesionales, ¿afecta a su capacidad y eficacia?

De igual modo, hasta ahora se cree que estos sesgos se asocian a estilos cognitivos y con rasgos de personalidad, pero pueden cambiar en función de nuestro estado emocional (¿los mostramos más al estar felices o al estar deprimidos?). ¿Razonamos mejor en un contexto social feliz o deprimente?