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Departamento de Personalidad, Evaluación y Tratamiento Psicológico

Tesis Doctoral

NEUROPSICOLOGÍA CULTURAL EN POBLACIÓN ÁRABE: EVALUACIÓN EN ADULTOS Y NIÑOS

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Dedication

With all my love and respect

I would like to dedicate this Thesis to:

My parents

My wife

My brothers & sisters

And specially

To my beloved homeland "Palestine"

Agradecimientos

Quiero expresar mi agradecimiento a los directores de esta tesis doctoral a Miguel Pérez García y a Isabel Peralta Ramírez por sus trabajos y supervisiones durante los 4 años de la tesis. Les quiero agradecer y reconocer que sin ustedes este trabajo no habría sido posible.
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Índice

Resumen

Esta tesis doctoral consta de un total de nueve capítulos presentados en cuatro secciones principales: (i) parte teórica (ii) parte empírica (iii) discusiones generales, (iv) conclusiones, recomendaciones y perspectivas futuras.

La parte teórica está compuesta por dos capítulos. En el primer capítulo presentamos una introducción sobre los estudios realizados en el campo de neuropsicología transcultural destacando las diferencias culturales encontradas en el rendimiento neuropsicológico y las variables que pueden explicar estas diferencias. A continuación, expondremos una revisión teórica sobre el estado de neuropsicología en el mundo árabe mostrando tanto los estudios realizados como las pruebas neuropsicológicas utilizadas en esta cultura. Considerando el estado de la cuestión, en el siguiente capítulo presentamos los objetivos de la Tesis Doctoral, incluyendo el objetivo principal, los objetivos específicos y las hipótesis.

La parte empírica consiste en cinco capítulos, cada capítulo es un estudio empírico realizado para alcanzar un objetivo específico. Como el objetivo principal de esta Tesis es iniciar un programa de investigación sobre la neuropsicología cultural en población árabe en general, dos estudios han sido realizados en adultos y tres en niños/as. El capítulo 3 estudia las diferencias entre un grupo marroquí y otro español tanto en una prueba de inteligencia no verbal como en una batería de pruebas neuropsicológicas. Los resultados indican que el grupo español puntúa mejor que le grupo marroquí en todas las pruebas neuropsicológicas y en la prueba de inteligencia. Además, los resultados muestran que los dos grupos utilizan diferentes habilidades neuropsicológicas para realizar la misma prueba de inteligencia. Esto puede explicar las diferencias en el rendimiento entre los dos grupos. Para estudiar otras variables que pueden explicar las diferencias entre los dos grupos hemos realizado el siguiente estudio.

El capítulo 4 consiste en un estudio en el que teníamos como objetivo comprobar el papel de variables tradicionales como la aculturación, clase socio-ocupacional e inteligencia y nuevas variables, como las habilidades de cálculo, a la hora de explicar las diferencias culturales en el rendimiento neuropsicológico entre tres grupos (marroquí, español y colombiano) igualadas en edad, sexo, nivel educativo y nivel socio-económico. En este estudio el cálculo junto la inteligencia eran los mejores predictores de las

puntaciones neuropsicológicas obtenidas en los tres grupos. Así mismo, proponemos que las habilidades de cálculo pueden ser utilizadas para medir la calidad de la educación en las personas que hablen idiomas diferentes y donde las habilidades lectoras no se deban utilizar para medir la calidad de dicha educación.

La influencia de educación y, en general, de las variables culturales en el neurodesarrollo en particular está poco estudiada. Por ello, los siguientes capítulos se han enfocado en población árabe infantil. El capítulo 5 incluye un estudio en el que investigamos las diferencias culturales en el rendimiento del *"Children's Color trails Test",* una prueba neuropsicológica bastante utilizada en los estudios transculturales. El *"Children's Color trails Test"* se presenta en su manual (Llorente, Williams, Satz y D'Elia, 2003) como una prueba libre de cultura. Los resultados de este capítulo revelan un efecto de la cultura en este tipo de pruebas en el que los/as niños/as marroquíes rendían significativamente más bajo que los/as niños/as americanos/as en comparación con las normas de la prueba para niños/as igualados en edad, sexo y el nivel educativo. Estos hallazgos confirman la necesidad de crear y adaptar pruebas específicas y válidas para la cultura árabe, así como, utilizar estas pruebas en los estudios transculturales.

El capítulo 6 de esta tesis está formado por un estudio sobre las diferencias culturales en el neurodesarrollo. En este artículo, además de estudiar las diferencias en el rendimiento neuropsicológico entre niños/as marroquíes y ecuatorianos/as mediante una batería fiable y valida en las dos culturas (BENCI: Batería de Evaluación Neuropsicológica Infantil; Cruz-Quintana, Pérez-García, Roldan-Vílchez, Fernández-López y Pérez-Marfil, 2013), estudiamos si el neurodesarrollo de estos/as niños/as es diferente según el país. Los resultados muestran diferencias culturales en 4 de las 11 pruebas utilizadas para evaluar el rendimiento neuropsicológico en niños/as marroquíes con respecto a los/as niños/as ecuatorianos/as. Además, estas diferencias entre los dos grupos cambiaron según la edad en el desarrollo de la memoria verbal y el costo de cambio.

El capítulo 7 consta de un estudio de validación en el que comprobamos la fiabilidad y validez de versión árabe de la Batería de Evaluación Neuropsicológica Infantil (BENCI). La versión árabe de esta batería ha sido traducida y adaptada a la cultura árabe según la normas internacionales de adaptación (International Test Committee, 2010). Los resultados mostraron una buena fiabilidad y validez de la versión árabe de la batería

BENCI en niños/as marroquís. Además, dicha batería muestra capacidad de captar los cambios propios del neurodesarrollo de estos/as niños/as.

La tercera sección está compuesta por el capítulo 8, donde discutimos los principales resultados obtenidos tanto en la revisión teórica como en los cinco estudios empíricos y destacamos las implicaciones teóricas y clínicas de esta Tesis Doctoral.

Por último, en la cuarta sección se presentan las conclusiones, las recomendaciones y perspectivas futuras derivadas de esta Tesis (capítulo 9).

PARTE TEÓRICA

Capítulo 1

Neuropsicología cultural en el mundo árabe

1. 1 Neuropsicología Transcultural

1.1.1 Introducción

Hoy en día, vivimos en un mundo multicultural compartido por más de 7 mil millones de habitantes. De esta población, el 3.2 % viven fuera de sus países de origen (Naciones Unidas, 2013). Este número está creciendo con el tiempo y ha pasado de 191 millones en 2005 a 232 millones en 2011 (*International Organization for Migration,* 2011). Este movimiento de personas ha generado una nueva necesidad: ¿Cómo hacer una evaluación neuropsicológica a personas inmigrantes que tienen una cultura de origen diferente a la del lugar donde viven? En estos casos, las recomendaciones de la literatura indican que se deben considerar las variables culturales del individuo en todo el proceso de la evaluación y/o rehabilitación neuropsicológica, incluyendo la selección de las pruebas, la administración y la interpretación de los resultados (Ardila, 2005; Puente, Pérez-García, Vilar-López, Hidalgo-Ruzzante y Fasfous, 2013).

Numerosos estudios han demostrado el efecto de la cultura en la ejecución de las pruebas neuropsicológicas (Agranovich y Puente, 2007; Agranovich, Panter, Puente y Touradji, 2011; Ardila, 1995, 2005, Ardila y Moreno, 2001; Baird, Ford y Podell, 2007; Bakos, Denburg, Fonseca y Parente, 2010; Buré-Reyes y cols., 2013; Byrd, Touradji, Tang y Manly 2004; Greenfield, 1997; Jacobs y cols., 1997; Kempler, Teng, Dick, Taussing y Davis, 1998; Ostrosky-Solís, Ramírez, Lozano, Picasso y Vélez, 2004; Patton, et al., 2003; Ramírez, Ostrosky-Solis, Fernández y Ardila, 2005; Razani, Burciaga, Madore y Wong, 2007; Razani, Murcia, Tabares y Wong, 2007; Puente y Ardila, 2000; Touradji, Manly, Jacobs y Stern, 2001). De modo global, esta literatura indica que las personas de diferentes países y/o grupos culturales suelen mostrar diferencias en el rendimiento neuropsicológico. Por ejemplo, los norteamericanos caucásicos normalmente puntúan mejor que los norteamericanos africanos y mejor que los inmigrantes hispanos en las pruebas neuropsicológicas (p.e., Byrd y cols., 2004; Jacobs y cols., 1997; Manly, Jacobs, Touradji, Small y Stern, 2002; Vilar-López y Puente, 2010). En ocasiones, pero menos frecuentemente, algunas minorías norteamericanas como los asiáticos han puntuado mejor que los norteamericanos caucásicos (Puente y Pérez-García, 2000). Aunque estas diferencias podrían ser atribuidas a las diferencias en el idioma, lo cierto es que también se han encontrado en grupos culturales que comparten el mismo idioma. En esta línea, en un estudio reciente, se han encontrado diferencias entre hispanohablantes de Chile, Republica Dominicana, Puerto Rico y España evaluados en sus propios países (Buré-Reyes y cols.,

2013). Por otro lado, numerosos trabajos muestran que las diferencias culturales en el rendimiento neuropsicológico de las personas que hablan diferentes idiomas no desparecen a la hora de utilizar pruebas no-verbales, incluso pueden ser mayores, al emplear pruebas no-verbales como pruebas libres de cultura (Jacobs y cols., 1997; Rosselli y Ardila, 2003; Puente y cols., 2013).

Estos resultados motivaron el estudio de las variables explicativas de las diferencias entre personas de diferentes culturas en la pruebas neuropsicológicas. Las diferencias culturales en la ejecución neuropsicológica han sido explicadas por variables tradicionales que tienen un efecto significativo en el rendimiento neuropsicológico de la personas, no solo cuando comparamos personas de diferentes culturas, sino también cuando comparamos personas del mismo país o de la misma cultura. En concreto, variables como edad, nivel educativo y nivel socioeconómico afectan al rendimiento neuropsicológico de una persona pero también podrían explicar diferencias en el rendimiento de personas provenientes de culturas diferentes (Armengol, 2002; Boone, Victor, Wen, Razani y Pontón, 2007; Byrd, Sánchez y Manly, 2005; Kempler y cols., 1998; Llorente, 2008; Ostrosky-Solís y Lozano, 2006; Ostrosky-Solís, Ramírez y Ardila, 2004; Rosselli y Ardila, 2003).

A pesar del control de las variables tradicionales (edad, nivel educativo y nivel socio económico), las diferencias neuropsicológicas entre grupos de diferentes culturales siguen apareciendo (Boone et al., 2007; Manly y cols., 2002). Por tanto, nuevas variables relacionadas con la cultura están siendo consideradas. Por un lado, el tiempo y grado de asimilación de la nueva cultura (aculturación) y, por otro, la calidad de la educación recibida en términos de habilidades cognitivas adquiridas durante el proceso educativo, se han propuesto como responsables de las diferencias en rendimiento neuropsicológico entre personas de diferentes culturas. De hecho, cuando variables como la aculturación y la calidad de educación se controlan, las diferencias culturales en el rendimiento neuropsicológico disminuyen (Boone y cols., 2007; Byrd y cols., 2005; Cofffey, Marmol, Schock y Adams, 2005; Manly y cols., 2002).

La aculturación juega un papel importante en las diferencias neurosicológicas en el caso de las minorías étnicas y/o los inmigrantes que viven fuera de su país (Boone y cols., 2007; Cofffey y cols., 2005; Kennepohl, Shore, Nabors y Hanks, 2004; Manly y cols., 1998, Razani, Burciaga, Madore y Wong, 2007). La aculturación es un proceso complejo

de adaptación psicológica y cultural a la nueva cultura y refleja habilidades individuales que llevan a las personas a vivir con éxito en dos culturas diferentes (Berry, 2001, 2005). Así, la aculturación, medida por los años de residencia en el nuevo país a partir de cuestionarios formales, correlaciona significativamente con el rendimiento neuropsicológico (Boone y cols., 2007; Razani, Murcia, Tabares y Wong 2007; Saez y cols., 2013). En un estudio llevado a cabo en Estados Unidos, Razani y cols. (2007) encontraron que las personas de grupos étnicos minoritarios escolarizadas durante más años fuera de Estados Unidos obtienen una puntuación inferior en pruebas de atención que personas de los mismos grupos con más años de escolaridad en dicho país.

Por otro lado, diferentes estudios han mostrado que la calidad de la educación medida por las habilidades lectoras (Byrd y cols., 2005; Manly, Byrd, Touradji y Stern, 2004; Manly y cols., 2002; Schneider y Lichtenberg, 2011) explica mejor las diferencias culturales en la ejecución neuropsicológica que el nivel educativo evaluado a partir de los años de escolaridad. En estudios realizados con ancianos afroamericanos, se ha encontrado que la calidad de la educación era el mejor predictor de las diferencias culturales, después de controlar variables como la edad, el nivel socioeconómico, la aculturación y/o el nivel educativo medido a partir de años de educación formal (Ryan y cols., 2005; Manly y cols., 2002, 2004). Sin embargo, en otros estudios, estas diferencias culturales no han sido reducidas controlando la calidad de educación (Morgan, Marsiske y Whitfield, 2008). En esta línea, otros autores han destacado la utilidad de considerar ambos conceptos, la calidad de educación y el nivel educativo, cuando evaluamos el rendimiento neuropsicológico (Lezak, Howieson y Loring, 2004; Puente y cols., 2013). Sin embargo, a pesar de controlar el efecto de las variables descritas, los estudios siguen mostrando diferencias en la ejecución entre personas de distintas culturas. Esto ha motivado que se estén explorando nuevas aproximaciones para entender la relación entre Neuropsicología y cultura. Por un lado, nuevas variables están siendo consideradas a la hora de explicar las diferencias en rendimiento neuropsicológico entre personas de diferentes culturas. Por otro lado, los nuevos desarrollos tecnológicos del campo de las neurociencias se están aplicando para entender mejor la relación cerebro-cultura. Finalmente, también se ha empezado a investigar si lo que conocemos hasta ahora centrado sobre todo en norteamericanos, puede ser aplicable a otras culturas. Por todo ello, tanto la búsqueda de nuevas variables, como la aplicación de las nuevas tecnologías y la investigación en nuevas

culturas han empezado a ser consideradas en el campo de la Neuropsicología Cultural. En el siguiente apartado se presentan estos nuevos desarrollos.

1.1.2 Nuevas variables, nuevas metodologías y nuevas culturas.

Estudiar nuevas variables relacionadas con la cultura nos puede ayudar a entender las diferencias culturales en ejecución neuropsicológica. Sin embargo, estas nuevas variables, están más centradas en investigar la influencia de los valores culturales en sí, y no tanto su influencia en el rendimiento cognitivo. Por ejemplo, Agranovich y cols. (2011) encontraron que los universitarios norteamericanos puntúan mejor que los universitarios rusos en diversas pruebas cronométricas. Estas diferencias han sido explicadas por las diferencias culturales entre los dos grupos en su actitud hacia el tiempo (la cultura del tiempo). Sabiendo que cada grupo cultural tiene su propia idiosincrasia, los estudios transculturales deben considerar el peso cultural de los factores que pueden afectar a la evaluación y la rehabilitación neuropsicológica en general.

Por otro lado, desarrollar y utilizar nuevas pruebas o metodologías de evaluación es básico en el campo de Neuropsicología Cultural. Hoy en día, la Neurociencia Cultural ha emergido como disciplina que estudia la relación bidireccional entre cultura y cerebro (Chiao, 2009; Rule, Freeman y Ambady, 2013). Por ejemplo, los estudios de resonancia magnética funcional (*fMRI*) han mostrado diferencias entre asiáticos y occidentales en el funcionamiento cerebral mientras estos realizaban una tarea similar (Gutchess, Welsh, Boduroglu y Park, 2006; Gutchess, Hedden, Ketay, Aron y Gabrieli, 2010). Por otro lado, investigaciones provenientes de la Neurociencia Cognitiva han mostrado diferencias entre los asiáticos y occidentales en atención, percepción y cognición (Nisbett y Masuda, 2003; Nisbett, Peng, Choi y Norenzayan, 2001). En concreto, Nisbett y cols. (2001) encontraron que los asiáticos tienen un procesamiento de la información más holístico, centrándose especialmente en las relaciones entre objetos; mientras los occidentales son más analíticos, centrándose en el objetivo y su categoría.

Por último, parece evidente que existe un sesgo muestral en las investigaciones en Psicología (Arnett, 2008), en Neuropsicología Transcultural (Puente y Pérez-García, 2000) e incluso, en los nuevos estudios de la Neurociencia Cultural (Chiao, 2009). Esto se puede comprobar en un artículo de Jeffrey Arnett (2008) titulado "*Los abandonados son el 95%, ¿por qué la Psicología americana tiene que ser menos americana?*" mediante el cual ha destacado que las publicaciones de las revistas de la Asociación Americana de Psicología

(*APA)* solo se enfocan en poblaciones norteamericanas, las cuales representan el 5% de la población mundial. En Neuropsicología Transcultural esto constituiría un importante sesgo que incluso afecta a la interpretación de las diferencia. Como han puesto de manifiesto Puente y Pérez-García (2000), las interpretaciones de las mayores puntuaciones de los caucásicos frente a los afroamericanos y los hispanos se han centrado en variables como la aculturación y el estatus socioeconómico. Sin embargo, cuando los asiáticos han obtenido mayores puntuaciones que los caucásicos, las interpretaciones se han centrado en las pautas de crianza. Por otro lado, el sesgo en investigación no es exclusivo de Norteamérica sino que se puede extender a otros países desarrollados ya que existe un sesgo económico de fondo. Por ejemplo, en el nuevo campo de la Neurociencia Cultural, Chiao (2009) hizo una revisión de las publicaciones que han utilizado *fMRI* desde 1990 hasta 2008. Los resultados de esta revisión han mostrado que el 90% de los estudios de *fMRI* eran en países occidentales.

Como consecuencia de dicho sesgo, una cultura poco estudiada en el ámbito de la neuropsicología es la cultura árabe, aún representando una de las grandes culturas mundiales ya que son más de 350 millones de personas. Desarrollar investigaciones con el objetivo de profundizar en ella puede ampliar nuestro conocimiento sobre el efecto de la cultura en la ejecución neuropsicológica y, en última instancia, nos puede ayudar a conocer nuevas variables culturales que afectan en el rendimiento neuropsicológico de personas de diferente ámbito cultural. Además, ampliar el desarrollo de la Neuropsicología a países que tradicionalmente no ha sido objeto de la misma, más en concreto, evaluar culturas poco estudiadas y profundizar en la relación entre la cultura y la Neuropsicología es nuestra responsabilidad como científicos para mejorar el desarrollo de esta disciplina en el mundo.

En el siguiente apartado se presenta de modo resumido como es el desarrollo de la Neuropsicología en el mundo árabe.

1.2 Neuropsicología en el mundo árabe

1.2.1 La necesidad de la neuropsicología en el mundo árabe

En el mundo árabe viven más de 350 millones de personas, que representan alrededor del 5% de la población total mundial (Mirkin, 2010). Además, en el año 2000, cerca de 5 millones de árabes vivían en los países miembros de la Organización para la Cooperación y el Desarrollo Económicos "OCDE" (Dumont, 2006). Si bien la

representatividad de la cultura árabe en el mundo es evidente, escasas investigaciones se han realizado desde el campo de la Neuropsicología en dicha cultura. Desde nuestro punto de vista, esta brecha puede influir no sólo en el impulso de la Neuropsicología en el mundo árabe, sino también en el desarrollo de la Neuropsicología en general como disciplina. En el caso de los neuropsicólogos árabes, contar con un bagaje de conocimientos neuropsicológicos relacionados específicamente con su cultura podría ser de gran utilidad, especialmente por las implicaciones que ello puede conllevar en términos de nuevos desarrollos. Además, conocer qué pruebas son válidas y adecuadas para su cultura podría facilitar el trabajo de los neuropsicólogos árabes tanto clínicos como investigadores.

Por otra parte, en el caso de la Neuropsicología en general, proporcionar información sobre la Neuropsicología árabe a neuropsicólogos de otros países puede facilitar su trabajo con personas de origen árabe. Además, investigaciones centradas en esta cultura poco estudiada podrían aportar conocimientos de gran relevancia en el campo de la Neuropsicología Cultural, los cuales ayudarían a reducir el sesgo occidentalista que hemos indicado anteriormente, así como a comprender mejor si el conocimiento generado a partir de culturas occidentales puede ser generalizado a la cultura árabe o es específico de dichas culturas.La cultura árabe presenta características que la diferencian del resto. El mundo árabe está constituido por 22 países y, de ellos, 12 países se encuentran en Asia (Arabia Saudita, Bahréin, Emiratos Árabes Unidos, Iraq, Jordania, Kuwait, Líbano, Omán, Palestina, Qatar, Siria, Yemen), mientras que los otros 10 países están situados en África (Argelia, Comoras, Egipto, Yibuti, Libia, Mauritania, Marruecos, Sudán, Somalia, Túnez). El Islam es la religión de la mayoría de la población árabe y el árabe es la lengua del "Corán" y la lengua materna de los árabes. En los 22 países, las personas leen y escriben en árabe por igual (clásico - formal). Sin embargo, cada país tiene su propio dialecto, que puede ser considerado como la variación informal de la lengua árabe clásica. En algunos países árabes, existe un alto porcentaje de bilingües por motivos históricos coloniales (por ejemplo, Marruecos, Túnez, Líbano). Este factor puede afectar en la ejecución neuropsicológica (p.e., Gollan, Fennema-Notestine, Montoya y Jernigan, 2007; Harris, Cullum y Puente, 1995; Kamat y cols., 2012; Puente, Zink, Hernandez, Jackman-Venanzi y Ardila, 2013) y, por esa razón es importante considerarlo en la evaluación neuropsicológica en los bilingües árabes.

En general, la cultura árabe se considera una cultura colectivista (Al-Issa, 2005; Feghali, 1997). En esta línea, Buda y Elsayed-Elkhouly (1998) encontraron que las personas árabes son más colectivistas que las norteamericanas. Las fuertes relaciones sociales y la importancia de la familia en las sociedades árabes parecen ser una de las características fundamentales de esta cultura. También existe una clara diferenciación de los papeles del hombre y la mujer dentro de dicha cultura. A pesar de que los países árabes hablan el mismo idioma y tienen valores culturales comunes, estos países pueden diferir en la situación económica, los sistemas de educación, el número de habitantes y en algunos aspectos culturales.

Dado que el número de personas árabes en el mundo es mayor que el número de habitantes EE.UU., las necesidades de los servicios neuropsicológicos tendrían que ser, por lo menos, similares. Sin embargo, el número de neuropsicólogos y/o pruebas neuropsicológicas en el mundo árabe son bastante escasos. Esto puede afectar tanto al desarrollo de la Neuropsicología como disciplina científica, así como a su aplicación a pacientes con algún tipo de daño cerebral, ya que está ampliamente demostrado que la cultura afecta a las funciones cognitivas y los valores culturales deben ser considerados en la evaluación neuropsicológica (Ardila, 2005; Puente y cols., 2013). Así, parece evidente que la mayoría de las pruebas neuropsicológicas se desarrollaron en las culturas occidentales. Sin embargo, estas pruebas se administran a personas de diferentes culturas, por lo que su adaptación y validación a las nuevas culturas es imprescindible (International Test Commission, 2010; Echemendia, 2004). Todo ello nos sitúa ante la necesidad de una evaluación neuropsicológica adecuada a la cultura tanto para los habitantes árabes que residen en sus países de origen, como para los inmigrantes árabes residentes en el extranjero.

Por lo anteriormente expuesto, es importante conocer qué estudios neuropsicológicos se han realizado en el mundo árabe, con el objetivo de estudiar la adaptación de pruebas y sus diferencias con otras culturas. Para esto, hemos revisado los estudios neuropsicológicos desarrollados en los países árabes en el período 1993-2013. A continuación se presentan los resultados de esa revisión.

1.2.2 Estudios neuropsicológicos en los países árabes

Si bien existen diversos estudios que utilizan pruebas de evaluación neuropsicológica, sólo un reducido número de los mismos se centran en estudiar la

influencia de variables como el sexo, edad, educación, nivel socioeconómico y cultura en la ejecución neuropsicológico de personas árabes. Por otro lado, también existe un reducido número de estudios que tengan como objetivo estudiar las propiedades psicométricas de pruebas adaptadas a la cultura árabe. A continuación se revisan estos trabajos.

Así, comenzaremos por destacar que durante 20 años y en 22 países árabes, sólo se han realizado 23 estudios en el campo de la neuropsicología (ver tabla 1) contando, por tanto, con una media de 1 estudio por año. A pesar de que hay pocos estudios al respecto, es evidente que el número de los mismos se incrementó en la última década (5 estudios vs. 21 estudios). Otro hándicap encontrado es que los estudios neuropsicológicos árabes se llevaron a cabo sólo en 8 de los 22 países árabes (Egipto, Kuwait, Libia, Palestina, Arabia Saudita, Siria, Sudán y Emiratos Árabes Unidos), mientras que no se encontraron estudios en los catorce países restantes. La mayoría de las investigaciones neuropsicológicas se llevaron a cabo en 3 países: Egipto, Arabia Saudita y Kuwait. Como se puede comprobar en la tabla 1, el número de estudios realizados en niños/as y en adultos fue similar (11 estudios se llevan a cabo entre los adultos y ancianos, mientras que 12 se llevan a cabo con niños/as).

Basándonos en nuestra búsqueda, 10 estudios han examinado las propiedades psicométricas o han tenido como objetivo proporcionar datos normativos para algunas pruebas neuropsicológicas. De estos estudios, 8 se realizaron en los últimos 10 años en 5 países árabes (Arabia Saudí, Egipto, Kuwait, Sudán y Emiratos Árabes Unidos). Los otros 13 estudios han investigado las diferencias socio-demográficas y culturales en la ejecución neuropsicológica, sin embargo, diferentes publicaciones incluidas en la búsqueda, han sido del mismo estudio y de la misma base de datos. En concreto, tres publicaciones de Palestina (Josman, Abdallah y Engel-Yeger, 2006, 2010, 2011), dos de Siria (Sobeh y Spijkers, 2012; Sobeh y Spijkers, 2013), dos de Egipto (Elwan, 1995,1997), dos de Libia (Shebani, van de Vijver y Poortinga, 2005,2008) y dos de Kuwait (El-Korashy, 1995, 1997).

Siete estudios mostraron diferencias culturales entre personas árabes y personas de otras culturas en el rendimiento neuropsicológico (Alansari y Baroun, 2004; Josman y cols., 2006, 2010, 2011; Shebani y cols., 2008; Sobeh y Spijkers, 2013; Stanczak, Stanczak y Awadalla, 2001). En los estudios mencionados arriba, tanto los/as niños/as como los

adultos árabes suelen tener puntuaciones más bajas que las personas de otros países en las evaluaciones neuropsicológicas. Por otro lado, existen muy pocos estudios que comparen el rendimiento neuropsicológico entre personas árabes pertenecientes a diferentes países árabes. En esta línea, en dos estudios diferentes (uno en niños/as y el otro en adultos), se encontraron diferencias en el rendimiento neuropsicológico de los participantes provenientes de diferentes países árabes. Así, Alansari y Soliman (2012) encontraron diferencias en el rendimiento entre los/as niños/as de Egipto y los/as niños/as de Kuwait en las pruebas de memoria de trabajo. Por otro lado, en un estudio en el que comparaban universitarios de Arabia Saudí, Bahréin y Kuwait en coordinación visomotora y la flexibilidad no se encontraron diferencias. (Abdul Razzak, 2013).

Una variable importante que afecta la ejecución neuropsicológica es el bilingüismo (Alladi y cols., 2013; Ardila y cols., 2000; Kamat y cols., 2012; Puente y cols. 2013). Sin embargo, un estudio reciente llevado a cabo por Abdul Razzak (2013), no encontró diferencias neuropsicológicas al realizar el *Trail Making Test* (TMT) entre los universitarios bilingües de Arabia, Kuwait y Bahréin, aunque los participantes bilingües completaron la versión en inglés del TMT más rápidamente que la versión árabe. Por otro lado, Al-Ghatani, Obonsawin y Al Moutaery (2010) en un estudio centrado en el efecto del idioma en el rendimiento neuropsicológico de la prueba de *Stroop* en árabe y en inglés en adultos árabes bilingües, no encontraron diferencias en las puntaciones de las dos versiones.

1.2.3 Pruebas neuropsicológicas disponibles en árabe

De los estudios anteriormente citados en el mundo árabe, solo 19 pruebas neuropsicológicas han sido utilizadas para evaluar el rendimiento neuropsicológico de niños/as y adultos (ver tabla 1). Por otro lado, en algunos estudios han utilizados diferentes versiones de la misma prueba (por ejemplo, la prueba del *Stroop*). Todas estas pruebas han sido desarrolladas fuera del mundo árabe y la mayoría de las pruebas utilizadas se centran en las funciones ejecutivas.

Actualmente existe consenso en que la a traducción sola no es suficiente para aplicar una prueba psicológica y/o neuropsicológica desarrollada en un país y en un contexto cultural a personas de otro país y/u otra cultura (International Test Commission, 2010; Puente y cols., 2013). En este caso, la adaptación lingüística y cultural es básica para comprobar la validez y la fiabilidad de la nueva versión (*International Test Commission*,

2010). En realidad, 7 pruebas *(Cambridge Cognitive Examination (CAMCOG), German Test Battery of Attentional Performance for Children (KITAP), Arabic version of the Stroop Test, Motor-Free Visual Perception Test-Revised (MVPT-R), Developmental Test of Visual-Motor Integration-4th Revision (VMI), Bruininks-Oseretsky Test of Motor Proficiency & Trail Making Test)* de las 19 utilizadas en los estudios neuropsicológicos descritos en tabla 1 han sido traducidas al árabe sin adaptar ni validar para la población árabe. Para las otras 7 pruebas *(Automated Working Memory tasks, Arabic version of the Montreal Cognitive Assessment, Arabic version of Test your memory test (TYM), Expanded Trail Making Test, Kaufman Assessment Battery for Children (K-ABC), The Otis-Lennon Mental ability Test (OLMAT) & Bruininks-Oseretsky Test of Motor Proficiency)* si se han descrito su fiabilidad y validez siendo, por tanto, válidas para esta población (Abdel Rahman y El Gaafary, 2009; Abd-Al-Atty, Abou-Hashem, Abd El Gawad y El-gazzar, 2012; Alansari y Soliman, 2012; El-Korashy, 1995,1997; Elwan, 1995, 1997; Hassan, 2001; Stanczak y cols., 2001). Actualmente, existen solo 7 pruebas que presenten datos normativos para poblaciones árabes *(Arabic versions of FAS (WRG; WRT; SDG) & the Semantic fluency test (animals); Design fluency (the Five-Point test); Arabic version of Test your memory test (TYM); Wisconsin Card Sorting Test (WCST) Arabic version of the Stroop test; Vocabulary and Picture Completion (sub-tests of WAIS-R))*. De estas 7, solo para una prueba, la "*Arabic version of Test your memory test*" los datos normativos han sido calculados después de examinar la fiabilidad y validez de esta prueba.

Tabla 1. Los estudios neuropsicológicos realizados en el mundo árabe desde 1993 hasta 2013 (una revisión de los estudios árabes publicados en PubMed y PsycINFO)

Autores y años	**País**	**Muestra**	**Grupos**	**Pruebas**	**Resultados Principales**
Elwan, 1995	Egipto	172 niños/as egipcios de 6.3 – 12.2 años	G1:82 niños en el 1, 3 y 5 grado G2:90 niñas en el 1, 3 y 5 grado	*Kaufman Assessment Battery for Children (K-ABC):* - *Gestalt Closure* - *Spatial Memory* - *The Number Recall* - *Hand Movements* *WIAS-R:* - *The Block Design*	Los niños superaron las niñas en los procesos cognitivos simultáneos y secuenciales en todos los grados. La edad tuvo un efecto sobre los procesos cognitivos secuenciales. Estructuras Factor fueron similares para niños y niñas.
El-Korashy, 1995	Kuwait	599 estudiantes de secundaria y universitarios (de 14 – 24 años)	250 niños/hombres y 349 niñas/mujeres	*The Otis-Lennon Mental ability Test (OLMAT)*	Se establecieron la validez y fiabilidad de los ítems del *OLMAT* utilizando el modelo de *Rasch* .
Bahri y Bendania, 1997	Emiratos Árabes Unidos	40 estudiantes universitarios de los Emiratos Árabes Unidos (mujeres de 20-24 años)	G1: 20 especializados en educación G2: 20 especializados en inglés	*Traditional version of the Stroop (color y words)* *New version of the Stroop (numbers)*	Había diferencia entre los dos grupos en el tiempo de reacción medido por las dos versiones del *Stroo*p. El orden de las tareas afecta los dos grupos e maneras diferentes.
Elkorashy, 1997	Kuwait	400 estudiantes Kuwaiti de 15 - 23 años	174 niños/hombres y 226 niñas/mujeres	*The Otis-Lennon Mental ability Test (OLMAT)*	Se obtuvo la fiabilidad y la validez de la versión modificada del *OLMAT* en población kuwaití.
Elwan,1997	Egipto	170 niños/as egipcios de 6.3 – 12.2 años	G1: 82 niños en el 1, 3 y 5 grado G2: 90 niñas en el 1, 3 y 5 grado	*Kaufman Assessment Battery for Children:* - *Gestalt Closure* - *Spatial Memory* - *The Number Recall* - *Hand Movements* - *Reading Decoding and Arithmetic (achievement)* *WIAS-R:* *The Block Design*	Las puntuaciones en el procesamiento simultáneo se correlacionaron significativamente con las notas aritméticas, así como la decodificación durante la lectura. Las puntuaciones en el procesamiento secuencial no correlacionaron con nada.

Hassan, 2001	Emiratos Árabes Unidos	194 niños/as escolares de los emiratos árabes unidos	96 niños y 98 niñas de 6 – 11 años	*Bruininks-Oseretsky Test of Motor Proficiency*	El análisis factorial reveló cuatro factores y el patrón general de las cargas se acordó moderadamente con el trabajo teórico de Bruininks. Los resultados mostraron una consistencia interna aceptable.
Stanczak, Stanczak y Awadalla, 2001	Sudan	574 participantes sanos y 81 pacientes con daño cerebral	Grupo control: 497 norteamericanos con una media de edad 42.78 (188 hombres y 307 mujeres) and 77 Sudaneses con una media de edad 24.84 (33 hombres y 44 mujeres) Grupo de pacientes con daño cerebral: 53 norteamericanos con una media de edad 36.02 (39 hombres y 14 mujeres) y 28 Sudaneses con una media de edad 26.61 (22 hombres y 6 mujeres)	*The Arabic version of the Expanded Trail Making Test (ETMT)*	Se presentaron las propiedades psicométricas preliminares de la versión árabe del *ETMT*. Se encontraron diferencias significativas entre los dos grupos en el rendimiento del *ETMT*. Se encontró que los resultados de los sudaneses sanos son similares a los resultados de los sujetos con daño cerebral de Estados Unidos.
Alansari y Baroun, 2004	Kuwait	210 estudiantes universitarios (96 hombres y 114 mujeres)	G1= 70 estudiantes de Escocia (36 hombres y 34 mujeres) G2= 140 estudiantes de Kuwait (60 hombres y 80 mujeres)	*An English version of the Stroop Color and Word Test* *An Arabic version of the Stroop Color and Word Test*	Las mujeres kuwaitíes han superado a los hombres kuwaitíes en la lámina de palabras. Las mujeres británicas se han superado los hombres británicos en la lámina de colores. Se encontraron diferencias culturales significativas a favor de los británicos en todas las partes de *Stroop*.

Shebani, van de Vijver y Poortinga, 2005	Libia	64 niños escolares (30 niños y 34 niñas)	64 niños/as libios/as (14 niños y 18 niñas de 8-9 años + 16 niños y 16 niñas 10 años).	*Digit span Test (short pronunciation task and long pronunciation task)* *Word Span test (long words task y short words task)*	Los niños/as mayores tenían una capacidad de memoria mayor que los niños/as más pequeños. Los/as niños/as mostraron mayor capacidad de memoria en la tarea de dígitos que en la tarea palabra y en las tareas de pronunciación cortas más que en las tareas largas. Las niñas han superado a los niños en todas las pruebas de capacidad de memoria.
Josman, Abdallah y Engel-Yeger, 2006	Palestina	226 niños/as (91 niños y 135 niñas)	G1; 125 niños/as palestinos/as en la guardaría, primero y segundo grado. G2: 101 niños/as Israelí en la guardaría, primero y segundo grado	*Motor-Free Visual Perception Test-Revised (MVPT-R)* *Developmental Test of Visual-Motor Integration-4th Revision (VMI)* *Bruininks-Oseretsky Test of Motor Proficiency*	Los/as niños/as israelíes han obtenido puntuaciones más altas que los/as niños/as palestinos en todas las pruebas utilizadas. La edad ha tenido un efecto significativo en MVPT-R, VMI y *Bruininks-Oseretsky Test*. Pero la educación de los padres no ha tenido ningún efecto.
Shebani, van de Vijver y Poortinga, 2008	Libia	<u>estudio 1 :</u> 104 niños/as escolares (50 niños y 55 niñas) <u>estudio 2</u>: 128 niños/as escolares (64 niños y 64 niñas)	<u>estudio 1:</u> G1:64 niños/as de Libia (14 niños y 18 niñas de 8 -9 años + 16 niños y 16 niñas de 10 años) G2:40 niños de Holanda (10 niños y 10 niñas de 6 años + 10 niños y 10 niñas de 8 años) <u>estudio 2:</u> el grupo de libia : 32 niños/as de 8 y 10 años (grupo Control) 32 niños/as de 8 y 10 años (grupo experimental) El grupo de Holanda: Igual que el grupo libio pero los/as niños/as son de 6y8 años	*Digit Span test* *Word Span test (long words y short words)*	Se encontraron diferencias culturales entre los dos grupos en todas las pruebas utilizadas a favor del grupo holandés. Estas diferencias han desaparecido a la hora de controlar la velocidad de Pronunciación. Después de los ensayos del entrenamiento, los grupos experimentales mostraron un aumento de rendimiento más alto que hicieron los grupos de control. (libios > holandeses).

Abdel Rahman y El Gaafary, 2009	Egipto	Etapa I: 184 ancianos egipcios Etapa II: 268 ancianos egipcios	Etapa I: 94 hombres y 90 mujeres de 60-83 años divididos en 2 grupos: G1: (94) ancianos con deterioro cognitivo leve (medido por *CAMCOG*). G2: (90) ancianos sanos Etapa II: 268 ancianos de 60–76 años (146 hombres y 122 mujeres)	*Montreal Cognitive Assessment Arabic version (MoCA)* *Cambridge Cognitive Examination (CAMCOG)*	La versión árabe de la *MoCA* ha demostrado una adecuada fiabilidad de test-retest y consistencia interna. Se estableció una Validación de contenido a través de una buena correlación entre la versión árabe *MoCA* y el *CAMCOG*.
Al-Ghatani, Obonsawin y Al Moutaery, 2009	Arabia Saudí	198 participantes sanos de Arabia Saudí (edades de 18 - 65 años)	99 hombres y 99 mujeres divididos en 3 grupos de edad: G1: 66 personas (18 -30 años) G2: 66 personas (31 -50 años) G3: 66 personas (51 -65 años)	*Two versions of the Arabic Verbal Fluency test:* *-waaw, raa, taa* *- siin , daal, qaaf*	Se proporcionaron datos normativos para las dos pruebas de fluidez verbal en árabe. El rendimiento de las dos versiones fue altamente correlacionado. La puntuación total de las dos versiones se correlacionó con la edad, educación y nivel socioeconómico.
Al-Ghatani, Obonsawin y Al Moutaery, 2010	Arabia Saudí	10 bilingües sanos	5 hombres y 5 mujeres (media de edad: 31.9) han completado el *Stroop* en árabe y en inglés	*Arabic and English version of the Stroop Test*	No había diferencias en el rendimiento de las participantes en las dos versiones.

Josman, Abdallah y Engel-Yeger, 2010 , 2011	Palestina	226 niños/as (91 hombres y 135 mujeres)	G1: 125 niños/as palestinos/as en la guardaría, primero y segundo grado G2: 101 niños/as Israelí en la guardaría, primero y segundo grado	*Loewenstein Occupational Therapy Cognitive Assessment (LOTCA)*	Los resultados revelaron diferencias en la validez de constructo de la *LOTCA* en los dos países. Los niños/as palestinos/as han obtenido puntuaciones significativamente más bajas que los niños/as israelíes en la mayoría de los dominios de la *LOTCA*. Los resultados mostraron una interacción significativa entre el grupo cultural y el grado y entre el grado y la educación de la madre.
Khalil, 2010	Arabia Saudita	215 adultos de 18 a 59 años	215 participantes (125 hombres y 90 mujeres)	*Verbal fluency: The phonemic fluency task (Arabic version of FAS = WRG) y the Semantic fluency test (animals)* *Design fluency: the Five-Point test*	Este estudio ha proporcionado datos normativos preliminares de las pruebas de fluidez verbal y no verbal de una muestra de habla árabe. La edad y la educación afectan significativamente el rendimiento de las tareas de fluidez verbal, pero no el rendimiento de la prueba de fluidez de diseño. No se encontró efecto de género en cualquiera de las tres tareas.

Al-Ghatani, Obonsawin, Binshaig y Al-Moutaery, 2011	Arabia Saudita	198 Saudí sanos de 16 a 65 años	99 hombres y 99 mujeres (3 grupos de edad: 16-30, 31-50 y 51-65)	*Card Sorting Test (WCST)* *Arabic version of the Stroop test* *Vocabulary (VOC*) and Picture Completion (PC) sub-test of the WAIS-R*	Se proporcionaron datos normativos para WCST, test de Stroop, TONI-3, PC y VOC para las personas de Arabia Saudí. Los niveles educativos y socioeconómicos tenían un efecto en el rendimiento de todas las pruebas utilizadas. No se encontraron diferencias significativas de género en ninguna de estas pruebas.
Abd-Al-Atty, Abou-Hashem, Abd El Gawad y El-gazzar, 2012	Egipto	206 ancianos egipcios de 60 – 80 años	G1; 64 ancianos con deterioro cognitivo leve G2: 142 sanos (31, 26 individuales: *test-retest*)	*Arabic version of Test your memory test (TYM)*	Este estudio proporciona una versión fiable del TYM con mejores índices de validez en los adultos mayores y con más educación. Los resultados mostraron que el nivel de educación influye significantemente en las puntaciones del TYM.
Alansari y Soliman, 2012	Kuwait y Egipto	384 niños/as escolares, (192 niños y 192 niñas)	G1: (192) niños/as egipcios/as (9-10 años) G2: (192) niños/as kuwaití (9-10 años)	*Six computer-administered tasks of the Automated Working Memory Assessment* *Verbal Working Memory* *(1) The listening span task* *(2) The counting span task* *(3) The backward digit span task* *Visuospatial Working Memory Measures* *(1) The odd-one-out task* *(2) The Mr. X task* *(3) The spatial span task.*	Hay invariancia de la estructura psicométrica de la batería en los dos países. Se encontraron diferencias significativas entre los dos grupos en todas las tareas de memoria de trabajo (excepto para *spatial span task).*

Sobeh y Spijkers, 2012	Siria	143 niños/as sirios de 5 a 11 años	72 niños y 77 niñas divididos/as en 7 grupos de edad (5, 6, 7, 8, 9, 10, y 11 años)	*The German Test Battery of Attention Performance (KITAP)*	Se proporcionaron datos preliminares sobre la función atencional de los/as niños/as sirios/as. La influencia de la edad era más evidente en la velocidad de rendimiento que en la calidad de los resultados. El efecto principal de género sólo se encontró en el subtest distracción.
Abdul Razzak, 2013	Arabia Saudita, Kuwait y Bahréin	135 estudiantes universitarios (bilingües árabe – ingles) (69 hombres y 66 mujeres)	G1: 83 han utilizado el TMT en inglés G2: 52 han utilizado el TMT en árabe	*Trail Making Test (TMT)*	Los participantes árabes han realizado TMT en inglés más rápido que en árabe. No se encontraron diferencias entre los participantes de los tres países en la versión árabe del TMT.
Sobeh y Spijkers, 2013	Siria	562 niños/as pre escolares de 5 – 12 años	G1: 304 niños/as sirias (154 niños y 150 niñas) G2: 258 niños/as alemanes/as (128 niños y 130 niñas)	*Test of Attentional Performance for Children (KITAP)*	La edad tuvo un significativo en todas las funciones atencionales. Se encontraron diferencias culturales entre los dos grupos en todas las funciones atencionales (excepto: alerta y vigilancia).

Nota: G = grupo

En resumen, a pesar que el mundo árabe está constituido por 22 países y tiene una población de más de 350 millones, la Neuropsicología prácticamente no está desarrollada ya que el número de estudios que se han realizado es muy reducido. En las últimas dos décadas, la proporción de estudios neuropsicológicos publicados (PsycINFO y PubMed: 1993-2013) en los países árabes es muy baja, teniendo una media de solo 1 estudio por año. Además, el número de las pruebas neuropsicológicas utilizadas en el mundo árabe es limitado. Estás pruebas desarrolladas en el mundo occidental requieren más fuerzo para mejorar su adaptación a la cultura árabe convirtiéndose por tanto necesario realizar más estudios que examinen y mejoren sus propiedades psicométricas. Los pocos resultados encontrados muestran que en la cultura árabe existe una peor ejecución neuropsicológica que en otros países y otras culturas. Sin embargo, los resultados encontrados por estos

estudios se han realizado con pruebas no validadas para esta población imposibilitando, por tanto, considerar como definitivos dichos resultados.

Por todo esto, el objetivo de esta Tesis han sido iniciar una línea de investigación sobre Neuropsicología Cultural en población árabe, intentando, en primer lugar, comprobar si para la cultura árabe se replican los resultados previamente descritos en otras culturas y, en segundo lugar, profundizar en el conocimiento del efecto de la cultura árabe en la ejecución neuropsicológica, así como contribuir a esta disciplina aportando una prueba de nuevo desarrollo validada para la población árabe. Estos objetivos se describen con detalle en el siguiente capítulo.

Capítulo 2

Objetivos y Justificaciones

2.1 Objetivos y justificación

Aunque la Neuropsicología Cultural está siendo desarrollada desde hace décadas, lo cierto es que ha estado restringida sólo a algunas culturas, especialmente la cultura anglosajona en comparación con otras (Puente y Pérez-García, 2000). Esta asimetría no puede ser explicada por distribución poblacional ya que culturas con millones de habitantes en el mundo, por ejemplo, la cultura árabe, han sido escasamente investigadas, tal como se puso de manifiesto en la introducción. Por esto, el objetivo general de esta Tesis Doctoral es investigar el efecto de la cultura en población árabe.

Abordar este objetivo supone casi empezar desde cero. Por ello, esta Tesis Doctoral supone el inicio de un **programa de investigación** sobre Neuropsicología Cultural en población árabe. Con este objetivo general en consideración, los distintos objetivos específicos siguieron los siguientes criterios fundamentales:

1. Realizar los estudios tanto en población adulta como infantil.
2. Estudiar el efecto de variables tradicionalmente consideradas en la Neuropsicología Cultural.
3. Profundizar en el campo de la Neuropsicología Cultural para población árabe.

Con estas consideraciones, se han desarrollado los siguientes objetivos específicos:

1. Investigar el efecto de la cultura árabe en el rendimiento neuropsicológico de adultos sanos. Concretamente, se investigará:
    a. Si existen diferencias entre un grupo de árabes (marroquís) y de españoles en pruebas de inteligencia no verbales (replicación en población árabe de estudios tradicionales) y si las habilidades neuropsicológicas involucradas en la realización de pruebas de inteligencia no verbal son similares en adultos árabes y adultos españoles.

Para alcanzar este objetivo se comparará un grupo de voluntarios adultos marroquís y otro de españoles en la prueba de inteligencia no-verbal (Beta-III) considerada "relativamente" libre de cultura (según el manual de la prueba: Kellogg y Morton, 1999). Además se estudiará si las habilidades neuropsicológicas involucradas en la realización del Beta-III son iguales para marroquís y para españoles

b. Investigar el papel de variables no tradicionalmente estudiadas como las habilidades de cálculo y en muestras habitualmente no consideradas (innovación en el campo de la Neuropsicología Cultural).

Para alcanzar este objetivo, se comparará a un grupo de voluntarios marroquís (diferente lengua y diferente cultura que los españoles), colombianos (misma lengua y diferente cultura que los españoles) y españoles en una batería de pruebas neuropsicológicas tradicionales algunas administradas en lápiz y papel y otras en versión computarizada. Se comparará la capacidad de explicar las diferencias culturales de las variables tradicionales como la aculturación o la clase socio-ocupacional con una nueva variable como es la habilidad de cálculo.

2. Investigar el efecto de la cultura árabe en el rendimiento neuropsicológico de niños/as sanos/as. Concretamente, se investigará:
    a. Si el rendimiento neuropsicológico en una prueba clásica no verbal como el *Children´s Color Trails Test* (CCTT) es similar en niños/as árabes y anglosajones/as (estudio de variables tradicionales).

Para alcanzar este objetivo se comparará el rendimiento de niños/as marroquís en la realización del CCTT con el rendimiento de los niños/as anglosajones/as de los baremos de dicha prueba.

    b. Si el desarrollo neuropsicológico en las distintas funciones (coordinación motora, velocidad de procesamiento, atención, memoria, función ejecutiva) es diferente en niños/as de árabes y niños/as hispanos/as (innovación en el campo de la Neuropsicología Cultural).

Para alcanzar este objetivo, se comparará el rendimiento neuropsicológico de niños/as normales de 7, 9 y 11 años que viven en Marruecos y Ecuador en pruebas de atención, memoria y función ejecutiva.

3. Desarrollar una batería de evaluación neuropsicológica para población árabe infantil.

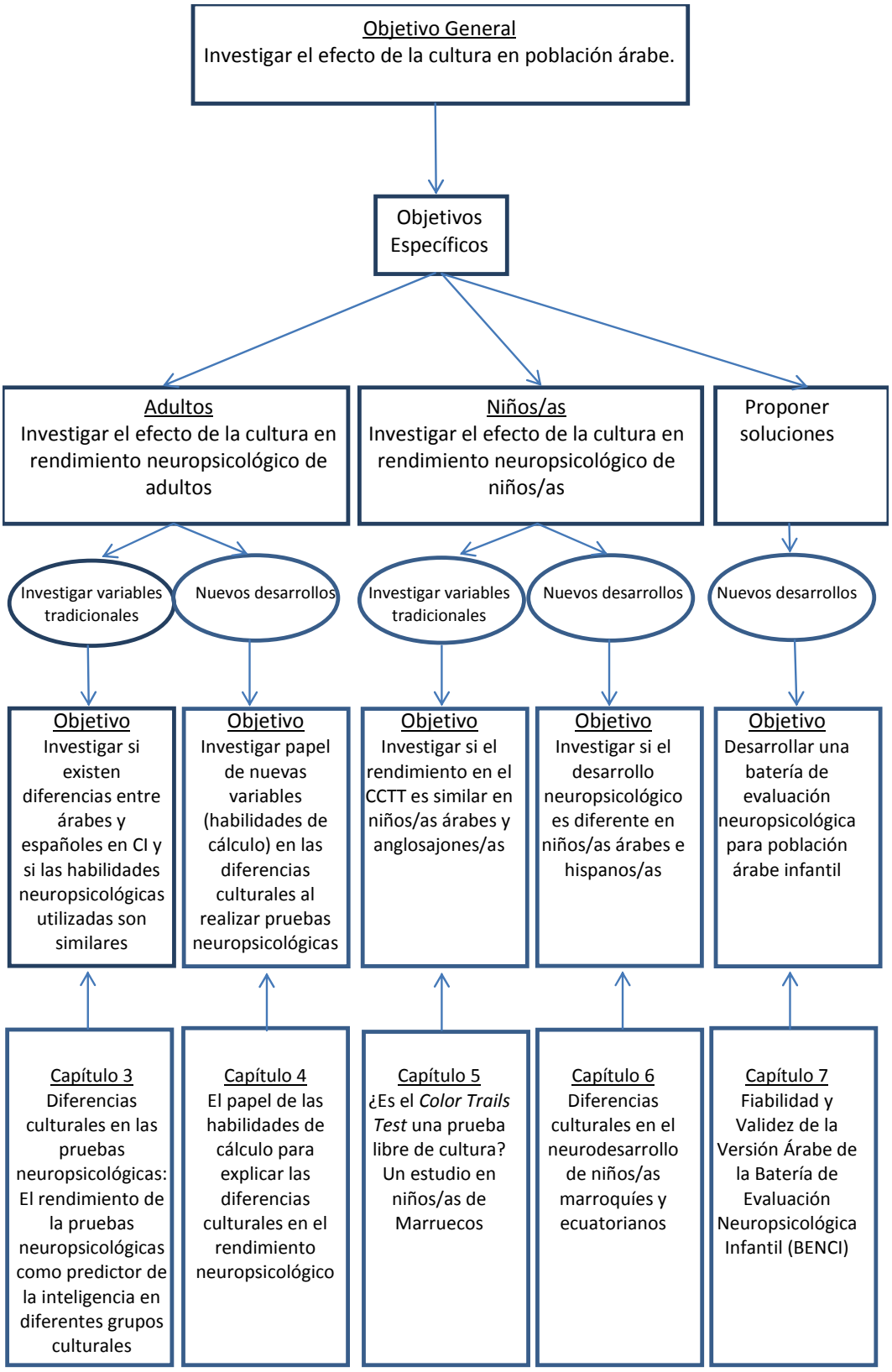
Para alcanzar este objetivo, se realizará la adaptación árabe de la Batería de Evaluación Neuropsicológica Computarizada Infantil (BENCI; Cruz-Quintana y cols., 2013). Esta batería está compuesta por 14 subtests que miden los principales dominios neuropsicológicos como son velocidad de procesamiento, coordinación visomotora, memoria verbal y visual, lenguaje y funciones ejecutivas. En la versión española realizada

en Ecuador, esta batería ha mostrado buenas propiedades psicométricas (Cruz-Quintana y cols., 2013).

De estos objetivos, se derivan las siguientes hipótesis:

1. Las diferencias culturales entre árabes y miembros de otras culturas dependerá del nivel de aculturación, del estatus socioeconómico y de la calidad de la educación.
2. Las habilidades neuropsicológicas involucradas en la realización de pruebas complejas como las pruebes de inteligencia no verbal serán diferentes para árabes y para españoles.
3. El rendimiento neuropsicológico de los/as niños/as árabes en el CCTT será inferior al de los/as niños/as anglosajones/as de su misma edad y sexo.
4. El desarrollo de las distintas funciones neuropsicológicas será diferentes para los/as niños/as árabes y los/as niños/as hispanos/as (concretamente, ecuatorianos).
5. La versión árabe de la Batería de Evaluación Neuropsicológica Computarizada Infantil (BENCI) mostrará buenas propiedades psicométricas en población infantil normal.

Cada uno de estos objetivos supondrá un capítulo de la presente Tesis Doctoral. De modo gráfico se puede ver en el siguiente diagrama:


Objetivo General
Investigar el efecto de la cultura en población árabe.
Objetivos Específicos
Adultos
Investigar el efecto de la cultura en rendimiento neuropsicológico de adultos
Niños/as
Investigar el efecto de la cultura en rendimiento neuropsicológico de niños/as
Proponer soluciones
Investigar variables tradicionales
Nuevos desarrollos
Investigar variables tradicionales
Nuevos desarrollos
Nuevos desarrollos
Objetivo
Investigar si existen diferencias entre árabes y españoles en CI y si las habilidades neuropsicológicas utilizadas son similares
Objetivo
Investigar papel de nuevas variables (habilidades de cálculo) en las diferencias culturales al realizar pruebas neuropsicológicas
Objetivo
Investigar si el rendimiento en el CCTT es similar en niños/as árabes y anglosajones/as
Objetivo
Investigar si el desarrollo neuropsicológico es diferente en niños/as árabes e hispanos/as
Objetivo
Desarrollar una batería de evaluación neuropsicológica para población árabe infantil
Capítulo 3
Diferencias culturales en las pruebas neuropsicológicas: El rendimiento de la pruebas neuropsicológicas como predictor de la inteligencia en diferentes grupos culturales
Capítulo 4
El papel de las habilidades de cálculo para explicar las diferencias culturales en el rendimiento neuropsicológico
Capítulo 5
¿Es el *Color Trails Test* una prueba libre de cultura? Un estudio en niños/as de Marruecos
Capítulo 6
Diferencias culturales en el neurodesarrollo de niños/as marroquíes y ecuatorianos
Capítulo 7
Fiabilidad y Validez de la Versión Árabe de la Batería de Evaluación Neuropsicológica Infantil (BENCI)

PARTE EMPIRICA

Capítulo 3

Diferencias culturales en las pruebas neuropsicológicas: El rendimiento de la pruebas neuropsicológicas como predictor de la inteligencia en diferentes grupos culturales

Fasfous, A. F., Hidalgo-Ruzzante, N., Vilar-López, R., Catena-Martínez, A., & Pérez-García, M. (2013). Cultural Differences in Neuropsychological Abilities Required to Perform Intelligence Tasks. *Archives of Clinical Neuropsychology*.
doi: 10.1093/arclin/act074

3.1 Introduction

Cultural differences in intelligence tests performance are widely accepted (Herrnstein & Murray, 1994; Kaufman, Mclean & Reynolds, 1988; Neisser et al., 1996), and several studies have shown differences in the Intelligence Quotient (IQ) among different cultural groups (i.e., Rushton & Skuy, 2000). It is accepted that the concept of intelligence may differ for various cultures (Sternberg & Grigorenko, 2004; Sternberg & Kaufman 1998), and that to measure intelligence, we must understand it within its cultural context (Sternberg & Grigorenko, 2004).

On a related note, the fundamental role of culture in developing cognitive abilities is well known (Luria 1973, 1976). The cognitive abilities developed may vary from one culture to another. Thus, people from different cultures may perform differently on the same cognitive test according to the importance of this specific cognitive ability in their own culture (Bakos et al., 2010; Ostrosky-Solís, Ramírez & Ardila, 2004). Furthermore, recent studies show that cultural factors may not only influence cognitive functions, but also neural function (Gutchess et al., 2006; Park & Huang, 2010) and neuronal structure (Zilles, Kawashima, Dabringhaus, Fukuda, & Schormann, 2001).

Numerous studies have shown a positive correlation between IQ and neuropsychological performance; people with a high IQ tend to have higher performance on neuropsychological tests compared with people with a lower IQ (Diaz-Asper, Schretlen, & Pearlson, 2004; Tremont, Hoffman, Scott & Adams, 1998). Nevertheless, there is a lack of consensus about what specific neuropsychological functions and/or tests are related to intelligence. Thus, processing speed (Sheppard & Vernon, 2008; Neisser et al., 1996), long-term memory (Unsworth, 2010) or working memory (Colom, Flores-Mendoza, & Rebollo, 2003; Conway, Nelson, Buntinga, Therriault, & Minkoff, 2002; Kane, Hambrick, & Conway, 2005) have been related to fluid intelligence. As an example, intelligence matrix test has been related with working memory (i.e., Conway et al., 2002), but the matrix subtest of the WAIS-III is included into the visual perceptive index (Wechsler, 1997).

Although the relationship between intelligence and performance in neuropsychological tests has been investigated in various studies (Diaz-Asper et al., 2004; Conway et al., 2002), researchers have not yet studied the cognitive abilities that people with different cultural backgrounds use to perform the same intelligence test or whether

these abilities are different for each culture. Such studies could be of great interest and would reveal not only what intelligence tests are measuring in each culture but also whether the cognitive processes used to carry out these tests are the same in all cultures.

Thus, our objective is to study whether there are differences between the Spaniard and Moroccan groups in the neuropsychological abilities used to perform the same intelligence test. In accordance with previous studies mentioned above that have shown relation between neuropsychological and intelligence tests, and the influence of culture on various cognitive areas (i.e., Rule et al., 2013), we hypothesize that the cognitive processes will differ for participants based upon their cultural background.

3.2 Method

3.2.1 Participants

As this study was conducted in Spain, we selected a group of Spaniards and also a group of Moroccans because the Arab is one of the largest minorities in Spain (National Institute of Statistics - Spain, 2011). This group selection guarantees cultural differences, since both have different languages (Arabic vs. Spanish), religions (Muslim vs. Christian), traditions, and radically different geographies (Africa vs. Europe).

The study included 54 healthy adults with a mean age of 26.67 years (SD = 4.39 years). A total of 27 participants were from Spain, and 27 participants were Moroccan immigrants living in Spain. Most of Moroccan participants (77.8%) were University students that attend to classes taught in Spanish language. Also, according to the initial interview with the participants, 46.7% of the Moroccan group speaks Spanish since they were children, 55.6% speak Spanish at home, and 48.1% normally think in Spanish. Thus, Spanish language proficiency was quite high in this sample.

To select the participants, we considered the following inclusion criteria: a range between 18 and 55 years old; the ability to read and write in Spanish sufficient to understand the instructions and tests; and no history of mental disorders, neurological disorders or substance abuse.

The participants received verbal and written information about the study objectives and details and provided informed consent to be included in the study. The confidentiality of personal information was guaranteed in accordance with Spanish legislation on personal

data protection (Organic Law 15/1999, December 13th). The Ethics Committee of the University of Granada approved the present study. The volunteers received 20€ for participating in this study.

3.2.2 Instruments

The Beta III was selected to assess intelligence because it is a non-verbal test supposedly not influenced by language influences and minimally influenced by culture (Kellogg & Morton, 1999). To evaluate neuropsychological components, we used a comprehensive neuropsychological battery with instruments typically used in our laboratory because they are commonly used for the Spanish population. Most of these instruments are used internationally in neuropsychological cross-cultural studies (Agranovich & Puente, 2007; Bakos et al., 2010; Boone et al., 2007; Ostrosky-Solís, Lozano Gutierrez, Ramírez Flores, & Ardila, 2007). All tests were administered in Spanish in the following order:

Non-verbal intelligence test:

Beta III (Kellogg & Morton, 1999) is a non-verbal intelligence test composed of five subtests: coding, picture completion, clerical checking, picture absurdities and matrix reasoning. The duration for the Beta III test is 20-25 minutes. Various studies have demonstrated the validity of Beta III as well as its correlation with WAIS-III and progressive matrices (Kellogg & Morton, 1999).

Neuropsychological tests:

A comprehensive neuropsychological battery of tests was administered to all participants.

Hooper Visual Organization Test (HVOT) (Hooper, 1958; revised in 1983): This test evaluates the capacity of an individual to visually integrate information.

Color Trails Test (CTT-A&B; D'Elia, Satz, Uchiyama, & White, 1996): To assess motor function and cognitive flexibility.

Test of Attention (d2; Brickenkamp, 1962): This test concisely measures selective attention and mental concentration.

Hopkins Verbal Learning Test (HVLT; Benedict, Schretlen, Groninger, & Brandt,1998): To measure learning and verbal memory capacity. We used the Spanish version by Bilbao et al. (2007).

Rey Complex Test and Figure Test and Recognition Trial (ROCFT; Meyers and Meyers, 1995): This test measures visual memory capacity.

Semantic Verbal Fluency Test (VFT; Valencia et al., 2000): This test was included to assess verbal fluency.

Ruff Figural Fluency Test (RFFT; Ruff, 1996): This test is for non-verbal fluency.

Backward Digit Span (WAIS-III; Wechsler, 1999): To evaluate working memory.

Iowa Gambling Task (IGT; Bechara, Damasio, Damasio, & Anderson, 1994): This computerized test evaluates decision-making.

3.2.3 Procedure

The participants were recruited as volunteers from January 2009 to July 2011 from various non-profit organizations working with immigrants in Granada and among the University of Granada students. Assessments were conducted in Spanish, and the total duration of the evaluation was approximately two and a half hours per participant, including a 15-minute break at the middle of the session and an initial interview to collect socio-demographic information and to guarantee the inclusion/exclusion criteria.

3.2.4 Statistical analysis

First, either Student *t*-test or contingency analysis (chi-squared) was performed as appropriate, to compare the principal socio-demographic variables between the two groups.

Second, Student *t*-test was used to study whether the Moroccan and Spanish groups were different for the intelligence and cognitive variables.

Third, we analyzed whether the neuropsychological performance predicted the Beta III scores based on the country of origin. Thus, five regression analyses were performed, one for each Beta III subtest. Neuropsychological scores and their relationship with the country of origin variable were used as predictors, and the dependent variables were the Beta III subtest scores. The relationships were identified by multiplying the

neuropsychological scores using a different constant for each group. Because the total score for Beta III is a linear sum of the subtest scores, this process was not performed for the total score. The level of significance was adjusted to 0.01 in accordance with the Bonferroni correction.

Finally, to understand the variance and predictors using the Beta III test, ten regression analyses were performed - five for each country- using only the neuropsychological variables related to the country of origin variable as predictors for each subtest.

3.3 Results

First, we compare the socio-demographic variables between Moroccan and Spaniards participants. Results indicate no difference between groups in age, gender; education level and monthly income (see Table 2).

Table2. Descriptive statistics and analysis for the different groups on the socio-demographic variables

Characteristics	Moroccan (n=27)	Spaniards (n=27)	χ^2 / t	P
Males	48.1% (13)	48.1% (13)	0.074	0.79
Females	51.9% (14)	51.9% (14)		
Age (years)	27.77 (5.1)	25.63 (3.33)	1.77	0.08
Elementary education	14.8% (4)	0% (0)		
Secundary education	7.4% (2)	11.1%(3)	4.53	0.209
Undergraduate education	44.4% (12)	55.5% (15)		
Graduate education	33.4% (9)	33.4% (9)		
Income/month <360 €	37% (10)	48.1% (13)	0.216	0.642
Between 361€-900€	51.9% (14)	51.9% (14)		

Note: the monthly income is low because the majority of participants are students.

Differences in Intellig ence and neuropsy chological tests betw een Spaniards and Moroccans

The results showed significant differences in the Beta III subtests and the total score between both groups in favor of the Spanish group. Also, results indicate that the Spaniard group significantly outperformed the Moroccan one in all of the neuropsychological tests, with the exception of the Ruff Figural Fluency. Cohen's d was calculated to obtain the effect sizes (see Table 3).

Table 3. Differences between Moroccan and Spaniards groups in intelligence and neuropsychological tests

Tests	Spaniards	Morrocans	*t*	*P*	D
	M (SD)	M (SD)			
HVOT	26.72 (2.04)	18.30 (5.23)	-7.799	**<0.001**	2.32
CTT –A	33.04 (10.28)	57.26 (30.31)	3.932	**<0.001**	1.19
CTT-B	64.11 (12.32)	96.41 (38.06)	4.195	**<0.001**	1.28
d2	472.56 (70.48)	419.07 (72.63)	-2.746	**0.008**	0.75
HVLT	28.63 (3.96)	23.41 (3.90)	-4.883	**< 0.001**	1.33
RCFT-C	35.37 (1.08)	32.78 (3.93)	-3.303	**0.002**	1.03
RCFT-DR	27.46 (4.43)	20.28 (6.67)	-4.663	**< 0.001**	1.29
RCFT-IR	26.59 (5.32)	20.17 (6.16)	-4.102	**< 0.001**	1.19
VFT-ANIMALS	25.23 (5.54)	12.22 (4.59)	-8.997	**< 0.001**	2.59
VFT-FRUITS	14.41 (3.12)	11.26 (3.35)	-3.367	**0.002**	0.97
RFFT	100.22 (17.61)	95.41 (30.39)	-0.712	0.480	0.2
BDS	7.04 (1.70)	5.52 (1.70)	-3.288	**0.002**	0.89
IGT	24.74 (27.76)	6.37 (22.17)	-2.687	**0.010**	0.74
Coding*	82.15 (12.57)	64.30 (18.13)	-4.205	**<0.001**	1.16
Picture completion*	14.52 (3.53)	10.56 (2.72)	-4.616	**<0.001**	1.27
Clerical checking*	41.70 (3.59)	35.96 (7.50)	-3.586	**0.001**	1.04
Picture absurdities*	21.41 (2.33)	16.33 (4.37)	-5.329	**<0.001**	1.52
Matrix reasoning*	21.07 (2.50)	16.15 (4.70)	-4.807	**<0.001**	1.34
Beta – IQ	105.52 (11.48)	87.00 (11.82)	-5.980	**<0.001**	1.59

Note: HVOT= total scores in Hooper Visual Organization Test; CTT-A= completion time of Color Trails Test-A ; CTT-B= completion time of Color Trails Test-B; d2= d2 total score; HVLT= total scores in Hopkins Verbal Learning Test; RCFT-C = Complex Test and Figure Test and Recognition – copy: RCFT-DR = delayed recall; RCFT-IR = immediate recall; VFT = Verbal Fluency Test. RFFT = Ruff Figural Fluency Test; BDS= Backward Digit Span; IGT= total score in Iowa Gambling Task.= Beta subtests*

Which neuropsychological variables predict Beta III performance?

The results showed that the neuropsychological variables that predicted scores for the Beta III were dependent on the country of origin and were different for each subtest, except for subtest 4 (picture absurdities). The level of prediction for each variable was between 0.558 and 0.786 (see Table 4). For Beta III subtest 1 (coding), the performance on backward digit span was a predictor for the Moroccan group's score, $t = 3.93$, $p = 0.001$. However, none of the neuropsychological tests were predictive of the Spanish group's score.

Table 4. Regression models to analyze whether neuropsychological test results predict IQ scores based on the country of origin

Beta III subtests	Interaction			Spaniards			Moroccan		
	Variables	Adj. R^2	*P*	Variables	Adj. R^2	*P*	Variables	Adj. R^2	*P*
Coding	Country d2 BDS **Int_BDS**	.661	**<.001**				BDS	.357	**.001**
Picture Completion	Country CTT-A d2 HVOT **int_CTTA** **int_CTTB** **int_HVLT**	.664	**<.001**	CTTA HVLT	.525	**.001**	CTT-B	.315	**.014**
Clerical Checking	Country CTT-A d2 **int_CTT-B** **int_d2**	.558	**<.001**	CTTB	.204	**.016**	d2	.221	**.012**
Picture Absurdities	Educational Level HVOT	.532	**<.001**						
Matrix Reasoning	CTT-A d2 BDS IGT **int_CTT-A** **int_CTT-B** **int_BDS** **int_HVOT** **int_IGT**	.786	**<.001**	CTTA	.409	**.011**	CTT-B BDS IGT	.555	**.034** **.003** **.024**

Note. Adj. = Adjusted; d2= d2 total score; BDS= Backward Digit Span; int= interaction with country (i.e., int_BDS= interaction between country and BDS is significant); CTT-A= completion time of Color Trails Test-A; HVOT= total scores in Hooper Visual Organization Test; CTT-B= completion time of Color Trails Test-B; HVLT= Hopkins Verbal Learning Test; IGT= total score in Iowa Gambling Task.

For subtest 2 (picture completion), performances on the Color Trails Test-A, t = -2.54, p = 0.018, and Hopkins Verbal and Learning Test, t = 3.92, p = 0.001, were predictive for the Spanish group, whereas performance on the Color Trails Test (A and B) was the predictor for the Moroccan group, t = -2.65, p = 0.014.

For Beta III subtest 3 (clerical checking), the Color Trails Test (trail 2) performance was a predictor for the Spanish group, t = -2.60, p = 0.016, and d2 was the predictor for the Moroccan group, t = 2.70, p = 0.012.

Finally, the Color Trails Test (trail 1) performance was a subtest 5 predictor (matrix reasoning) of performance for the Spanish group, t = -2.79, p = 0.011; whereas performance on the Color Trails Test (trail 2), t = -2.27, p = 0.034, backwards digit span, t = 3.41, p = 0.003, and Iowa Gambling Task, t = 2.43, p = 0.024, were the three predictors of the matrix reasoning subtest for the Moroccan group.

3.4 Discussion

The present study aimed to explore differences between two different cultural groups (Spaniards and Moroccans) in non-verbal IQ (measured by the Beta III) and the cognitive skills used to perform this test for these two different cultures. The results showed significant differences between the Spanish and Moroccan groups for Beta III subtests and total IQ, as well as for all of the cognitive tests except for the Ruff Figural Fluency Test. The neuropsychological tests that predicted IQ were different for each cultural group.

Although the Spanish and Moroccan groups were similar in terms of age, sex, economic status and educational level, the cognitive performance of the Spaniards was better than that of the Moroccans. This is the first study that compares these groups on a comprehensive neuropsychological battery, and the results support the vast literature demonstrating cultural differences on cognitive tests (Agranovich et al., 2011, Bakos et al., 2010, Boone et al., 2007; Rosselli & Ardila 2003). Also, total IQ for the Spanish group was significantly higher compared with the Moroccan group. These results are consistent with previous literature to confirm the cultural difference in IQ. And agree with certain studies conducted in the Netherlands, where Moroccan immigrants generated a lower IQ than the Dutch (te Nijenhuis & van der Flier, 1997, 2001). Our results are also consistent with another study that used the Raven test (a non-verbal test) to compare Spaniards living in Spain with Moroccans living in Morocco (Díaz, Sellami, Infanzón, Lanzón, & Lynn, 2012). Also, similar to other studies (Ardila, 2005; Agranovich & Puente, 2007; Rosselli & Ardila, 2003), our results emphasize the notion that non-verbal tests are not necessarily free of cultural influence.

The performance on various neuropsychological tests predicted the performance on intelligence tests, which is consistent with the results of previous studies (Colom, et al., 2003; Diaz-Asper et al., 2004). However, the principal novelty for this study herein is that

the neuropsychological test performances that predict Beta III scores (except for picture absurdities) differed between the Spaniard and Moroccan groups. For the Moroccan group, the cognitive tasks that predict performance on Beta III are Backward Digit Span (working memory), Color Trail Test -B (shifting), d2 (attention), and Iowa Gambling Task (decision-making). In contrast, Color Trails Tests - A&B (motor coordination, shifting) and Hopkins Verbal Learning Test (verbal memory) predicted Beta III scores for the Spanish group. Those differences could be due to familiarity with psychological tests and timed testing (Agranovich, et al., 2011; Agranovich & Puente 2007; Ardila, 2005; Puente et al., 2013). Processing of novelty stimulus has been related with an increased cognitive control and activation of prefrontal cortex (Barcelo, Escera, Corral, & Periáñez, 2006; Kishiyama, Yonelinas & Knight, 2009; Løvstad et al., 2011). Thus, coping with unfamiliar task could require using more complex neuropsychological processes.

In our study, 80% of the Moroccan and 20% of the Spaniard participants never performed a psychological test, according to one of the questions included in the socio-demographic interview. This difference in familiarity may have impacted in the group performance (Díaz et al., 2012), so that Moroccans rely on more complex skills related to executive function compared with Spaniards to execute the same non-verbal intelligence task. This hypothesis is consistent with other studies that show differences in cognitive processes for Western and Eastern people (Nisbett & Masuda, 2003; Nisbett et al., 2001). This could be explored in future studies, including groups from different cultures with different ranks of familiarity with neuropsychological testing.

Among the limitations herein, the sample size is small, which may limit the data's statistical power and generalization. However, the Cohen's d showed moderate to large effect sizes. Another limitation is that we are comparing an immigrant group with a non-immigrant, but the two groups had similar educational and economic levels. In the future, it would be interesting to study the relationship between neuropsychological and intelligence test performances for people from different cultures who reside in their country of origin.

Despite the limitations, this study is one of the first to investigate the cognitive processes used to perform an intelligence test in two different cultures. Also, the groups studied here are under-represented in the cross-cultural neuropsychology research, mostly dominated by the various ethnic groups that co-exist in the United States; we believe that

studying other backgrounds will broaden our knowledge of the effect of culture on cognitive performance. In conclusion, besides showing the cultural effect on non-verbal intelligence test performance, our results suggest that a single test may measure different functions, depending on the subject's cultural background.

Capítulo 4

El papel de las habilidades de cálculo para explicar las diferencias culturales en el rendimiento neuropsicológico

4.1 Introduction

As previously mentioned in the theoretical part, different studies have emphasized the effect of cultural variables in neuropsychological performance. These differences have traditionally been explained by variables such as years of education, socioeconomic status, acculturation and quality of education. However, new cultural variables, such as calculation skills, have not been studied.

Calculation skill is a potential variable that could explain the cultural differences in neuropsychological test performance. Research suggests that there are differences in calculation skills between individuals from different cultures (Campbell & Gunter, 2002; Campbell & Xue, 2001; Carraher & Schliemann, 1988). In addition, neuroimaging studies have shown that different anatomical regions are involved in calculation depending on culture (e.g., Tang et al., 2006). However, the role of this variable to explain cultural differences in neuropsychological assessment has not yet been investigated. Campbell and Xue (2001) found that Chinese-Canadian university students and Chinese university students educated in Asia solve simple math problems better than Canadian students. However, in the case of complex mathematical problems, Chinese university students educated in Asia performed with better scores than the other two groups. In addition, other studies that use fMRI indicate evidence of cultural differences in brain structure activation between cultural groups in solving the same arithmetic operations (e.g., Tang et al., 2006). Moreover, calculation skills are correlated with academic performance (Rosselli, Ardila, Bateman & Guzman, 2001) and cognitive performance (Ardila, Galeano, & Rosselli, 1998). Calculation skills may therefore be another variable to explain cultural differences in neuropsychological tests.

In short, although the impact of variables such as gender, age, education level, language, acculturation, quality of education, and socioeconomic status have been tested on various neuropsychological tests before, the role of calculation skills has not. In the previous chapter, we demonstrated that the Spaniard group had significantly outperformed the Moroccan one in all of the neuropsychological tests (Fasfous, Hidalgo-Ruzzante, Vilar-López, Catena-Martínez & Pérez-García, 2013). Therefore, the aim of this study is to examine the role of calculation skills in explaining these differences. In this chapter we have included a Colombian group in addition to the Spaniard and Moroccan groups. A previous study has revealed significant cultural differences in neuropsychological test

performance between these groups (Hidalgo-Ruzzante, 2012). Considering the previous studies that demonstrate cultural differences in calculation skills, we hypothesize that calculation skills would explain differences in neuropsychological test performance between the three cultural groups of this study.

4.2 Method

4.2.1 Participants

A total of 81 participants (38 men and 43 women) from different countries of origin volunteered in the present study; two of the groups were composed of individuals who shared a language but not the same culture (Spanish: 27 Colombians and 27 Spaniards), and the third was composed of individuals whose backgrounds differed in both culture and language (Arabic: 27 Moroccans). Socio-demographic information of these groups is presented in table 1. The nationalities of these groups were selected because they are most representative of the population in Spain (National Institute of Statistics - Spain; 2011).

We considered two inclusion criteria: an age range between 18 and 55 years, and a sufficient level of Spanish comprehension to understand the instructions and tests. Spanish comprehension was assessed with *subtest 13, Passage Comprehension, of* the *Batería Woodcock-Muñoz Psicoeducativa en Español (Woodcock-Muñoz Psycho-Educational Survey in Spanish; Woodcock, 1982).* As exclusion criteria we considered the participants' previous history of mental disorders, neurological disorders and substance abuse.

4.2.2 Instruments

A structured interview was conducted to acquire data about socio-demographic and cultural variables.

Cultural variables:

Calculation Skills was assessed using the Calculation subtest from the *Batería Woodcock-Muñoz Psicoeducativa en Español (Woodcock, 1982).*

Acculturation was measured according to **Relational** Acculturation, which was assessed with questions such as, *"What is your best friend's nationality?" or "If you have a partner, what is his/her nationality?"*; **Language** Acculturation, which was assessed with questions such as, *"In general, what language do you speak and read?" or "In which*

language do you normally think?"; **Emigration** Acculturation, which was measured by the number of months the participants had resided in Spain.

***Occupational Social Class**:* Socioeconomic status, measured by a family's income level, is related to cultural differences in neuropsychological performance (e.g., Armengol, 2002). We have expanded on this measure by including an assessment of occupational social class (National Institute of Statistics, 1994). This measure is currently more accepted and is widely used in other fields such as public health (Marmot & Wilkinson, 1999; Regidor, 2006). Each participant's current class, class in his/her country of origin, and class of his/her father/mother were recorded. This taxonomy is based on the Goldthorpe class schema, which accounts for the set of tasks that constitute a job and includes aspects related to the ownership of the means of production, supervisory work, and skill level according to academic qualifications (Regidor, 2001).

IQ and Neuropsychological measurements

Beta III (Kellogg & Morton, 1999) is a non-verbal intelligence test that is used to estimate the IQ. Then, a comprehensive neuropsychological battery of tests was administered to all participants (see Fasfous et al., 2013). This battery measures: **Perception**: The *Hooper Visual Organization Test (HVOT*; Hooper, 1958; revised in 1983); **Visuo-Motor coordination**: The *Color Trails Test A (CTT-A*; D'Elia et al., 1996); **Attention:** Brickenkamp's *Test of Attention (d2)* (1962); ***Verbal Memory:*** The *Hopkins Verbal Learning Test (HVLT*; Benedict et al., 1998). The Spanish version of this test was published by Bilbao et al. (2007); ***Visual Memory***: The *Rey Complex Test and Figure Test and Recognition Trial (ROCFT;* Meyers & Meyers, 1995); ***Updating:*** The *Semantic Verbal Fluency* test (*SVF;* Valencia et al., 2000), The *Ruff Figural Fluency Test (RFFT*; Ruff, 1996) is a nonverbal fluency test, The *Backward Digit Span (WAIS-III*; Wechsler, 1999); ***Flexibility***: The *Color Trails Test B (CTT-B*; D'Elia et al., 1996); ***Decision-making***: The *Iowa Gambling Task (IGT*; Bechara et al., 1994).

4.2.3 Procedure

The assessment was conducted in Spanish, and the total duration of the evaluation was approximately two and a half hours per participant. This time included a 15-minutes break at the middle of the session, and an initial interview to collect socio-demographic information and to guarantee the inclusion/exclusion criteria.

The participants received verbal and written information about the study objectives and details, and were provided with informed consent to be included in the study. The present study was approved by Ethics Committee of the University of Granada. The volunteers received 20€ for participating in this study.

4.2.4 Statistical Analysis

An analysis of variance (ANOVA) and *t* test student were conducted on the quantitative variables of age and the number of months of residence in Spain. Chi-square tests were conducted on the qualitative variables of gender, income level, and education level to examine differences in these variables among groups.

Correlation analysis was used to determine which variables (occupational social class, acculturation, IQ, and calculation skills) are correlated with neuropsychological tests scores. Then, hierarchical multiple regression analyses were performed using the occupational social class, IQ and calculation skills as predictors in this order. The purpose of this regression analysis was to know if calculation skills could increase the explained variance after the other variables were entered in the model. When the change of variance was statistically significant, coefficients were included in the results.

To study the effect of calculation skills on test performance, a linear regression analysis was conducted using calculation skills as a predictor, and neuropsychological tests as dependent variables. Then, standardized residuals of the neuropsychological test scores were saved. Finally, differences between groups on the residuals were examined using ANOVAS.

4.3 Results

The results showed that there were no differences among the three groups (Spaniards, Colombians, and Moroccans) according to age, gender, educational level (years of schooling), source, use of new technology or monthly income (Table 5).

Table 5. Descriptive statistics and analysis for the different groups on the sociodemographic variables

	Spaniards (n=27)	Colombians (n=27)	Moroccan (n27)	F/χ^2	*p*
Sex				.694	0.707 (1)
-Male	48.1% (13)	40.7% (11)	48.1% (13)		
-Female	51.9% (14)	59.3% (16)	51.9% (14)		
Age (years)	25.63 (3.33)	29 (7.17)	27.77 (5.1)	2.120	0.127 (2)
Education				8.754	0.188 (1)
Elementary education	0% (0)	7.4% (2)	14.8% (4)		
Secondary education	11.1%(3)	22.2% (6)	7.4% (2)		
Undergraduate education	55.5% (15)	29.6% (8)	44.4% (12)		
Graduate education	33.4% (9)	40.7% (11)	33.4% (9)		
Income/ month				1.306	0.520 (1)
- Less than 360€					
- Between 361€-900€	48.1% (13)	57.7% (15)	41.7% (10)		
	51.9% (14)	42.3% (11)	58.3% (14)		
Source				4.829	0.089 (1)
Rural					
Urban	11.1% (3)	14.8% (4)	33.3% (9)		
	88.9% (24)	85.2% (23)	66.7% (18)		
Use of New Technology				0.588	0.745 (1)
Once a month	3.7% (1)	7.7% (2)	3.7% (1)		
Several times a month	96.3% (26)	92.3% (24)	96.3% (26)		

(1) *Chi-square test*
(2) *ANOVA (analysis of variance)*

Effects of cultural variables on neuropsychological performance

First, the correlation between variables (acculturation, occupational social class, IQ, and calculation skills) and the neuropsychological performance was examined. Results show that acculturation is the only variable that is not correlated with any neuropsychological test scores. For this reason, we decided not to include acculturation in the regression analysis as a predictor.

Second, the relationship between these variables and the cultural differences in neuropsychological performance was examined. Hierarchical multiple regression analyses were performed using occupational social class, IQ, and calculation skills as predictors and the scores from each neuropsychological test as the dependent variables. Results show that the general model was significant for all variables except for the immediate recall on the HVLT and ROCFT, and for the fruits variable of the verbal fluency test. Considering all

the significant models, *occupational social class did not predict any test scores.* IQ, not calculation skills, was a significant predictor for test scores in *visual memory (ROCFT delayed recall), visuomotor (CTT—A), flexibility (CTTT-B), decision-making (IGT), updating (VFT animals & Digit span) and perception (HVOT).* Calculation Skills and not IQ was the significant predictor for *test scores in motor ability (ROCFT copy) and* updating (Ruff Figural Fluency Test). Calculation skills significantly increase the explained variance of IQ for *test performance on attention (d2), verbal memory (HVLT delayed recall) and updating (Backwards digits)* (see table 6).

Finally, we studied the differences between groups when the effect of calculation skills (residuals) was controlled. Results show that differences among groups disappeared in visual memory (ROCFT-RI), attention (d2-hits & con) and decision-making (IGT). However, differences remained in the other variables.

Table 6. Effects of cultural variables and IQ on neuropsychological performance

Dependent Variable	Predictor Variable	*Corrected R2*	*P(model)*	*Beta*	*P*
HVOT- Total	Occupational Social Class	.229	<.001	-.034	.973
	IQ			.515	**<.001**
	Calculation Skills			-.016	.897
ROCFT- Copy	Occupational Social Class	.194	<.001	-.006	.957
	IQ			.182	.153
	Calculation Skills			.341	**.009**
ROCFT- IR	Occupational Social Class	.003	.361	-.103	.414
	IQ			.079	.576
	Calculation Skills			.071	.616
ROCFT- DR	Occupational Social Class	.225	. <.001	-.157	.157
	IQ			.376	**.003**
	Calculation Skills			.067	.595
HVLT-IR	Occupational Social Class	-.002	.425	-.074	.558
	IQ			.193	.174
	Calculation Skills			-.096	.502
HVLT-DR	Occupational Social Class	.200	<.001	.020	.856
	IQ			.268	**.036**
	Calculation Skills			.281	**.030**
HVLT-Total	Occupational Social Class	.085	.020	.018	.881
	IQ			.256	.061
	Calculation Skills			.137	.317
CTT-A	Occupational Social Class	.121	.005	.059	.619
	IQ			-.339	**.012**
	Calculation Skills			-.042	.753
D2 Hits	Occupational Social Class	.328	<.001	.011	.102
	IQ			.426	**<.001**
	Calculation Skills			.240	**.043**
D2 Con	Occupational Social Class	.331	<.001	.020	.849
	IQ			.437	**<.001**
	Calculation Skills			.236	**.046**
RFFT	Occupational Social Class	.226	<.001	-.076	.490
	IQ			.233	.063

	Calculation Skills			.290	**.023**
VFT-Animals	Occupational Social Class	.098	0.015	.100	.419
	IQ			.334	**.019**
	Calculation Skills			.090	.535
VFT- Fruits	Occupational Social Class	.042	.370	-.011	.931
	IQ			.254	.087
	Calculation Skills			-.128	.398
Digit Span	Occupational Social Class	.272	<.001	-.023	.829
	IQ			.373	**.003**
	Calculation Skills			.225	.067
CTT-B	Occupational Social Class	.267	.<.001	-.042	.694
	IQ			-.459	**<.001**
	Calculation Skills			-.150	.222
IGT	Occupational Social Class	.224	<.001	.153	.183
	IQ			.435	**.001**
	Calculation Skills			.173	.180

NOTE: ROCFT= RO Complex Figure Test, CTT= Color Trails Test, RFFT= Ruff Figural Fluency Test, VFT= Verbal Fluency Test , d2= d2 Test of Attention, HVLT= Hopkins Verbal Learning Test, HVOT= Hooper Visual Organization Test, IGT= Iowa Gambling Test, DR=Delayed Recall, CON= Concentration Index, IR= Immediate Recall, E= Errors.

4.4 Discussion

Our results have demonstrated that IQ and calculation skills are independent and related predictors for the cultural differences in neuropsychological performance. Although study groups were matched for age, gender, educational level and socioeconomic status, differences in neuropsychological performance between groups were quite clear (Agranovich et al., 2011; Ardila & Moreno, 2001; Baird et al., 2007; Byrd et al., 2004; Ramírez et al., 2005). This study addresses issues that have been rarely considered in previous studies. First, we focused on participants who had a medium-high degree of education instead of those with a low level of education. Second, many prior studies were limited because they only examined specific neuropsychological areas (Byrd et al., 2004; Ostrosky-Solís & Lozano 2006; Ramírez et al., 2005), and they did not study neuropsychological performance exhaustively using a complete battery of tests. Third, we have included new cultural groups who are seldom studied, such as Spaniards, Colombians, and Moroccans.

In our study, calculation skills have played an important role in predicting the neuropsychological tests scores for the three cultural groups, and it accounted for neuropsychological differences between these groups. Despite the fact that cultural differences in neuropsychological performance have been explained by variables such as education level, socioeconomic status, and acculturation (e.g, Byrd et al., 2005; Manly et al., 2002), calculation skills have not been considered. When comparing calculation skills with the traditional variables (acculturation, occupational social class, and IQ), calculation

skills was a predictor of neuropsychological performance between the different cultural groups in this study. This may be due to the relation between calculation skills and neuropsychological abilities. Solving calculation problems requires abilities such as working memory (Raghubar, Barnes, & Hecht, 2010), spatial organization (Gunderson, Ramírez, Beilock, & Levine, 2012) and processing speed (Swanson & Beebe-Frankenberger, 2004). However, calculation skills in different cultures differ depending on the educational system (Tang et al., 2006) or culture-specific variables (Cambell & Xue, 2001; Ng & Rao, 2010). Subsequent research is needed to understand these variables.

Considering the aforementioned findings, future studies should consider assessing calculation skills when comparing the quality of education of different countries. Recent research has found that cultural differences in neuropsychological performance of minority groups are related to quality of education in the United States (Kennepohl et al., 2004; Manly et al., 2002). These studies utilized the reading ability test, which is an appropriate measure for quality of education for individuals from the same country, with the same educational system and language. In order to study the cultural differences in neuropsychological performance among people from different countries who speak different languages, we hypothesize that calculation skills could be used to measure the quality of education. In fact, the Program for International Student Assessment (PISA) uses calculation skills as an index to compare the educational systems of over 70 countries around the world (Organisation for Economic Co-operation and Development, 2010).

The present study has some limitations. The sample was relatively small because of its special characteristics and the long duration of assessment (about 3 hours). Furthermore, all included participants of this study were healthy; it would be useful to study the cultural differences in clinical samples. Future studies with large sample sizes, and participants of different educational levels, socioeconomic status, and cultures could be helpful in understanding the cultural differences in neuropsychological performance. Finally, in order to examine the ability of calculation skills to measure the quality of education, it would be interesting to study the correlation between calculation skills and reading ability of individuals in the same culture.

In summary, this chapter emphasizes the effect of cultural variables on neuropsychological tests performance, and reveals the impact of calculation skill on neuropsychological assessment. Therefore, calculation skills could be considered as a

measure of quality of education and should be considered when studying cultural differences in neuropsychological performance among individuals from different cultures and languages.

Capítulo 5

¿Es el *Color Trails Test* una prueba libre de cultura?

Un estudio en niños/as de Marruecos

Fasfous, A. F., Puente, A. E., Pérez-Marfil, M. N., Cruz-Quintana, F., Peralta-Ramírez, M. I., & Pérez-García, M. (2013). Is the Color Trails Culture Free? *Archives of Clinical Neuropsychology*, 28(7), 743-749.

5.1 Introduction

Culture is a critical issue in neuropsychological assessment, and a number of studies have emphasized the significant effect of culture on neuropsychological assessment (Agranovich et al., 2011; Ardila, 1995, 2005; Greenfield, 1997; Jacobs et al., 1997; Ostrosky-Solís, Ramírez, Lozano, Picasso & Vélez, 2004; Puente & Ardila, 2000). Trying to address this influence, several neuropsychological tests have been developed under the label of "culture fair." However, most of these tests have only been tested in Anglo-Saxon or Hispanic samples of adults. For this reason, the main objective of this paper is to examine if the Children's Color Trails Test could be considered as a culture fair test using an Arabic children sample.

Two types of tests can be used in cross-cultural studies - the Culture Free Test and the Culture Specific Test. In this study, we utilized the Children´s version of the Color Trails Test (CTT: D'Elia et al., 1996), which is presented as a culture free version of the Trail Making Test (TMT A&B: Reitan, 1979). The TMT is one of the most often used neuropsychological tests in the United States (Rabin, Barr, & Burton, 2005) and is sensitive to cognitive impairment (Lezak, 1995; Mitrushina, Boone, & D'Elia, 1999; Reitan, 1979). Research has suggested that culture and language may have an effect on the TMT and the Children´s TMT (Reitan, 1971), perhaps due to the usage of the English alphabetic letters (Dugbartey, Townes, & Mahurin, 2000; Lee, Cheung, Chan &Chan, 2000; Leon-Carrion, 1989; Mok, Tsang, Lee, & Llorente 2008; Rosin & Levet, 1989). However, in a study using an Arabic Version of the Expanded Trail Making Test to compare healthy and brain damaged adults from Sudan with healthy and brain damaged adults from the United States, researchers found that the healthy Sudanese group scored similar to the North American brain damaged group (Stanczak et al., 2001).

The CTT was developed to reduce the effect of the language and culture on the TMT by using numbers and colors instead of numbers and alphabetic letters (D'Elia et al., 1996). The Children's Color Trails Test (CCTT: Llorente et al., 2003) is a special version for children that is similar to the children´s TMT. The CCTT is functionally equivalent to the children´s TMT in distinguishing the difference between normal children and children with cognitive impairment in different countries, such as Korea (Koo & Shin, 2008) and the United States (Llorente et al., 2003; Williams et al., 1995). The validity and reliability

for the CCTT have been reported in different studies (Koo & Shin, 2008; Llorente et al., 2009; Wiliiams, 1995).

Literature suggests that multiple variables such as age, gender, and IQ could have an impact on CCTT scores. Several studies show evidence that age is highly correlated with better performance on the CCTT (Koo & Shin, 2008; Llorente et al., 2003; Williams et al., 1995), while gender appears to have a smaller effect. Although Williams and colleagues (1995) found that girls were faster than boys in completing the CCTT2 and Llorente and colleagues (2003) found girls were faster in the CCTT1, more recent research has found no significant gender differences in CCTT scores (Mok et al., 2008). Another variable that seems to have an effect on CCTT performance is IQ, in that children with higher IQs tend to be able to complete the CCTT more quickly (Mok et al., 2008; Williams et al., 1995). Recently, in a study conducted among Chinese children from Hong Kong, Mok and colleagues (2008) found that the CCTT was influenced by children's language backgrounds, in that children with Chinese as their dominant language tended to perform better than both English-Chinese bilinguals and children with English as their dominant language.

Although the CCTT is widely used in neuropsychological assessment (Mok et al., 2008; Strauss, Sherman, & Spreen, 2006), only two cross-cultural studies to our knowledge have examined the effect of culture on the CCTT (Koo & Shin, 2008; Mok et al., 2008). While normative data for the CCTT are provided for North American (Llorente et al., 2003) and Korean children (Koo & Shin, 2008), normative data and cross-cultural studies using the CCTT are not available in the Arab world.

The Arab world consists of 22 countries with more than 350 million inhabitants (Mirkin, 2010). Clinical neuropsychology is not developed in these countries, and few studies have examined the effect of the Arab culture on neuropsychological test in children (Sobeh & Spijkers, 2013) and adults (El-Sheikh, El-Nagdy, Townes & Kennedy, 1987; Khalil, 2010; Stanczak et al., 2001). The aim of this study was to obtain preliminary CCTT data for Moroccan Arab children, and also to examine the effect of culture on CCTT performance. We hypothesized that the results of normal Moroccan children ages 7, 9 and 11 will be different from those presented in the manual.

5.2 Method

5.2.1 Participants

Participants included a total of 154 school-aged children (76 boys and 78 girls) ages 7, 9 and 11 and from different grade levels were recruited from schools belonging to two different areas in the province of Chefchaouen. The children in the first group were recruited from a school located in the downtown area of Chefchaouen. This group consisted of 78 children (39 boys and 39 girls), including 26 second graders (13 boys and 13 girls), 26 fourth graders (13 boys and 13 girls), and 26 sixth graders (13boys and 13 girls). The children in the second group were recruited from a school located in the outskirts of Chefchaouen. This group consisted of 76 children (37 boys and 39 girls), including 24 second graders (11 boys and 13 girls), 26 fourth graders (13 boys and 13 girls), and 26 sixth graders (13boys and 13 girls). According to teachers and parents interviews, all participants were free from any medical problems.

Approval was obtained from the Ethical Committee of the University of Granada (Spain) to conduct the study, and permission from the Delegation of Education in the province of Chefchaouen (Morocco) was obtained to conduct this study in the aforementioned schools. Informed consent was then obtained from a parent of each of the participants.

5.2.2 Instrument

Children's Color Trails Test (CCTT: Llorente et al., 2003): The CCTT measures speed of visual attention, sequencing, mental flexibility, and motor function among children ages 8 to 16. This test consists of two parts - Parts 1 (CCTT1) and 2 (CCTT2). Part 1 (CCTT1) is comprised of a page with 15 randomly arranged numbered and colored circles, with the even numbers printed in yellow circles and the odd numbers printed pink circles. The child uses a pencil to rapidly connect circles numbered 1 through 15 in sequence. Part 2 (CCTT2) is comprised of a series of colored circles, also numbered 1 to 15. Each number (from 2 to 15) is presented twice - once in a pink circle and once in a yellow circle. The child rapidly connects the numbered circles in sequence, alternating between pink and yellow circles. The examiner records the time needed to complete each trial and all errors committed. In this study, completion time for each trial and the interference score (CCTT1 – CCTT2 / CCTT1) were used as variables for analysis.

5.2.3 Procedure

Initially, the senior author met with the directors of the respective schools to explain the objective and the process of the study. This meeting, as well as all other aspects of the research conducted in Morocco, was done so in Arabic (the native language of the senior author). Each of the schools' directors verbally agreed (as is the custom) to allow their students to participate in the study. An empty classroom was provided in each school to conduct the study. Participants were then randomly selected from each school's list of students and assent to participate in the study was obtained from each participant (also, the custom). The CCTT was subsequently individually administered to the participants during the academic day. The CCTT was administrated according to the administration guidelines provided by the manual of the CCTT (Llorente et al., 2003). Completion time for each trial was recorded.

5.2.4 Statistical analysis

Descriptive statistics regarding performance according to age, gender, and location (school) were initially obtained. Student´s t test was then used to study gender differences, and a one-way ANOVA was used to study age differences. Finally, eight estimated *t* tests were conducted using the GraphPad software to test differences in CCTT performance between Moroccan and North American children (Llorente et al., 2003) according to age and gender.

5.3 Results

Descriptive data from the two forms of the CCTT

Means and standard deviations for CCTT1 and CCTT2 completion time and the interference score were calculated according to age and gender (see Table 7).

Table 7. Means and standard deviations of CCTT variables by age and gender

Age (years)	*N*		Time completion CCT1				Time completion CCT2				Interference			
	Boys	Girls	Boys		Girls		Boys		Girls		Boys		Girls	
			M	(SD)	M	(SD)	M	(SD)	M	(SD)	M	(SD)	M	(SD)
7	24	26	82.9	(30.19)	78.67	(29.17)	137.87	(54.40)	134.56	(47.50)	.81	(.76)	.83	(.75)
9	26	26	59.98	(26.03)	54.03	(18.79)	90.99	(30.73)	87.11	(28.61)	.64	(.50)	.70	(.52)
11	26	26	45.07	(16.19)	36.75	(12.40)	73.33	(17.11)	58.54	(18.19)	.77	(.61)	.68	(.49)

Gender differences

Student´s *t* test was used to examine gender differences in CCTT performance. There was no statistically significant effect of gender on CCT completion time variables. Similarly, no gender differences were found in the interference index.

Age differences

A one-way ANOVA was used to evaluate differences in CCTT performance according to age. Results indicated a statistically significant influence of age on the completion time of both the CCTT1 [F (2,151) = 38.52, p< .001] and CCTT2 [F (2,151) = 52.42, p< .001]. No statistically significant age differences were found in the interference index [F (2,151) = 0.78, p< 0.461]. A posteriori comparisons (Bonferroni) indicated that children aged 11 faster than children ages 9 and 7 in time completion for both CCTT trials, and no statistically significant differences were found between children aged 9 and 7 years (see Table 8).

Table 8. Results of a one-way ANOVA evaluating age differences in CCTT performance.

Variables	7 years Mean (SD)	9 years Mean (SD)	11 years Mean (SD)	*F*	*P*
CCTT 1	80.72 (29.44)	57.01 (22.68)	40.91 (14.89)	38.52	**<.001**
CCTT 2	136.15 (50.43)	89.05 (29.46)	65.94 (19.01)	52.42	**<.001**
Interference	0.82 (0.75)	0.67 (0.51)	0.72 (0.55)	0.78	.461

Geographical differences

Student's t test was performed to evaluate differences in CCTT performance according to geographical location. Results indicated no significant differences between

children from the downtown area and children from the border area in CCTT1 completion time, CCTT2 completion time, or in the interference score.

Cultural differences

To examine the effect of culture on CCTT performance, the Moroccan data obtained in the present study were compared to the North American data provided in the CCTT manual (Llorente et al., 2003). Results indicated significant differences between groups, in that the American children were much faster than the Moroccan children in completing both trials of the CCTT (see Table 9).

Table 9. Differences between North American children and Moroccan children in CCTT time to completion.

	CCTT1					
	American Boys	Moroccan Boys		American Girls	Morocca-n Girls	
Age	M (SD)	M (SD)	*P*	M (SD)	M (SD)	*P*
9	24.42 (11.70)	59.98 (26.03)	**<.001**	22.38 (11.70)	54.03 (18.79)	**<.001**
11	21.41 (8.42)	45.07 (16.19)	**<.001**	15.82 (5.05)	36.75 (12.40)	**<.001**
	CCTT2					
	American Boys	Moroccan Boys		American Girls	Moroccan Girls	
Age	M (SD)	M (SD)	*P*	M (SD)	M (SD)	*P*
9	52.80 (18.90)	90.99 (30.73	**<.001**	51.95 (21.13)	87.11 (28.61)	**<.001**
11	49.27 (19.57)	73.33 (17.11)	**<.001**	35.82 (13.42)	58.54 (18.19)	**<.001**

5.4 Discussion

Normative data for psychological and neuropsychological tests are necessary for appropriate assessment and interpretation. The aim of the present study was to obtain preliminary CCTT data for Arabic children, and also to examine the effect of culture on CCTT test scores. Results indicated that age has a potential effect on completion time for the two trials of the CCTT. No gender differences were found between boys and girls, or between the two geographical areas identified in the CCTT performance.

Despite the Children´s Color Trails Test being presented as a culture free-test by its authors, results indicated that completion times of the CCTT1 and CCTT2 for Moroccan children were higher than those provided in the professional manual for North American children (LLorente et al., 2003). In other words, Moroccan children were significantly slower than North American children in completing the two CCTT trials. In applying the North American norms to the Moroccan children (controlling for age, education level and gender), we found all Moroccan children to be in the clinically impaired range; similar

results were found when comparing the normally developing Moroccan children with North American children who have learning disabilities, mild neurological conditions, or learning disabilities with attention deficits (LLorente el al., 2003; Williams et al., 1995). These findings are consistent with those of Stanczak and colleagues (2001), who found that normal Sudanese adults perform similar to North American patients with brain damage on the Expanded Trail Making Test. The significant difference in CCTT performance between Moroccan and North American children as demonstrated in the present study may be due to the effect of cultural factors on cognitive functions; in other words, the test itself may not be truly "culture-free". Differences in the degree of importance placed on time in the Moroccan and North American cultures may have also impacted these differences in performance, particularly given that the CCTT is a timed test. In other words, American children may be more exposed to living with time constraints in their culture as compared to Arab children, who may not have received such exposure. Additionally, the educational system in Morocco is generally more flexible with time than is the American educational system. For example, Moroccan teachers design the day's schedule according to the ability of children in understanding the subjects; also, more time is often given to Moroccan children during their exams. Furthermore, the American culture may be more competitive in nature than the Arab culture. This may be the case in other cultures as well. A study conducted by Agranovich and Puente (2007) suggested that American adults performed better than Russian adults on the CCT and other timed tests due to the familiarity of the American participants with timed testing procedures. Another factor which may impact cultural differences may be familiarity with standardized testing and/or with this type of test. In fact, most of the children who participated in this study have not been exposed to testing. Some research has in fact indicated that familiarity with tests could be a cultural factor that has an effect on neuropsychological test performance (Ardila, 2005; Puente & Pérez-García, 2000).

Age had a significant effect on CCTT performance in the present study, as older age was associated with faster CCTT1 and CCTT2 completion time. This is most likely a result of the normal neurodevelopment in these children, particularly given that this finding is consistent with results from studies in the normative sample as well as in with other cultures (Koo & Shin, 2008; Llorente et al., 2003; Williams et al., 1995). While previous research has suggested a small effect of gender on CCTT performance (Llorente et al., 2003; Williams et al., 1995), our results did not find any such differences to be statistically

significant. This is in contrast with findings reported by Llorente and colleagues (2003), who found that girls complete the CCTT1 more quickly than boys, and also in contrast with those of Williams and colleagues (1995), who found that girls were faster than boys in completing the CCTT2. However, our results are in agreement with those of Mok and colleagues (2008), who found that the CCTT is not influenced by gender.

Finally, it is important to consider that in some variables the magnitude of the differences between the two groups is double. Although there are few studies about cultural differences among children, other studies revealed similar differences to the present results in Children´s TMT (Leon-Carrion, 1989) and other nonverbal tests (Rosselli & Ardila, 2003). Furthermore, differences between groups should consider standard deviations. Previous research has demonstrated that standard deviations in nonverbal tests are different across groups from different cultures (Rosselli & Ardila, 2003). For example, if the standard deviation of the Moroccans group in the CCTT1 is used, 9 years old Moroccans children scored 1.36 standard deviations less than the US sample. At the same time, when using the standard deviation of American children, Moroccan group scored 3.03 standard deviations less than the US one. We hypothesize that cultural differences may be more robust in children than in adults. This could be because education can reduce such differences (Ardila, Ostrosky-Solís, Rosselli, & Gómez, 2000) or that the interface between culture and development make differences more likely. This effect can also be seen in the present results. Differences in 11 years old Moroccan and American children are lower than those in 9 years old groups.

The present study does have several limitations. First, the sample was collected only from the city of Chefchaouen, which is located in northern of Morocco and is generally considered a rural area. The generalizability of these findings to urban children or those living in other areas of the Arab world is not known. Secondly, variables such a socio-economic status and IQ that could conceivably affect CCTT performance were not measured or controlled for in the present study. Finally, this study was conducted among healthy children and does not include a clinical sample.

Nevertheless, this study is the first of its kind to provide data regarding CCTT performance in Moroccan Arab children. Our results do suggest that cultural factors have an effect on CCTT performance, thus highlighting the need for further development of the CCTT before it is be considered to be truly culture-free test. These findings also emphasize

the need to consider culture-specific tests in clinical neuropsychology. Finally, this study further supports the need to consider culture as important as other demographic variables, such as age and education, in neuropsychological assessment.

Capítulo 6

Diferencias culturales en el neurodesarrollo de niños/as marroquíes y ecuatorianos/as

6.1 Introducción

A pesar de que la relación entre las variables culturales y el rendimiento neuropsicológico en adultos ha recibido mucha atención (p.e., Agranovich y cols., 2011; Agranovich y Puente, 2007; Boone y cols., 2007; Cofffey y cols., 2005; Manly y cols., 2002; Ostrosky-Solís, Ramírez y Ardila, 2004; Razani, Murcia, Tabares y Wong, 2007), los estudios transculturales en la neuropsicología infantil son escasos (p.e., Kail, McBride-Chang, Ferrer, Cho y Shu, 2013; Levav, Mirsky , French y Bartko, 1998; Rosselli y cols., 2001).

En una revisión teórica sobre el estado de la evolución neuropsicológica en niños/as de diferentes grupos culturales (Byrd, Arentoft, Scheiner, Westerveld y Baron, 2008), los autores han encontraron solo diez estudios que trataron este tema desde el 2003 hasta el 2008. De estos, la mitad han sido realizados Estados Unidos. De entre los pocos estudios realizados en el campo de la neuropsicología transcultural, varios estudios mostraron diferencia en el rendimiento neuropsicológico entre niños/as pertenecientes a minorías y niños/as de grupos mayoritarios del mismo país (Llorente, Turich, y Lawrence, 2004; Mezzacappa, 2004; Restrepo y cols., 2006) o entre niños/as de diferentes países y diferentes culturas (Demetriou y cols., 2005; Sobeh y Spijkers, 2013; Shebani y cols., 2008). Los/as niños/as árabes en comparación con niños/as de otras cultural suelen tener puntaciones más bajas en las pruebas neuropsicológicas (Josman y cols., 2006, 2010, 2011; Shebani y cols., 2008; Sobeh y Spijkers, 2013). En un estudio comparando niños/as alemanes/as y sirios/as, los/as niños/as alemanes/as superaron los/as niños/as sirios/as en la mayoría de la pruebas de atención (Sobeh y Spijkers, 2013), mientras que en otro estudio, los niños Israelís rendían mejor que los/as niños/as palestinos en pruebas de percepción visual, psicomotora y razonamiento (Josman y cols., 2006, 2010, 2011). En estos estudios las pruebas utilizadas han sido desarrolladas en Alemania e Israel y administrada a los/as niños/as árabes sin validación. En realidad, utilizar pruebas válidas y fiables es el primer paso de comparar las diferencias culturales en el rendimiento neuropsicológico (Byrd y cols., 2008).

Además de estudiar las diferencias en las puntaciones obtenidas en las pruebas neuropsicológicas entre los/as niños/as de diferentes países creemos que puede ser interesante estudiar el efecto de la cultura en el desarrollo de las funciones

neuropsicológicas. En otras palabras, estudiar las diferencias culturales en las curvas de neurodesarrollo en el rendimiento de las pruebas neuropsicológicas.

En resumen, las diferencias culturales en la ejecución neuropsicológica han sido estudiadas en adultos más que en niños/as. Hasta donde sabemos, para población árabe, solo un estudio ha investigado las diferencias culturales en las curvas del desarrollo de funciones neuropsicológicas (Sobeh y Spijkers, 2013) y en este estudio la batería utilizada no ha sido válida para población árabe. Por tanto el objetivo de este trabajo es estudiar las diferencias culturales entre niños/as marroquíes y niños/as ecuatorianos/as en el rendimiento neuropsicológico y examinar el efecto de la cultura en el desarrollo de las funciones neuropsicológicas utilizando una batería valida y fiable en las dos culturas.

6.2 Metodología

6.2.1 Participantes

En este estudio han participado 332 niños/as (media de edad= 9.16; DT: 1.63) de Marruecos y Ecuador. El grupo marroquí está compuesto de 198 niños/as (98 niños y 100 niñas) de la cuidad de Chefchaouen divididos en 3 grupos de edades: 51 niños/as de 7 años (25 niños y 26 niñas del segundo grado); 63 niños/as de 9 años (30 niños y 33 niñas del cuarto grado) y 84 niños/as de 11 años (43 niños y 41 niñas del sexto grado). Por otro lado, el grupo ecuatoriano está compuesto por 134 niños/as ecuatorianos/as (67 niños y 67 niñas) de la ciudad de Guayaquil divididos en 3 grupos de edades: 45 niños/as de 7 años (23 niños y 22 niñas del segundo grado), 45 niños/as de 9 años (22 niños y 23 niñas del cuarto grado) y 44 niño/as de 11 años (22 niños y 22 niñas del sexto grado). Todos los participantes de este estudio eran niños/as normales sin problemas médicos o neurólogos y han participado voluntariamente después de obtener el permiso de los padres.

6.2.2 Instrumentos

La Batería de Evaluación Neuropsicológica Computarizada Infantil (BENCI; Cruz-Quintana y cols., 2013) ha sido administrada para evaluar el neurodesarrollo de los/as niños/as marroquíes y ecuatorianos/as. En ese trabajo hemos utilizado dos versiones de la Batería BENCI: la versión española para evaluar los/as niños/as ecuatorianos/as y la versión árabe para evaluar los/as niños/as marroquí. Estas dos versión han demostrado buena validez y fiabilidad tanto en población ecuatoriana (Cruz-Quintana y cols., 2013) como en población marroquí (Fasfous y cols., en revisión). La BENCI se administra con

ordenador pero no requiere conocimientos previos de informática para realizarla. Once de las 14 pruebas de la batería BENCI han sido utilizadas en este estudio. Estas pruebas son las siguientes:

Comprensión verbal: seguir instrucciones en relación a las imágenes presentadas en la pantalla.

Memoria verbal: recordar de modo inmediato tres veces una lista de palabras, luego con una demora de 20 minutos y luego, en reconocimiento.

Memoria visual: recordar una serie de imágenes de modo inmediato, de modo demorado a los 20 minutos y en reconocimiento.

Memoria de trabajo: recordar secuencias de colores y números.

Fluidez semántica: decir en un minuto tantos animales como conozca.

Fluidez fonética: decir en un minuto tantas palabras como pueda que empiecen con una letra.

Razonamiento: realizar series lógicas.

Stroop espacial: comprobar la diferencia entre ensayos congruentes (pulsar con la mano derecha cuando la una flecha aparece en la parte derecha de la pantalla y con la izquierda cuando aparece en la izquierda) o incongruentes (pulsar con la mano derecha cuando aparece en la izquierda o viceversa).

Coste de cambio: comparar la diferencia en tiempo de reacción entre repetir el mismo ensayo o cambiar el tipo de ensayo.

Tiempo de reacción simple: tiempo de reacción ante el mismo estímulo que aparece en el centro de la pantalla.

Go/ No-Go: tarea en la cual el/la niño/a tiene que pulsar ante un estímulo A pero no pulsar ante otro B en la mitad de los ensayos y después de un sonido, dejar de pulsar al A y pulsar al B.

Planificación: el/la niño/a tiene que elegir en un tiempo limitado y con una limitada cantidad de dinero en cuantas atracciones de un parque de atracciones se puede subir.

6.2.3 Procedimiento

Este estudio ha sido parte de dos proyectos internacionales realizados al mismo tiempo para evaluar el neurodesarrollo de los/as niños/as escolares en Ecuador y Marruecos. Los dos proyectos contaban con los preceptivos permisos de la comisión ética de investigación en la Universidad de Granada - España. Después, hemos conseguido los permisos de las autoridades locales de las dos ciudades de este estudio. Por último, también se obtuvo el permiso de los directores de colegios y el de los padres de niños/as seleccionado al azar para participar en nuestro estudio.

Todas las evaluaciones han sido realizadas de manera individual durante el día académico y en aulas proporcionadas por los directores de los colegios. Las sesiones duraban entre 60 y 80 minutos con 10 minutos de descanso.

6.2.4 Análisis estadísticos

En primer lugar para comprobar si los/as niños/as marroquíes y los/as niños/as ecuatorianos/as estaban igualados en las principales variables sociodemográficas se llevaron a cabo *t* de *Student* donde la variable independiente tenía dos niveles (niños/as marroquíes y niños/as ecuatorianos/as) y la variable dependiente fueron edad, numero de hermanos, horas de sueño y estatus socioeconómico (una combinación de trabajo de padres y nivel educativo de padres). Para ver si estaban igualados en sexo se realizó un análisis de *Chi-cuadrado*. Ambos grupos estaban igualados en las principales variables sociodemográficas menos en el estatus socioeconómico. Para controlar esto se realizaron regresiones lineales de dicha variable sobre las variables neuropsicológicas y se guardaron los residuos estandarizados. Los siguientes análisis estadísticos se realizaron con dichos residuos.

Para comprobar si existían diferencias entre ambos grupos se llevaron a cabo diferentes ANOVAs factoriales 2x3, teniendo la variable país dos niveles (marroquíes y ecuatorianos) y la variable edad tres niveles (7, 9 y 11) y las variables dependientes fueron las puntuaciones en diferentes variables neuropsicológicas.

Para aquellas tareas neuropsicológicas que tenían varios tipos de ensayos como Stroop Espacial, costo del cambio o *Go/ No-Go* se realizaron análisis ANOVAS factoriales mixtos de medidas repetidas (2x3xtipo de ensayo) teniendo el Stroop espacial dos ensayos

(congruentes versus incongruentes), costo del cambio 3 ensayos (cambio, 1ªrepetición y 2ª repetición) y para *Go/ No-Go* dos ensayos (bloque precambio y bloque postcambio).

Para aquellas variables en las que se encontraron diferencias entre países o efecto de la interacción, se realizaron análisis a posteriori entre grupos para cada variables neuropsicológicas en cada una de las tres edades estudiadas.

6.3 Resultados

Diferencias entre países en las variables sociodemográficas.

La realización de diferente *t* de *Student* muestra que ambos grupos, ecuatorianos y marroquíes, estaban igualados en las principales variables sociodemográficas como edad, número de hermanos y horas de sueño. Sin embargo, se encentraron diferencias estadísticamente significativas en el nivel socioeconómico de los padres ($t=16,63$; $p<0,0001$) siento de mayor nivel socioeconómico los padres de los/as niños/as ecuatorianos (16,93) que los padres de los/as niños/as marroquíes (años de escolaridad = 9.4). El análisis de *Chi-cuadrado* mostró que ambos grupos estaban igualados en la variable sexo. Edad y nivel educativo.

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En la tabla 10 se pueden comprobar las variables en las que se encuentran efectos significativos entre los factores edad, país, ensayos o interacción entre dichos factores. También se muestran las diferencias entre grupos por edades en aquellas variables en las que se encontró interacción.

En segundo lugar, también se encontró un efecto principal de la variable país (diferencias entre los/as niños/as de los dos países, sin considerar la edad) en memoria visual recuerdo demorado [$F(1,209)=4,61$; $p<0,033$] y fluidez categórica [$F(1,207)=5,38$; $p<0,021$]. En estas variables, los/as niños/as ecuatorianos puntuaron mejor que los/as niños/as marroquís.

Por último, encontramos efecto de la interacción ensayo, país y edad en las variables memoria verbal [$F(1,283)=4,17$; $p<0,001$] y costo del cambio [$F(1,283)=5,14$; $p<0,001$]. Para la tarea de memoria verbal, el análisis de interacción mostró que los/as niños/as marroquís puntuaban más que los/as niños/as ecuatorianos/as a los 9 años y a los 11 años. En concreto, encontramos diferencias significativas entre ambos grupos a los 9 años en el

primer ensayo [F(1,67)=22,71; p<0,0001] segundo ensayo [F(1,67)=24,88; p<0,0001] tercer ensayo [F(1,67)=14,37; p<0,0001] y cuarto ensayo [F(1,67)=12,64; p<0,001] esto se repite a los 11 años donde encontramos diferencias en el primer ensayo [F(1,70)=75,54; p<0,0001] segundo ensayo [F(1,70)=53,31; p<0,0001] tercer ensayo [F(1,70)=37,13; p<0,0001] y cuarto ensayo [F(1,70)=6,46; p<0,013]. En la tarea de cambio, los análisis mostraron que en los/as niños/as ecuatorianos/as aparecía un efecto del costo del cambio en las tres edades (ver figura 1) pero en los/as niños/as marroquís, no apareció dicho efecto del cambio ni a los 9 ni a los 11 años (ver figura 1). De este modo se encontraron diferencias significativas entre los niños/as ecuatorianos/as y marroquíes de 7 años en la tarea de cambio [F(1,67)=83,88; p<0,0001] en las 1ª repetición [F(1,67)=37,95; p<0,0001] y en la 2ª repetición [F(1,67)=28,96; p<0,0001], en los 9 años se encuentran diferencias entre ambos países en la tarea de cambio, solo en la 1ª repetición [F(1,70)=19,97; p<0,0001] y en la 2ª repetición [F(1,70)=24,40; p<0,0001] y por último a los 11 años no se encuentran diferencias entre los dos países.

No encontramos ningún efecto significativo ni de edad, país e interacción en las variables *Go/ No-Go* y el *Stroop*.

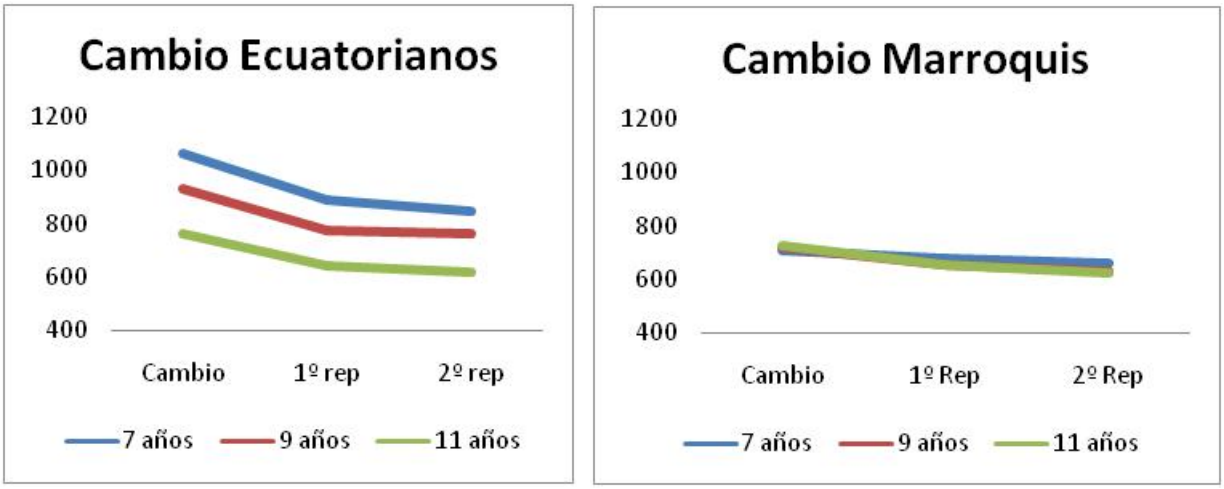


Figura 1: el efecto de cambio (milisegundo) en la prueba de Stroop espacial en niños/as ecuatorianos/as y marroquís.

Tabla 10. Diferencias en neurodesarrollo entre niños/as ecuatorianos/as y marruecos

Variables	Ecuatorianos/as			Marroquíes			Efectos significativos	Entregrupos
	7 años M (D.T)	9 años M (D.T)	11 años M (D.T)	7 años M (D.T)	9 años M (D.T)	11 años M (D.T)		
Com. Imagines (Ac)	9,04 (0,99)	9,40 (0,99)	9,43 (0,79)	8,391 (1,22)	8,83 (1,00)	9,17 (0.99)	Edad	
MV1Ratio	0,58 (0,16)	0,50 (0,13)	0,49 (0,13)	0,55 (0,16)	0,70 (0,14)	0,77 (0,14)	Ensayo memoria*edad Ensayo memoria*país*edad	7 (m=e); 9 (m>e); 11(m>e)
MV2 Ratio	0,78 (0,16)	0,69 (0,15)	0,68 (0,16)	0,78 (0,14)	0,88 (0,15)	0,92 (0,10)		7 (m=e); 9(m>e); 11(m>e)
MV3 Ratio	0,87 (0,16)	0,80 (0,15)	0,78 (0,17)	0,86 (0,21)	0,95 (0,16)	0,97 (0,17)		7 (m=e); 9 (m>e); 11(m>e)
MV4 Ratio	0,78 (0,16)	0,72 (0,14)	0,75 (0,15)	0,71 (0,21)	0,86 (0,16)	0,84 (0,17)		7 (m=e); 9(m>e); 11(m>e)
Memoria de Trabajo	4,69 (1,49)	5,98 (1,60)	6,66 (1,46)	4,47 (1,29)	6,25 (0,66)	6,59 (1,47)	Edad	
Fluidez fonética	5,62 (2,04)	5,29 (2,13)	7,09 (2,72)	3,90 (1,98)	5,44 (2,40)	6,27 (2,40)	Edad	
Fluidez categorial	10,53 (2,76)	14,80 (4,45)	16,82 (4,10)	7,71 (2,75)	10,92 (3,13)	13,22 (3,40)	País Edad	7 (m=e); 9 (m<e); 11(m=e)
MVS-RI (AC)	7,84 (1,84)	9,38 (2,40)	10,25 (2,16)	5,94 (2,14)	7,41 (1,94)	9,30 (2,36)	Edad	
MVS-RD (AC)	6,11 (1,82)	7,51 (2,44)	8,66 (2,12)	4,35 (1,96)	5,95 (2,00)	7,60 (2,16)	Edad País	7 (m=e); 9 (m=e); 11(m=e)
MVS-REC (AC)	46,13 (3,05)	46,76 (3,26)	46,89 (3,31)	44,92 (3,48)	47,11 (2,37)	47,46 (2,03)	Edad	
Planificación (Ac)	18,53 (2,74)	19,67 (3,21)	20,70 (3,51)	18,33 (2,55)	20,08 (3,40)	20,31 (3,57)	Edad	
Razonamiento (Ac)	14,18 (5,04)	16,96 (4,07)	20,09 (2,70)	12,65 (4,417)	17,05 (3,89)	18,84 (3,07)	Edad	
AtenSel – CC (TR)	1064,08 (175,81)	928,34 167,48	764,29 (164,96)	707,79 (108,53)	721,28 (68,15)	725,37 (64,04)	Ensayos Ensayos*edad Ensayos*país*edad	7(m<e); 9(m<e); 11 (m=e)
AtenSel-1ª REP-C	886,27 (179,07)	776,03 (141,84)	641,24 (153,29)	678,55 (67,72)	651,18 (78,96)	651,18 (80,79)		7(m<e); 9(m<e); 11 (m=e)
AtenSel-2ª REP-C	844,40 (168,35)	760,43 (143,82)	616,04 (137,24)	656,85 (75,11)	626,58 (63,39)	621,69 (80,99)		7(m<e); 9 (m<e); 11(m=e)
TR-(promedio)	491,56 (82,94)	471,17 (131,00)	404,32 (105,40)	519,13 (138,36)	445,79 (103,45)	432,13 (118,27)	Edad	

M= marroquís; e= ecuatorianos; Com.= comprensión; Ac= aciertos; MV1,2,3 = memoria verbal – primer, segundo y tercer ensayo (recuerdo inmediato); MV4= memoria verbal – el cuarto ensayo (recuerdo demorado); Ratio= número de palabra recordadas/ número total de palabras en la Lista; AtenSel= atención selectiva; CC= cambio congruente; TR= tiempo de reacción; 1ªREP-C = primera repetición congruente; 2ªREP-C= segunda repetición congruente.

6.4 Discusión

El objetivo principal de este trabajo fue estudiar las diferencias culturales tanto en el rendimiento neuropsicológico como en el desarrollo de las funciones neuropsicológicas en niños/as marroquíes y ecuatorianos/as de 7, 9, y 11 años. Los resultados revelaron un efecto claro de la edad en todas las variables neuropsicológicas de la misma manera en los dos grupos. Además, los resultados mostraron diferencias culturales en 4 de las 11 pruebas utilizada para evaluar el rendimiento neuropsicológico en niños/as marroquíes y ecuatorianos/as. Estas diferencias entre los dos grupos cambiaron según la edad en el desarrollo de la memoria verbal y el costo de cambio.

En todas las pruebas utilizadas en este estudio, como era de esperar, la edad tiene un efecto significativo en el rendimiento neuropsicológico tanto en los/as niños/as marroquíes como en los/as ecuatorianos/as. Los/as niños/as mayores de edad han superado a los/as niños/as menores en todas la pruebas neuropsicológicas. Estos resultados coinciden con la literatura previa (Sobeh y Spijkers, 2013) en que la edad es un predictor del rendimiento neuropsicológico en niños/as. Estos resultados también señalan la capacidad de la batería BENCI en detectar el efecto de la edad en el rendimiento neuropsicológico en los/as niños/as dos culturas diferentes.

Los/as niños/as marroquís rendían de una forma parecida a los/as niños/as ecuatorianos en 7 pruebas. Estas pruebas incluyen pruebas verbales y no-verbales pudiendo ser tanto pruebas simples (por ejemplo: tiempo de reacción simple) como complejas (por ejemplo: razonamiento o memoria de trabajo). Sin embargo, estos resultados no coinciden con el único trabajo similar realizado con niños/as árabes. En un estudio reciente Sobeh y Spijkers (2013) utilizando una batería no validada para niños/as árabes han encontrado diferencias en el rendimiento de los niños/as sirios/as y alemanes en 6 de 8 pruebas neuropsicológicas. Esto podrían deberse a que en nuestro estudio se ha utilizado una prueba validada y adaptada a población árabe mientras que en el estudio anteriormente descrito se utilizó la misma prueba para las dos culturas.

Los/as niños/as marroquís han obtenido mejor puntación en la prueba de memoria verbal y de "costo de cambio". Las diferencias en la memoria verbal pueden ser por la diferencias en el sistema educativo entre los dos países ya que en marruecos enseñan los/as niños/as desde el primer grado repetir en voz alta las cosas aprendidas durante la clase escolar mejorando la memoria verbal de los/as niños/as. Sin embargo, es importante

mencionar que estas diferencias pueden ser debidas a la manera de calcular el ratio de cada ensayo de la prueba de memoria ya que se producía un efecto techo y el número de palabras por ensayo para los/as niños/as de Ecuador fue de 9 palabras para los/as niños/as de 9 y 12 palabras para los/as niños/as de 11 años. En el caso de los/as niños/as marroquís, no detectamos efecto techo y se mantuvo una longitud de 6 palabras para todas las edades. Esto ha podido hacer que la tarea de memoria verbal fuera más fácil para los/as niños/as marroquís de 9 y 11 años, aumentando su rendimiento. Esta explicación se ve apoyada por el hecho de no encontrar diferencias cuando la longitud de la lista era igual para los dos grupos de niños/as. Por otro lado, el sistema de repetición diaria y en voz alta de grandes cantidades de información cada dos horas ha podido mejorar el sistema atencional y explicar las diferencias en la tarea atencional de costo de cambio. Aunque esto podrían ser posibles explicaciones a los resultados encontrados no tenemos suficiente información para apoyarlas así que serán necesarias futuras investigaciones. Este sistema didáctico utilizado en las escuelas marroquís de repetir los contenidos en voz alta una y otra vez podría haber favorecido que los/as niños/as ecuatorianos/as hayan puntuado más en la prueba de memoria visual. Sin embargo, va en contra de los resultados en la prueba de fluidez semántica en la cual los/as niños/as marroquís han puntuado menos que los/as ecuatorianos/as en los tres grupos de edad. Tal vez, las diferencias podrían deberse a las diferencias entre el árabe clásico (forma en la que ha sido administrada la prueba y el dialecto marroquí). En árabe hay dos formas de hablar: el clásico formal y el dialecto local de cada país árabe. El dialecto es una forma más corta de hablar y puede que los/as niños/as hayan nombrado menos palabras porque todas las evaluaciones han sido realizadas en árabe clásico. Shebani y cols. (2008) encontraron diferencias entre niños/as libios/as y holandeses/as en la prueba de dígitos pero estas diferencias han desparecido cuando estaba controlada la velocidad de pronunciación.

Este estudio presenta varias limitaciones entre las que se encuentra que el CI de los niños/as no está controlado. Sin embargo, debido a la ausencia de pruebas de CI comunes validadas y baremadas en Marruecos y Ecuador, esta limitación no ha podido ser resuelta. Por otro lado, las calificaciones escolares podrían aportar más información a este artículo. En el futuro, será interesante incluir más pruebas y ampliar la muestra incluyendo más grupos de edades para examinar el efecto de la cultura en el neurodesarrollo.

En resumen, este estudio es de los primeros en examinar el efecto de la cultura en el desarrollo de la funciones neuropsicológicas en niños/as de dos países diferentes y pocos

estudiados, utilizando una batería computarizada, simple y valida en la dos culturas. Los resultados han mostrado que en la mayoría de las pruebas utilizadas, las curvas de neurodesarrollo son similares en las dos culturas.

Capítulo 7

Fiabilidad y Validez de la Versión Árabe de la Batería de Evaluación Neuropsicológica Infantil (BENCI)

7.1 Introduction

Neuropsychological tests are scarce in developing countries (Nell, 2000) and are even less available for children. Recently, our team has developed a computerized battery for the Neuropsychological Evaluation of Children (*BENCI: Batería de Evaluación Neuropsicológica Infantil*; Cruz-Quintana et al., 2013) by means of international cooperative projects. This battery has been used in different studies to evaluate neuropsychological domains and neurodevelopment in children (Cruz Quintana et al., 2013), and has demonstrated discriminate validity in a study comparing the neuropsychological performance of preterm and normal 7 years old children (García-Bermúdez et al., 2012). Also, BENCI subtests have showed good convergent validity with other similar and validated paper and pencil tests, and have demonstrated good test-retests reliability in a sample of Hispanic children (Cruz-Quintana et al., 2013). The BENCI includes tests that evaluate different neuropsychological areas such as processing speed, visuomotor coordination, attention, memory, language, and executive functions. In addition to the fact that the BENCI battery has good psychometric properties, it is easy and enjoyable for children.

In the Arab world, over 350 million inhabitants live divided between 22 countries (Mirkin, 2010). Of these inhabitants, over 35% are children (Mirkin, 2010). These children have been exposed to distinct factors (Shonkoff, 2010, Shonkoff, Richter, van der Gaag, & Bhutta, 2012) that can affect their neurodevelopment. Among these factors is the exposure to war violence (e.g., Palestine and Iraq) or poverty and malnutrition, (e.g., Mauritania and Somalia). Nevertheless, there is a very scarce number of studies that have evaluated the impact of these factors on the neuropsychological development of these children (Abu Zaydeh, Zalina, Wan, & Aljeesh, 2012; El Hioui, Azzaoui, Touhami Ahami, Rusinek, & Aboussaleh, 2012). Therefore, it is important to evaluate the neurodevelopment of Arabic children in order to understand how these variables are influential and to develop prevention programs and interventions.

Nevertheless, despite the millions of people in the Arabic population, there are very few neuropsychological tests adapted to this culture. In a literature review about tests mostly used in Arabic culture, Fasfous, Puente, Peralata-Ramírez, & Pérez-García (submitted) have found that more than 46% of the neuropsychological tests had not been translated, adapted, or it´s psychometric properties had not been examined in this culture.

Only 13 tests had normative data in some Arab countries (Fasfous et al., submitted). Literature reveals a cultural effect on neuropsychological tests (e.g., Ardila, 1995, 2005; Greenfield, 1997; Ostrosky-Solís, Ramírez, Ardila, 2004; Puente et al., 2013). Recently, of the few neuropsychological studies in the Arab world, different works demonstrate that there is cultural difference in neuropsychological performance between Arabs and individuals from other cultures (e.g., Fasfous et al., 2013; Sobeh & Spijkers, 2013). Sobeh and Spijkers (2012) have found a differential attentional pattern when comparing Syrian and German children. Fasfous and collegues (2013) found that Spanish adults outscored Moroccan Arab adults in verbal and non-verbal neuropsychological tests where each cultural group utilized different neuropsychological abilities to perform the same intelligence test. Different studies have confirmed the need to create and validate specified neuropsychological tests for the Arabic population (Alansari & Baroun, 2004; Fasfous, Hidalgo-Ruzzante, Vilar-López, Catena-Martínez, & Pérez-García, 2013).

In summary, despite the large number of inhabitants in the Arabic world, there are few valid neuropsychological tests, and the comprehensive batteries for the evaluation of children are non-existent. To our knowledge, BENCI is the first computerized battery to evaluate the neurodevelopment of Arabic children. Therefore, the objective of this study is to test the validity and reliability of the Arabic version of the computerized battery for the Neuropsychological Evaluation of Children (BENCI) in a sample of Moroccan children. This battery uses the classic Arabic language. Classic Arabic is the common and official language for the 22 Arab countries and it is the common writing system in those countries. School children learn classic Arabic in their schools.

7.2 Method

7.2.1 Participants

In this study, 198 children participated (98 boys and 100 girls) from the city of Chefchouen, Morocco. This city is the capital of the Chefchauen province and it has more than 35,000 inhabitants in the northwest of Morocco. The main economic activities are trade and tourism. The unemployment rate is currently 7.18% and the literacy rate was 26% in 2004 (Chefchaun Townhall, 2013). The participants were selected from two public schools from the middle class neighbourhoods of this city. Both schools have a computer lab where the BENCI tests were administered. According to the recorded information, most of the parents were working as civil servants or private business owners. The sample

was made up of three age groups: 7 years old (51 children, 25 boys and 26 girls from second grade), 9 years old (63 children, 30 boys and 30 girls from fourth grade), and 11 years old (84 children, 43 boys and 41 girls from sixth grade). To examine the test re-test reliability of the BENCI battery, we administered the battery 2 times to 43 children (23 boys and 20 girls) with 15 days in-between the pre and post-test.

Schools were selected by the Chefchaouen Education Office of the Moroccan Ministry of Education based on the representation criteria of the children of Chefchauen. There were two classrooms for each grade and 52 children (26 boys and 26 girls) were selected randomly from each classroom. And from the fourth and sixth grades, more than 43 children were selected to conduct the study of test-retest reliability. All of the selected children had accepted to participate in this study, except for one child from the second grade who did not complete the battery.

According to professors and parents in the initial interviews, all of the children were free of medical problems. The questions were about antecedents of any relevant illness and medication intake, this information was included as a part of a comprehensive interview about health status. Nevertheless, the children with developmental problems attend a special and separate program in the Moroccan educational system, and all of the children from our study were selected from the ordinary schools. In ordinary school, children assist 4 hours in classroom, six days a week, and during that time they take class about science, math, Arabic language, French, and social sciences (two hours in French per day). Arabic is the native and everyday speaking language.

7.2.2 Instruments

The original version of the BENCI battery (Cruz-Quintana et al., 2013) was developed among Ecuadorian children as a result of an International Cooperative Program. BENCI is composed of basic neuropsychological domains required to conduct a comprehensive neuropsychological assessment (Lezak, et al., 2004): speed processing, visuomotor coordination, attention, memory, language, and executive functions). Neuropsychological tests were developed to cover these domains. As a result, the BENCI consists of 14 neuropsychological tests. This version has norms for Ecuadorian children between 6 and 12 years old and it has demonstrated good psychometric properties. The test-retest reliability was good (correlation ranged between r=.927 and r= .351). The convergence validity of the BENCI with valid tests (for example, The Stroop Word Color

test, backward digits, RAVEN test, Spanish adaptation of California Verbal Learning Test) showed acceptable correlations (r=.689 - r=.335) (Cruz-Quintana et al., 2013). This battery is computerized but requires no previous experience to be administered. This computerized format allows for standardized administration, records hits, errors, or reaction time (when proceeded) in a very easy manner, and it is simple and enjoyable for children.

The Arabic version of the BENCI Battery (Cruz-Quintana et al., 2013) was administered to 198 children by an Arabic neuropsychologist (A. Fasfous). Translation and back-translation were completed. One bilingual neuropsychologist translated the test from Spanish to Arabic and another bilingual had translated the BENCI from Arabic to Spanish language. Adaptations to Arabic culture were needed for some words of the memory list and for some of the pictures (for example we changed the pig picture to a sheep one). We did not need to adapt numbers since Arabic numbers are used in Morocco.

BENCI consists of 14 neuropsychological tests. It takes about 75 minutes to complete in one session with a break of 10 minutes. The order of administration was the same for all subjects and the order of administration was determined following the recommendations of Lezak et al. (2004). Domains and tests were the following:

Processing speed

- ***Simple time reaction test.*** This test requires that the child press any key as fast as possible every time a cross (+) appears on the screen. *Recorded values:* Reaction Time (RT: ms)

Visuomotor coordination

- ***Visuomotor.*** The child should reach numbers in an increasing order (or elements, according to the given sequence) that appear on the screen out of order. *Recorded values:* R.T. (ms).
- ***Alternate visuomotor.*** The child should reach in an alternate order and reach the increasing numbers of the two distinct series that appear on the screen out of order. *Recorded values:* R.T. (ms).

Sustained attention

- ***Continues Performance Test (CPT)***. In this task, various blocks in a series of letters (essays) will appear on the screen so that the child should press the key each time

the correct stimulus appears, (i.e. an A after an X). The rest of the letters are distractor elements. *Recorded values:* R.T. (ms), number of correct answers.

Memory

- ***Verbal memory.*** The child listens to a series of words and should memorize as many as possible. After each sequence the user should repeat all of the words he/she remembers. *Recorded values:* correct answers.
- ***Verbal memory (delayed recall).*** After 20 minutes, the child should repeat out loud all of the words he/she can remember that were presented in the list of the previous task (test of *Verbal Memory*). *Recorded values:* correct answers.
- ***Verbal memory (essay of recognition).*** The child listens to a series of words, half of which are from the previous list. The child answers yes or no to whether or not each word was in the memory list. *Recorded values:* correct answers.
- ***Visual Memory.*** Pictures are presented with a series of common objects to which the child should memorize the greatest number possible. After each sequence, the child should repeat all of the objects that he/she remembers. *Recorded values:* correct answers.
- ***Visual memory (delayed essay).*** After 20 minutes, the child should name out loud all of the images that he/she can remember from the sequence in the visual memory task. *Recorded values:* correct answers.
- ***Visual memory (essay of recognition).*** Next, a series of images will be presented and for each one the child must indicate if it had appeared in the sequence of the previous test. *Recorded values:* correct answers

Language

- ***Verbal comprehension (images).*** A combination of images of a given category (e.g. animals) are shown and the user is given a series of instructions (auditory), indicating that he/she should select a given image that fulfils the indicated conditions (e.g. type of animal, position, type of activity that one can carry out and/or color: for example, "touch the frog that is next to the dog"). *Recorded values:* correct answers.
- ***Verbal comprehension (figures)***. Similar to the previous test, but in this case the images on the screen are replaced by geometric shapes (circles, triangles, squares) of different colors, which signal the ones that fulfil the indicated conditions (figure, size,

position and/or color: for example, "touch the small blue circle"). *Recorded values:* correct answers.

- ***Phonetic fluency***. This test indicates a letter and the child should respond, as fast as he/she can, with all of the words he/she knows that start with the same letter. *Recorded values:* correct answers. Time: 60 seconds.

Executive function

- ***Working memory.*** The child listens to a series of number sequences and colors. After each sequence the user should separately repeat the numbers and the colors that he/she has heard (first all of the numbers and next all the colors, or in reverse order). *Recorded values:* correct answers.
- ***Abstract reasoning***. In this exercise, a sequence of logical series. For each one, the child should select the element that appears that completes the series. *Recorded values:* R.T. (ms) and correct answers.
- ***Semantic fluency***. The child listens to a semantic category and he/she states all of the elements that he/she knows from the given category (colors/animals). *Recorded values:* correct answers. Time: 60 seconds
- ***Inhibition***: ***Go/ no-go***. During this test, two alternating elements keep appearing on the screen. In the first phase of the test, the child should state the distinguishing element of the two and press any key when it appears. Afterwards, by listening to a sound that represents the phase change, the distinguished element will appear to be the other, to which the user should press a key when it appears. *Recorded values:* R.T. (ms) and correct answers.
- ***Flexibility: Spatial Stroop***. A sequence of arrows appears on the screen, either pointing to the left (←) or to the right (→). Each time that the arrow appears, the child should press the key LEFT ARROW if the arrow points to the left or the key RIGHT ARROW if the arrow points towards the right. In some occasions, the stimuli are presented on the side of the screen in coherence with the arrow, and in other occasions in the reverse order. *Recorded values:* R.T. (ms) correct answers.
- *Planning*: ***Attraction park.*** An attraction park is presented and the child's goal is to collect the highest number of attractions with the money he/she is allotted. The user is informed that there is a time limit for being in the festival and that each attraction expires

part of this time. The user's objective should be to acquire the highest number of different attractions with the available resources. *Recorded values:* number of activities.

7.2.3 Procedure

This study was a part of an International Cooperative Project about neurodevelopment between the University of Granada and the town hall of Chefchauen. After the Ethical Committee at the University of Granada (Spain) approved the study, permission by the Department of Education in the province of Chefchaouen (Morocco) was obtained in order to begin the study in the elected schools. Next, parental informed consent was collected for each of the participants.

All of the participants were selected randomly utilizing a list of students from the two chosen schools for this study. The researchers received permission from the parents and acceptance from the children to participate voluntarily in the study. The directors of the two schools provided an empty classroom in each school to carry out the study. Afterwards, the BENCI battery was administered on an individual basis to participants during the school day.

Finally, in order to validate the Arabic version of the BENCI, we had a lot of difficulties in finding neuropsychological tests that covered different neuropsychological functions in the Arabic population. For this reason, we did not complete convergent validity and used construct validity.

7.2.4 Statistical Analysis

G3*Power was used to calculate the sample size required for the test-retest reliability and convergence validity analysis. In order to obtain a 0.35 correlation, with an alpha at 0.05 and a power of 80%, 46 children by group were required.

The sample characteristics were analysed with descriptive statistics and frequency distributions. The reliability test-retest was calculated using the intraclass correlation coefficient (ICC), the recommended statistic for this type of study (Armstrong, White and Saracci, 1992; Scientific Advisory Committee of the Medical Outcomes Trust, 2002). To determine this, a two-dimensional ANOVA of random effects was conducted. The obtained ICC is essentially the same as the analysed Kappa coefficient based on quadratic weight in disagreement, provided that the number of observations is sufficiently large, as it

is in this case (Fleiss and Cohen, 1973). Given that the calculated ICC of this study is a measurement of absolute agreement, the same as the Kappa coefficient, the standards of Landis and Koch (1977) were followed in order to interpret the magnitude. The analyses fulfilled the scaled units of measurements (reliability) of the statistical program, SPSS version 20.

To confirm the factorial structure of the BENCI, a confirmatory factorial analysis was carried out using AMOS 5.0. The method of confirmatory factorial analysis was based on the method of standard estimate in models of structural equations and on the criteria of the highest probability, in accordance with the assumption of normal multivariate distribution. To evaluate the adjustment of the confirmatory models, a variety of ratings were used, just as is recommended in the literature. The CFI and TLI were utilized for those that indicate 0.9 or more which is considered the minimum to accept the model; RMSEA standard of error, with values less than 0.08 are considered acceptable and 0.06 considered optimal; in addition to the the chi-squared test (Hu & Bentler, 1995).

Finally, an ANOVA was carried out to test the differentiated validity of the BENCI between the different ages.

To prevent error type I with multiple comparison, Bonferroni adjustment was obtained for *p* value. According to this adjustment, the level of significance was established at 0.002.

7.3 Results

Reliability: Tests re-test

In table 11, the intraclass correlation coefficients (ICC) for each of the battery tests and the Pearson correlation coefficients are presented. 43 children participated, and some outliers were eliminated in general (maximum of two).

Table 11. Reliability test re-test of the BENCI battery

Test	ICC	CI 95%	Pearson Correlation
Visuomotor Coordination (R.T)	0.75	0.61 - 0.84	0.74
AltermateVisuomotor Coordination (R.T)	0.73	0.59 - 0.83	0.73
Sustained Attention CPT (C.A)	0.69	0.53 - 0.81	0.68
Sustained Attention CPT (R.T)	0.68	0.51 - 0.80	0.67
Immediate Verbal Memory (C.A)	0.58	0.33 - 0.70	0.57
Delayed Verbal Memory (C.A)	0.52	0.24 - 0.71	0.50
Verbal Recognition Memory (C.A)	0.03	-0.28 - 0.32	0.03
Immediate Visual Memory (C.A)	0.74	0.59 - 0.83	0.73
Delayed Visual Memory (C.A)	0.78	0.65 - 0.86	0.77
Visual Recognition Memory (C.A)	0.53	0.31 - 0.69	0.52
Comprehension of Figures (C.A)	0.75	0.47 - 0.78	0.75
Working Memory (C.A)	0.81	0.70 - 0.88	0.81
Reasoning (C.A)	0.81	0.70 - 0.88	0.81
Semantic Fluency (C.A)	0.77	0.64 - 0.86	0.76
Go/ No-Go (d-prime)	0.79	0.62 - 0.88	0.77
Selective Attention (C.A)	0.77	0.64 - 0.86	0.78
Selective Attention (R.T)	0.51	0.29 - 0.68	0.53
Planning (# visited Attractions)	-0.23	-0.46 - 0 .02	-0.23

Note: ICC= Intraclass Correlation Coefficient (two-dimensional ANOVA of the random effects, definition of absolute agreement); CI= confidence interval; R.T = reaction time; C.A = correct answer.

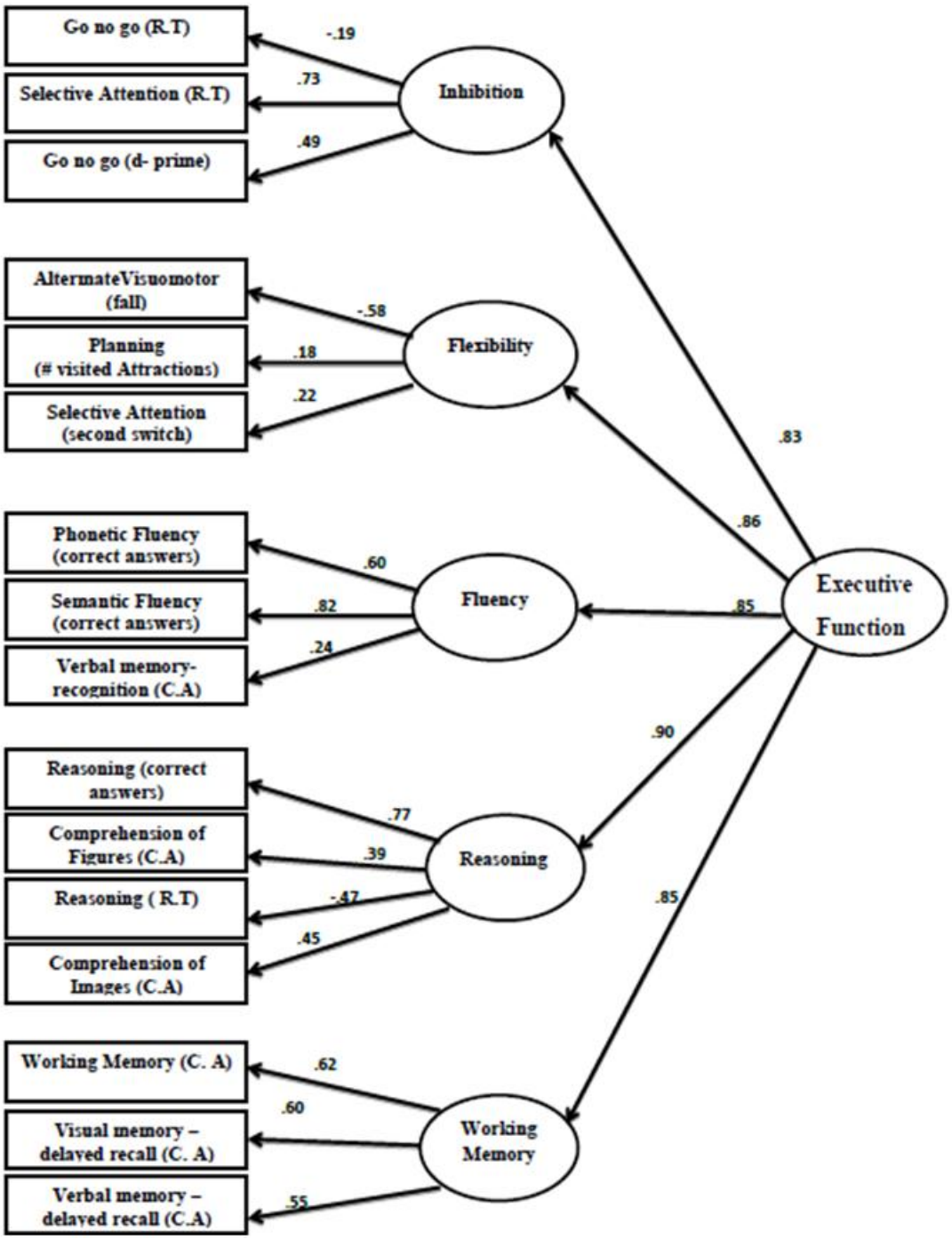
The intraclass correlation coefficients of the BENCI battery constituent tests fluctuate between 0.51 and 0.81. The coefficients are higher in the two components of the battery that measure Reasoning (ICC=0.81) and Working memory (ICC=0.81), with a notable magnitude in both cases. The magnitude of the ICC values for Selective Attention (RT) (ICC=0.51), Delayed Verbal Memory (ICC=0.52), and Immediate Verbal Memory (ICC=0.58) and Visual Memory of Recognition (ICC=0.53), are only moderate. In the case of the scale for Verbal Memory of Recognition (ICC= 0.03) and Planning (ICC= -0.23), the values reveal that there is no correlation. On the other hand, the Pearson correlation coefficients show almost identical values to the ICC for each one of the battery

components, which occurred because the measurements and the variances of the two series are the same (Fleiss and Cohen, 1973). This situation rules out the presence of biases between the two measurements, specifically the association between the effects of memory and learning.

Construct Validity

With regard to the battery that measures different factors based on the measurement criteria of all the important power factors involved in neurodevelopment, a theoretical model does not exist to explain the structure of the entire battery. Nevertheless, for the decision on which tests of executive function were to be included, the Diamond model was followed (2013). This was done to examine the theoretical model of 5 factors of executive function shown in the BENCI by Diamond (2013). An analysis was carried out utilizing an estimation of highest likelihood and a covariance matrix between the items such as input for the factor analysis. The adjustment of the model was evaluated with a combination of absolute and relative adjustment indexes that included, within the absolutes, a p value, associated with the *chi* squared statistic, which tests the null model in front of the hypothesized model; the CFI, which indicated the relative amount of variance and covariance reproduced by the specific model compared with the saturated model. Its value which should be the same or more than .90 for the adjustment model and RMSEA to be considered minimally acceptable, which minimizes the problem derived from the sample size and in the values of .06 or lower indicating an excellent adjustment (Hu and Bentler, 1999).

The confirmatory factorial analysis results indicate that 5 factors exist: inhibition, flexibility, fluency, reasoning and working memory. This 5 factor model demonstrates that the chi-square analysis was not statistically significant. There was a CMIN/DF of 1.240 which occurs when at least at 2 represents a good adjustment. With respect to the global adjustment indicators, the CFI= 0.939 and the TLI= 0.924, making it an acceptable model, just as was shown by the RMSEA=0.042 which is an excellent adjustment. These results suggest that it is a strong adjustment model (see figure 2).



Note : R.T = reaction time; C.A = correct answers

Figure 2: Structural diagram model. Model with five factors in the first order and three factors correlated in the second order in four of the five factors and 4 correlated factors in one of the five factors. The factors would be inhibition, flexibility, fluency, reasoning and working memory.

Validity in detecting neurodevelopmental changes

Because the BENCI is a battery used to evaluate the neurodevelopment of children, we have examined its detection of neuropsychological development based on age. The results demonstrate significant differences between children the ages of 7, 9, and 11 on the majority of the neuropsychological variables (see table 12).

Table 12: Age differences on the BENCI tests

Tests	7 years (n=51) M (SD)	9 years (n=63) M (SD)	11 years (n=84) M (SD)	*F*	*P*	*post hoc*
Comprehension of Figures (C.A)	8.59 (1.02)	8.95 (1.16)	9.48 (0.84)	13.33	**< .001**	11 > (7=9)
Comprehension of Images (C.A)	8.39 (1.22)	8.83 (1)	9.15 (1)	6.48	**.002**	11>7; 7=9; 11 =9
CPT (R.T1)	444,8 (97.95)	387.10 (92.80)	377.89 (69.50)	10.56	**< .001**	(11=9) > 7
CPT (R.T2)	431.47 (107.99)	389 (89.29)	379.68 (64.18)	6.16	.003	(11=9) > 7
Immediate Verbal Memory (C.A)	4.63 (0.81)	5.36 (0.87)	5.83 (0.95)	27.29	**< .001**	11> 9 > 7
Delayed Verbal Memory (C.A)	4.31 (1.31)	5.30 (0.95)	5.75 (1.40)	20.34	**< .001**	(11=9) > 7
Working Memory (C.A)	4.47 (1.30)	6.25 (1.67)	6.6 (1.48)	32.72	**< .001**	(11=9) > 7
Phonetic Fluency (C.A)	3.90 (1.98)	5.44 (2.41)	6.25 (2.96)	11.27	**< .001**	(11=9) > 7
Semantic Fluency (C.A)	7.7 (2.75)	10.92 (3.14)	13.31 (3.33)	48.88	**< .001**	11 > 9 > 7
Immediate Visual Memory (C.A)	5.94 (2.15)	7.41 (1.95)	9.33 (2.33)	38.13	**< .001**	11 > 9 > 7
Delayed Visual Memory (C.A)	4.35 (1.96)	5.95 (2)	7.63 (2.16)	39.18	**< .001**	11 > 9 > 7
Go/No-Go (d-prime)	2.7 (1.25)	3.38 (0.85)	3.67 (0.62)	19.04	**< .001**	(11=9) > 7
Go/No-Go (R.T)	605.51 (117.71)	574.83 (77.11)	544.96 (78.99)	7.31	**.001**	7 =9 11 >7 11 = 9
Verbal Memory—Recognition (C.A)	10.84 (1.97)	11.46 (1.04)	11.37 (1.73)	2.15	0.12	
Planning (# visited Attractions)	18.33 (2.55)	20.08 (3.40)	20.31 (3.60)	6.23	**.002**	(11=9) > 7
Reasoning (R.T)	22018.23 (9874.74)	16702.67 (7438.99)	13809.68 (5029,58)	20.05	**< .001**	11>9>7
Reasoning Correct Answers	12.65 (4.42)	17.05 (3.90)	18.83 (3.09)	44.16	**< .001**	11>9>7

Selective Attention Resume	73.69 (9.40)	83.24 (9.33)	86.95 (8.81)	33.93	**< .001**	11>9>7
R.T average	519.13 (138.37)	445.79 (103.46)	431.50 (119.33)	7.74	**.001**	(11=9) > 7
R.T median	470.36 8147.53)	400.08 (103.58)	388.96 (109.96)	6.75	**.002**	(11=9) > 7
Visuomotor (completion time)	139188.16 (56937.30)	90916.77 (34758.77)	67750.54 (17890.48)	60.14	**< .001**	11>9>7
Alternate Visuomotor (completion time)	146143.16 (60636.66)	88373.52 (34972.37)	69576.11 (25749.86)	59.00	**< .001**	11>9>7

Note: CPT= Continuous Performance Test; R.T = reaction time (milliseconds); C.A = correct answer. M= Mean; SD= Standard deviation.

7.4. Discussion

The objective of this work was to study the psychometric properties of the first Arabic version of the Computerized Battery for the Neuropsychological Evaluation of Children (BENCI). The results demonstrated good validity and reliability of the battery in Arabic children living in Morocco. It also showed that the BENCI battery is capable of differentiating children by their age group.

In general, the reliability of the BENCI battery has been good and similar to that of other neuropsychological studies (Gualtieri & Johnson, 2006; Schatz & Ferris, 2013). Ten of 12 tests of the battery have obtained an excellent or good Intraclass Correlation Coefficient. On the verbal and visual memory tests (except for the recognition essay), the ICC was acceptable. This result is in accordance with other studies, where the reliability of the test re-test was similar on these kinds of tests (Gualtieri & Johnson, 2006; Serra-Mayoral & Peña-Casanova, 2006). On the planning test, the ICC was very low. Different studies show a low test re-test reliability for planning tests in children (e.g., Bishop, Aamodt-Leeper, Creswell, McGurk, & Skuse, 2001) and when these tests are computerized, the reliability is even lower (Luciana & Nelson,1998). The novelty, difficulty and computerized presentation of these tests can affect the results (Lowe & Rabbit , 1998; Luciana & Nelson,1998).

With regard to the validity of the battery, our results showed a good validity construct. The confirmatory factorial analysis indicated a model of 5 factors: inhibition, flexibility, fluency, reasoning, and working memory. This model is acceptable and has a

good adjustment model by Diamond (2013). Planning was the only component to not be adjusted to the model. This could be because planning is the last component of executive function to develop in adolescents around 15-18 years. In this case, the sample was made up of children under the age of 12. It is probable that this function was still not developed in the children of this sample.

Moreover, the BENCI battery has demonstrated the capacity to differentiate between children by their age group. The older children score better than the youngest ones on all of the battery tests. These results are similar to a study conducted by Waber and colleagues (2007), which finds that age has a clear effect on the neuropsychological tests performance of children between 6 and 10 years of age. These results support good validity of the BENCI for detecting changes in neurodevelopment.

According to our findings, the BENCI battery is an important contribution to the field of the neuropsychological evaluation of children in the Arabic population. This battery evaluates the neurodevelopment of children utilizing computerized tests that cover different neuropsychological functions. In societies where tests are scarce (for example: the Arabic world), creating and validating psychological tests is ethically and professionally vital. To our knowledge, this study is the first to create and validate a computerized comprehensive battery to evaluate the neurodevelopment of Arabic children. The BENCI battery is a valid and reliable instrument for evaluating the neurodevelopment of Arabic children and responds to the need for creating neuropsychological tests specific to the Arabic world (Abdul Razzak, 2013; Fasfous et al., 2013; Sobeh & Spijkers, 2013).

Finally, our study has a few limitations. The IQ of the children was not controlled for in this study. Nevertheless, because the objective of this study was to test the validity and reliability of an instrument, we believe that the IQ does not affect the statistical properties of the Battery. In any case, in the Moroccan educational system, children with developmental problems attend special programs and all the children of this study were selected from the ordinary schools. On the other hand, the sample was chosen from only one Arabic country, Morocco, and only one city. Also, dialect differences could enhance differences among individuals from Arab countries in the neuropsychological performances, but no evidence exists about these distinctions. Nevertheless, this study is preliminary and future studies should test the validity and reliability of the BENCI in more

Arabic countries, using larger and more representative samples, and utilizing the BENCI to compare healthy children to children with brain trauma.

In conclusion, the BENCI is a neuropsychological battery that has demonstrated good validity and reliability in Arabic children. This battery can be of great use to both the research and clinical areas of Arabic countries and/or in assistance to Arabic immigrants that live outside of their native country. To facilitate this, BENCI is ready to be used and can be obtained by contacting the first author.

DISCUSIÓN GENERAL, CONCLUSIONES, RECOMENDACIONES Y PERSPECTIVAS FUTURAS

Capítulo 8

Discusión General

8.1 Discusión general

El principal objetivo de esta Tesis Doctoral ha sido investigar el efecto de la cultura en el rendimiento de las pruebas neuropsicológicas en población árabe. Este objetivo general se ha desarrollado a través de cinco estudios que incluyen tanto población adulta como infantil. En general, los resultados han mostrado que los participantes árabes rinden de modo diferente en las pruebas neuropsicológicas. En adultos, hemos hallado que existen diferencias en el rendimiento neuropsicológico entre personas marroquís en comparación con españoles tanto en pruebas neuropsicológicas (verbales y no verbales) como en pruebas de inteligencia no verbales. Además, hemos encontrado que los marroquís utilizan la función ejecutiva cuando realizan las pruebas de inteligencia no verbal (Beta III) y los españoles afrontan esta prueba como problemas visoperceptivos. Aunque estas diferencias culturales han sido explicadas con variables como el nivel educativo, el nivel socio económico y la aculturación, nuevas variables como las habilidades de cálculo también pueden explicar estas diferencias. En el caso de los/as niños/as, también se encuentran estas diferencias culturales, incluso en pruebas no verbales como el *Children Color Trails Test*. Sin embargo, hemos encontrado que estas diferencias no son tan notables en el desarrollo neuropsicológico cuando utilizamos pruebas validas en las culturas de comparación, como es el caso de la BENCI, para comparar niños/as marroquís y niños/as ecuatorianos/as.

En el caso de los adultos, los resultados pueden estar influenciados por el lenguaje de dos formas: primero, en los dos estudios realizados las pruebas han sido administradas en español. Esto puede beneficiar el grupo español y colombiano porque el español es su lengua materna y al mismo tiempo puede limitar el rendimiento del grupo marroquí especialmente en las pruebas verbales porque el español es su segunda idioma. Segundo, el español y el árabe tienen dos sistemas de escrituras totalmente diferentes. El árabe se escribe de derecha a izquierda y el español de izquierda a derecha. Algunos estudios han mostrado que la dirección del sesgo atencional se puede desarrollar de maneras diferente para estas dos formas de escribir (Mass y Russo, 2003). Incluso, un reciente estudio ha mostrado que la percepción de la temporalidad, incluyendo hacia donde creemos que fluye el pasado y el futuro está relacionado con la dirección de la escritura (Oullet, Santiago, Israelí y Gabay, 2010).

Sin embargo, las diferencias entre grupos han sido encontradas también en las pruebas no verbales y entre los dos grupos que hablan el mismo idioma. Esto indica que estas diferencias pueden ser debidas a otras variables. La familiaridad con las pruebas utilizadas en la evaluación neuropsicológica puede explicar las diferencias entre los diferentes grupos culturales (Ardila, 2005; Puente y cols., 2013). En nuestros estudios, los marroquís demostraron menos familiaridad con el tipo de las pruebas utilizadas. Por tanto, estas pruebas les pueden resultar más difíciles y, por esto, pueden haber rendido menos que el grupo de españoles quien demostró más familiaridad con el tipo de pruebas utilizadas. Por otro lado, como la mayoría de las prueba neuropsicológicas eran cronometradas, las diferencias culturales en la actitud hacia el tiempo (Agranovich, cols., 2011) entre los dos grupos puede tener un impacto en las diferencias encontrados. De todos modos, para comprobar esto hay que hacer más investigaciones utilizando cuestionarios sobre la actitud hacia el tiempo en estas culturas.

La calidad de educación es otra variable que puede afectar el rendimiento neuropsicológico (Boone y cols., 2007; Byrd y cols., 2005; Manly y cols., 2002) y puede explicar las diferencias encontradas entre el grupo español y el grupo marroquí. Aunque el grupo marroquí y el grupo español están igualados en el nivel educativo, en el sistema español, los españoles suelen escolarizarse a los 3 años mientras en el sistema marroquí es a los 6 años. Además de esto, los sistemas de educación son diferentes en varios aspectos, incluyendo que el número de alumnos por clase en España es menor en Marruecos. Esto puede afectar a la calidad de educción recibida. Sin embargo, la calidad de educación normalmente se mide por las habilidades lectoras (p.e., Manly y cols., 2002; 2004). Realmente, la calidad de educación medida por las habilidades lectoras puede servir para comprar grupos que hablen el mismo idioma. En el caso de comparar grupos de diferentes culturas e idiomas, las habilidades lectoras no permiten establecer dicha comparación y creemos que utilizar las habilidades de cálculo es una buena medida de calidad de educación para estos casos. Por último, aunque el grupo marroquí es un grupo de inmigrantes que viven en España, la mayoría son estudiantes universitarios y tienen un nivel educativo alto y un nivel económico igualado a los españoles. Esto indica que los marroquís no rendían menos que los españoles por el hecho de ser inmigrantes, y concuerda con un estudio reciente dónde se mostraban diferencias en la prueba del *Raven* entre marroquís que viven en Marruecos y españoles viven en España (Díaz y cols., 2012).

Uno de los resultados más interesantes de esta Tesis Doctoral es que el grupo español y el grupo marroquí han utilizado diferentes procesos neuropsicológicos para realizar la misma prueba de inteligencia no-verbal. Esto pone de manifiesto un gran cuestionamiento sobre lo que realmente estamos midiendo en las investigaciones transculturales. Por ejemplo, tanto las puntaciones en las pruebas de inteligencia como en las pruebas de razonamiento de las culturas occidentales se basan en gran medida en la habilidad de identificar elementos de la misma categoría, por ejemplo, ítems como "pera y manzana son…". Diferentes estudios mostraron diferencias culturales entre asiáticos y americanos a la hora de realizar este tipo de pruebas (Chiu, 1972; Ji, Zhang y Nisbett, 2004; Nisbett y cols., 2001); en concreto, cuando se presentaron objetos como "vaca, hierba y gallina", los asiáticos categorizan las cosas según su relación funcional y, por tanto, asocian vaca con hierba (vaca come hierba), mientras los americanos asocian vaca con gallina porque los dos son miembros de la misma categoría (animales). Si aplicamos estos resultados al campo de Neuropsicología Transcultural debemos empezar por entender el concepto de las funciones cognitivas (por ejemplo: ¿Qué es la inteligencia? según los miembros de esta cultura) y como se aplica y se mide en esa cultura (por ejemplo: identificar elementos de la misma categoría) a la hora de comparar personas utilizando pruebas desarrolladas en un contexto cultural diferente. Por tanto, creemos que comprobar los propiedades psicométricas (fiabilidad y validez) no es suficiente ya que asegurarnos que las pruebas miden las mismas funciones en diferentes culturas. El análisis de validez de constructo puede ser útil en este caso porque nos puede indicar si la prueba mide el mismo constructo en dos culturas diferentes.

En el caso de los/as niños/as, hemos encontrado diferencias en el rendimiento de las pruebas neuropsicológicas entre los/as niños/as marroquís y los/as niños/as de otras culturas (norteamericanos/as y ecuatorianos/as). En el *CCTT* los/as niños/as marroquís tardaron el doble de lo que tardaron lo/as niños/as norteamericanos en hacer esta prueba. Creemos que estas diferencias pueden ser debidas a las diferencias socioeconómicas entre los dos grupos. Sin embargo, otras variables explicadas anteriormente para discutir los resultados en los adultos como la actitud hacia el tiempo, el sistema de educación y la familiaridad nos pueden ayudar en entender está diferencias. También es importante mencionar que dos estudios en adultos mostraron que los árabes bilingües suelen tardar más en la versión árabe del *Trail Making Test* que en la versión inglés (Abdul Razzak, 2013) y la versión hebreo (Ibrahim, Eviatar y Aharon-Peretz, 2002). Estos resultados han sido explicados por la complejidad de la ortografía del idioma árabe (Ibrahim y cols., 2002;

Abdul Razzak, 2013). En nuestro estudio hemos utilizado el *CCTT* dónde no se utiliza letras y solo se utiliza colores y números. Las diferencias siguen apareciendo y otras variables deben ser consideradas.

En general, las diferencias entre los/as niños/as marroquís y niños/as ecuatorianos/as han sido menos que las encontradas entre adultos españoles y marroquís. Una explicación de estos resultados puede ser que el impacto de las variables culturales en niños/as es menor que en adultos y, por tanto, las diferencias culturales se manifiestan en adultos más que en niños/as. Por otro lado, las diferencias entre niños/as marroquí y ecuatorianos han sido en 7 pruebas de 11, creemos que tanto el control del nivel socio económico de los/as niños/as en los dos países como utilizar una batería validada para los/as niños/as en los dos países ha reducido las diferencias neuropsicológicas encontradas. Por último, es importante mencionar que las diferencias en curvas del desarrollo neuropsicológico entre los países han sido solo en dos pruebas y, por tanto, de manera general, podemos decir que la cultura afecta el rendimiento de las funciones pero su influencia es limitada en el neurodesarrollo.

Estos resultados globales que están detalladamente descritos en cada capítulo pueden tener tanto implicaciones teóricas para el campo de la Neuropsicología Cultural como aplicadas para el trabajo de los neuropsicólogos. A continuación procedemos a discutirlas.

8.2 Implicaciones teóricas de los resultados

Los resultados globales de esta Tesis nos han llevado a plantear su relación con distintas cuestiones de interés en el campo de la Neuropsicología Cultural, incluyendo si las diferencias culturales afectan a la estructura neuropsicológica y cerebral, cómo pueden estar condicionadas por las pruebas que utilizamos, si son estables durante el desarrollo o si todas las variables influyen de igual forma en todas las pruebas neuropsicológicas o en todas las culturas.

En nuestra opinión, las personas de diferentes culturas tienen la misma estructura cerebral y las mismas funciones neuropsicológicas. Sin embargo, existen diferencias entre las personas de diferentes culturas en su manifestación, utilización (y ejecución en pruebas) de estas funciones. Dependiendo de las características generales de la cultura, su estilo, sus hábitos, sus valores y sus reglas podemos desarrollar unas habilidades mejor que

otras. Por tanto, las diferencias en el rendimiento neuropsicológico entre personas de diferentes culturas pueden estar determinadas por el desarrollo de estas habilidades en sus propias culturas (por ejemplo, las personas que viven en el bosque desarrollan mejor las habilidades visuales mientras las persona que viven en la ciudad desarrollan mejor habilidades verbales). Así mismo, las diferencias encontradas en los estudios de neuroimagen deben ser explicadas por las experiencias culturales del individuo.

Por otro lado, las diferencias encontradas en las pruebas neuropsicológicas entre personas de diferentes culturas pueden estar aumentadas o disminuidas por el mal uso de las pruebas. En otras palabras, si aplicamos unas pruebas desarrolladas en un contexto cultural a personas de otra cultura y estas pruebas incluyen la utilización de habilidades no potenciadas por esa cultura, es muy probable que puntúen de forma inferior en dichas pruebas. En realidad, creemos que la fiabilidad y la validez no son suficientes para considerar una prueba válida para utilizar en nuevas culturas. Sabiendo que las personas de diferentes culturas utilizan habilidades diferentes para realizar la misma prueba y sabiendo que las personas de diferentes culturas procesan de modo diferente, no podemos asegurar que la misma prueba mida la misma función en diferentes culturas. La validez de constructo puede ser de utilidad para comprobar si las pruebas tienen el mismo constructo cuando se utilizan con personas de diferentes culturas.

Por tanto, pensamos que el efecto de la cultura en el rendimiento neuropsicológico no es estático y puede estar cambiando durante el desarrollo. En la edad infantil hay poco efecto de variables culturales como los valores sociales, las normas, y la concepción del tiempo. Por esta razón, creemos que las diferencias culturales son menores cuando comparamos niños/as de diferentes culturas y son mayores cuando comparamos adultos. Por ejemplo, la adolescencia es considerada la etapa de mayor de socialización y se considera un período crítico para la adquisición y consolidación de valores morales, la personalidad, la interiorización de normas sociales, etc… Por tanto, la influencia de los valores sociales y culturales debería ser mayor después de la adolescencia que antes de ella.

Por último, creemos que la Neuropsicología Cultural debe considerar que la influencia o el peso de las distintas variables propuestas para explicar las diferencias culturas probablemente no es equivalente. Es decir, variables como la calidad de la educación pueden ser más importantes que la aculturación pero ambas podrían tener menos

impacto que el estatus socioeconómico. Por otro lado, tampoco se ha considerado la influencia combinada de estas variables y, por ejemplo, se debería tener en cuenta que la influencia en las diferencias culturales de la baja calidad de la educación puede estar potenciada por un bajo nivel socioeconómico.

Sin duda, estos posicionamientos teóricos deben servir para guiar futuras investigaciones en este campo. Sin embargo, también es necesario considerar el trabajo diario del neuropsicólogo clínico con personas de otras culturas. Por tanto, es importante describir las posibles implicaciones clínicas que se derivan de esta Tesis Doctoral.

8.3 Implicaciones clínicas

Esta Tesis Doctoral tiene implicaciones clínicas tanto para los inmigrantes árabes que viven fuera de sus países como para los árabes que viven en el mundo árabe.

La población árabe que vive en España y otros países europeos como Francia e Italia es cada vez más significativa. Un porcentaje de estos inmigrantes árabes puede tener daño cerebral o problemas neuropsicológicos siendo necesario el uso de pruebas neuropsicológicas para evaluar el estado de estas personas. Aplicando los resultados encontrados en los estudios de adultos y otros estudios previos (Stanczak y cols., 2001) podemos suponer que los árabes sanos van a ser diagnosticados como personas con daño cerebral. Esto también pasaría si aplicamos las normas del CCTT a niños/as normales, incluso en sus países de origen. Sabiendo que los participantes de nuestros estudios tienen un buen nivel de español, no podemos suponer que la ayuda de un traductor podría resolver el problema. Por tanto, consideramos que crear datos normativos para los inmigrantes árabes sanos teniendo en cuenta su nivel de español, nivel educativo y nivel socioeconómico puede ayudar en resolver este problema.

Sin embargo, la solución anteriormente descrita para la evaluación de árabes inmigrantes no sería válida para la evaluación de árabes que viven en sus países de origen. En este caso, consideramos que, en primer lugar, hay que crear datos normativos por edad, sexo, nivel educativo y nivel socioeconómico para cada país por separado. Esto podría hacerse utilizando pruebas válidas, fiables y muy bien adaptadas a la cultura árabe en el caso de las pruebas desarrolladas en otras culturas. Posteriormente, estos datos normativos podrían ser utilizados en personas árabes con y sin daño cerebral.

En resumen, esta Tesis supone el inicio de un programa de investigación sobre Neuropsicología Cultural en población árabe que supondrá el desarrollo de nuevos estudios en este campo. Esto ha supuesto algunas limitaciones. Por ejemplo, los estudios se han realizado en un único país árabe, Marruecos, y por tanto, la generalización de nuestros hallazgos a otros países árabes debe ser estudiada en el futuro. Por otro lado, los aspectos lingüísticos del idioma árabe en relación con el rendimiento neuropsicológico también deberían ser abordados en futuros estudios.

Capítulo 9

Conclusiones Generales, recomendaciones y perspectivas futuras

9.1 Conclusiones

De esta tesis doctoral, basándose en una revisión teórica sobre el estado de la neuropsicología en el mundo árabe y en los cinco estudios empíricos, se extraen las siguientes conclusiones:

1. La neuropsicología en el mundo árabe está poco desarrollada. En los países árabes, hay pocos estudios realizados en el campo de la Neuropsicología y las pruebas neuropsicológicas disponibles para esta cultura son escasas.

2. Las diferencias culturales en la ejecución de pruebas neuropsicológicas existen tanto en población adulta como en niños/as.

3. En **adultos** existen diferencias entre participantes marroquís y españoles en todas las pruebas neuropsicológicas utilizadas en este trabajo. Estas diferencias se encuentran también entre los marroquís y los colombianos en la mayoría de las pruebas utilizadas. Comparados con los participantes españoles y colombianos los marroquíes suelen tener puntación más baja en las pruebas neuropsicológicas.

4. Además de la clase social ocupacional y el CI, en **adultos** las habilidades de cálculo tienen un papel importante en predecir el rendimiento de las pruebas neuropsicológicas. Por tanto, considerar las habilidades de cálculo (una medida de calidad de educación para personas que hablan diferentes idiomas) es recomendable a la hora de comparar neuropsicológicamente personas de diferentes grupos culturales.

5. En **adultos**, los participantes marroquíes utilizan habilidades neuropsicológicas diferentes a los que utilizan los participantes españoles para realizar la misma prueba de inteligencia.

6. Tanto en **adultos** como en **niños/as** las pruebas verbales y las no-verbales no están libres del efecto de la cultura. Aunque en el manual del *Color Trails Test* de niños/as la prueba está presentada como una prueba libre de la cultura, los resultados de esta Tesis mostraron un efecto claro de la cultura en el rendimiento de esa prueba.

7. La BENCI ha demostrado que puede detectar los cambios en el neurodesarrollo asociados a la edad tanto en la versión árabe como en la española. En relación con

las diferencias culturales en el rendimiento neuropsicológico, los/as **niños/as** ecuatorianos han superado los/as niños/as marroquís en fluidez semántica y la memoria visual, mientras que los/as niños/as marroquíes rendían mejor que los ecuatorianos en la memoria verbal y en el coste de cambio. Las curvas del desarrollo de las funciones neuropsicológicas eran parecidas en los dos países excepto en las dos pruebas en las que rendía mejor los/as niños/as marroquís.

8. La versión árabe de la batería BENCI es una prueba válida y fiable para evaluar diferentes funciones neuropsicológicas en **niños/as** marroquís.

9.2 Recomendaciones

Según los resultados obtenidos en esta Tesis, consideramos importante realizar las siguientes recomendaciones:

1. Creemos que no podemos asumir que las pruebas no verbales están libres de cultura y, por tanto, no deben ser aplicadas a otras culturas sin un proceso de adaptación y validación para esa cultura.
2. Es necesario crear o/y adaptar nuevas pruebas neuropsicológicas para la población árabe.
3. Es importante desarrollar baremos de las pruebas árabes para poder utilizarlas en un contexto de práctica clínica profesional. Así mismo, es conveniente que estas normas sean desarrolladas para cada país árabe.
4. Sería deseable profundizar en el conocimiento del efecto de la cultura árabe en el rendimiento neuropsicológico de **niños/as y adultos** árabes.
5. Las habilidades de cálculo deben ser consideradas a la hora de examinar las diferencias culturales en la ejecución neuropsicológica.
6. La batería BENCI es una batería valida y fiable y su aplicación es recomendable para la evaluación neuropsicológica de niños/as marroquíes.

9.3 Perspectivas futuras

Esta Tesis Doctoral se puede considerar como un primer paso para crear un programa de investigación con el objetivo de desarrollar la neuropsicología cultural en el mundo árabe. Por tanto, los resultados obtenidos sugieren una serie de investigaciones futuras que pueden ayudar a desarrollar la Neuropsicología como disciplina en los países árabes y mejorar nuestro conocimiento sobre el efecto de la cultura árabe en el rendimiento neuropsicológico.

En primer lugar, sería muy interesante investigar el efecto del idioma árabe en el rendimiento de las pruebas neuropsicológicas. Disociar el efecto del idioma del efecto de la cultura puede ser muy complicado ya que requeriría disponer de participantes con la misma cultura pero diferente idioma o personas de diferentes culturas pero el mismo idioma. En el caso de la cultura árabe, sería importante estudiar el efecto de dos versiones del lenguaje como son el árabe clásico y el dialecto ya que presentan diferente velocidad de habla, diferente longitud de palabras y diferentes normas gramaticales.

También sería útil investigar las diferencias culturales entre los países árabes ya que en otras culturas como la hispana, los estudios han mostrado diferencias entre los resultados obtenidos en pruebas neuropsicologías en los diferentes países de Latinoamérica. Esto se hace especialmente imprescindible dado que en la mayoría de países árabes no se ha llevado a cabo ningún estudio neuropsicológico.

Por otro lado, la literatura de Neuropsicología Cultural incluye tantos estudios con inmigrantes como personas residentes en su propio país. En el caso de inmigrantes, el efecto de la cultura de origen se podría mezclar con otras variables propias de la inmigración. Por tanto, sería conveniente realizar estudios que comparen árabes en su país con españoles en su país y/o árabes en su país con árabes residentes en España, para conocer el efecto de la inmigración.

Por último, sería interesante aplicar pruebas neuropsicológicas desarrolladas en el mundo árabe a personas de otros países para comprobar si el rendimiento de las personas árabes sigue más bajo o es un efecto de la prueba. Además, esto permitiría conocer en qué habilidades rinden mejor la cultura árabe en comparación con otras.

International PhD

Quality Criteria for Doctoral Thesis according to Spanish norms

a. International Doctorate

This thesis has been completed under the Spanish norm (*el artículo 15 del Real Decreto 99/2011 de 28 de enero)* for international theses. This normative is destined to increment the quality of doctoral theses and its international impact included the following requirements:

1. That the doctorate has completed a research practicum of at least three months in an international research center.
2. That the thesis has been positively evaluated by two international experts, different from the center in which the research practicum was completed.
3. That the thesis evaluation committee has at least one international expert, and that part of the defense is completed in English.
4. That at least the conclusion and the summary are written in English.

b. Quality of Publications

Finally and in accordance with the same normative, it is not possible to defend a doctoral thesis in Spain if one does not have at least one published article in a journal index-linked in the Journal of Citation Reports (JCR). For a better quality thesis, the University of Granada requires that there are at least two publications.

Summary

This doctoral thesis consists of a total of nine chapters presented in four principle sections: (i) the theoretical section, (ii) empirical section, (iii) general discussion, and (iv) conclusions, recommendations and future perspectives.

The theoretical part is composed of two chapters. In the first chapter, we present an introduction about the different studies that have been conducted in cross-cultural neuropsychology, highlighting the cultural differences found in neuropsychological performance and the variables that can explain these differences. Then, a literature review about neuropsychology in the Arab world is presented. In the second chapter, we justify the objectives of this Doctoral Thesis, including the principle objective, the specific objectives, and the hypotheses.

The empirical part consists of five chapters, each chapter is an empirical study carried out to achieve a specific objective. As the main objective of this Thesis is to initiate a research program on cultural neuropsychology in Arab population, two studies have been conducted in adults and three in children. In Chapter 3, we discuss the differences between a Moroccan and a Spaniard group in neuropsychological and nonverbal intelligence tests. Results indicate that the Spanish group scores better than the Moroccan group in all the neuropsychological tests and in intelligence test. Furthermore, the results show that the two groups utilize different neuropsychological skills to perform the same intelligence test. This may explain the differences in tests performance between the two groups. To study other variables that may explain the differences between the two groups we performed the following study.

The fourth chapter consists of a study in which traditional variables (e.g. acculturation, socio-occupational class, intelligence, and new variables such as calculation skills) are used to explain the cultural differences in the neuropsychological performance between three groups (Moroccans, Spaniards, and Colombians) that are equal in age, sex, education level, and socio-economic status. In this study, calculation skills and intelligence were the best predictors of the neuropsychological scores obtained from the three groups. Due to these findings, we proposed that calculation abilities can be used to measure the quality of education in people who speak different languages and in situations where reading abilities cannot be used to measure the quality of education.

Few studies had examined the effect of education and other cultural variables on neurodevelopment. Therefore, the following chapters focus on Arab children. Chapter five includes a study in which we research the cultural differences in the performance on the "Children's Color trails Test", a neuropsychological test that is used often in cross-cultural studies. The "Children's Color trails Test" is presented in its manual (Llorente et al., 2003) as a culture-free Test. The results of this chapter reveal a cultural effect on this test in which the Moroccan children scored significantly lower than the American children with regards to the test norms (children were equal in age, sex, and education level). These findings confirm the need to create and adapt specific and valid tests for people of the Arabic culture, so as to use them in cross-cultural studies.

Chapter 6 is composed of a study about cultural differences in neurodevelopment. In this article, in addition to studying the differences in neuropsychological performance in Moroccan and Ecuadorian children in a reliable and valid battery in two cultures (BENCI: Cruz-Quintana et al., 2013), we studied whether or not the neurodevelopment of these children was different depending on the country of origin. The results show cultural differences in 4 of the 11 tests used to evaluate the neuropsychological performance in Moroccan and Ecuadorian children. Moreover, the differences between these two groups changed depending on the age in development of verbal memory and the cost of change.

Chapter 7 consists of a study in which we tested the reliability and validity of the Arabic version of the Battery of Neuropsychological Evaluation of Children (BENCI). The Arabic version of this battery has been translated and adapted to the Arabic culture according to international norms of adaptation (International Test Committee, 2010). The results demonstrated good reliability and validity of the Arabic version of the BENCI battery in Moroccan children. Moreover, it shows the capacity to measure the neurodevelopment of these children.

The third section is composed of Chapter 8, where we discussed the obtained results in the literature review and in the five empirical studies. We also highlight the theoretical and clinical implications of this Doctoral Thesis.

Finally, in the fourth section we present the conclusions, the recommendations and future perspectives (chapter 9).

Conclusions

According to the results obtained from the five empirical studies and the literature review, we can conclude that:

1. The neuropsychology in the Arab world is not very developed. In Arabic countries, there are few neuropsychological studies and the available neuropsychological tests are scarce.
2. Cultural differences in neuropsychological test performance exist both in adults and in children.
3. In **adults** there are differences between Spaniard and Moroccan participants on all of the neuropsychological tests utilized in this work. These differences can also be found between Moroccans and Colombians on the majority of the tests used. As compared to the Spanish and Colombian participants, Moroccans tend to have lower scores on neuropsychological tests.
4. In addition to socio occupational class and IQ, **adults'** ability in calculation skills has an important role in predicting performance on neuropsychological tests. Therefore, taking calculation skills (a measurement for quality of education for subjects that speak different languages) into consideration is recommended when comparing people of different cultural groups on neuropsychological tests performance.
5. In **adults**, the Moroccan participants utilized different neuropsychological abilities than those of the Spanish participants when completing the same intelligence test.
6. For both **adults** and **children**, verbal tests and non-verbal tests are not "culture-free". Even though the Color Trails Test for Children manual is presented as a culture free, the results of this Thesis demonstrate a clear effect of culture on the performance of this test.
7. The BENCI has demonstrated that it can detect the changes in neurodevelopment associated with age both in the Arabic and Spanish version. With regard to the cultural differences in neuropsychological performance, the Ecuadorian **children** exceeded the Moroccan children in semantic fluency and visual memory, while the Moroccan children scored better than the Ecuadorian children in verbal memory and in the cost of change. The development curves of the neuropsychological functions were similar in both countries except on two tests in which the Moroccan children scored higher.

8. The Arabic version of the BENCI battery is a valid and reliable test for evaluating different neuropsychological functions in Moroccan **children**.

Recommendations

According to the results obtained in this Thesis, we consider the following recommendations:

1. We cannot assume that the non-verbal tests are free of cultural biases. Therefore, they should not be applied to other cultures without an adaption and validation process for these cultures.

2. It is necessary to create or/and adapt new neuropsychological tests for the Arabic population.

3. It is important to develop norms for the Arabic tests to be able to utilize them practically in clinical and professional contexts. It would be convenient for each of these scales to be developed for each Arabic country.

4. It would be ideal to deepen our knowledge on the effect of the Arabic culture on the neuropsychological performance of Arabic children and adults.

5. Calculation skills should be considered when examining different cultures in neuropsychological execution.

6. The BENCI battery is a valid and reliable battery, and its application is recommended for the neuropsychological evaluation of Moroccan children.

Future Perspectives

This Doctoral Thesis can be considered the first step in creating a research program with the objective of developing cultural neuropsychology in the Arabic world. Therefore, the obtained results suggest that future research should focus on the development of Neuropsychology as a discipline in Arabic countries and should promote a better understanding of the effect of the Arabic culture on neuropsychological performance.

First, it would be very interesting to study the effect of the Arabic language on the performance of neuropsychological tests. Dissociating the effect of language from the effect of culture can be very complicated since it would require participants of the same culture but with a different language or people of different cultures but with the same language. With regard to the Arabic culture, it would be important to study the effect of the two language versions. The two versions, classic Arabic and the dialect, present different velocities of speech, different lengths of words, and grammatical norms are of less importance in the dialect.

It would also be useful to study the cultural differences between different Arabic countries. In other cultures, like in the Spanish one, studies have demonstrated differences between South American countries.

On the other hand, literature from Cultural Neuropsychology includes as many studies with immigrants as with people who are residents in their country of origin. In the case of immigrants, the effect of origin culture can be mixed with other variables having to do with immigration. Therefore, it is convenient to conduct studies that compare Arabs in their country of origin with Spaniards in their country and/or Arabs in their country of origin with Arabs that are residents in Spain, to understand the effect of immigration.

Moreover, it would be interesting to apply neuropsychological tests that were developed in the Arabic world to people from other countries to compare and see if their performance is lower or if it is an effect of the test. Moreover, it would allow us to understand in what abilities the Arabic culture performs better in comparison with others.

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Anexos

Anexo 1

Entrevista estructurada

Código				/		
(a rellenar por el/la entrevistador/a)						

Cuestionario sobre las variables sociodemográficas y culturales en personas de diferente procedencia

A RELLENAR POR EL/LA ENTREVISTADOR/A

01. País de Origen:

02. Sexo:

    a. Varón
    b. Mujer

03. Edad:

04. Estado civil:
    a. Soltero-a
    b. Casado-a
    c. En pareja (convivencia)
    d. Viudo-a
    e. Separado-a o Divorciado-a

05. ¿Tienes hijos?
    a. No
    b. Si
    c. ¿Cuántos?.....

06. Tamaño del municipio (de origen):

    a. Menos de 5.000 habitantes.
    b. De 5.001 a 50.000 habitantes.
    c. Más de 50.000 habitantes.

07. ¿Procedencia?

    a. Rural
    b. Urbana

08. Meses desde la salida del país (primera migración)

09. Nivel de estudios

    a. Sin estudios
    b. Estudios primarios o equivalentes
    c. Enseñanza general secundaria 1er ciclo

d. Enseñanza profesional 2º grado 2º ciclo
e. Enseñanza general secundaria 2º ciclo
f. Enseñanzas profesionales superiores
g. Estudios universitarios u equivalentes de 1er ciclo
h. Estudios universitarios u equivalentes de 2º o 3er ciclo

10. ¿Es Bilingüe?

a. No
b. Sí
c. ¿Qué otros idiomas conoce?.....

11. Manejo de NNTT

a. Nivel usuario-a
b. Profesional
c. ¿Cuántas veces utiliza Internet al mes?
c.1. Ninguna
c.2. 1 vez por mes
c.3. Varias veces al mes

Código				/		
(a rellenar por el/la entrevistador/a)						

Cuestionario sobre las variables sociodemográficas y culturales en personas de diferente procedencia

Estamos realizando una investigación sobre las diferencias culturales en la ejecución neuropsicológica (es decir, en nuestro modo de recordar, prestar atención, tomar decisiones y organizar la información que percibimos. Nos llevará dos horas-dos horas y media aproximadamente. Muchas gracias por su colaboración.

COMENCEMOS HABLANDO DE SU PERFIL PERSONAL Y PROFESIONAL…

Clase social ocupacional:

P.1. ¿Cuál es su puesto de trabajo actual o el último que ha tenido? (NO LEER OPCIONES ASIMILAR RESPUESTA ABIERTA A LA OPCIÓN ADECUADA)

a. No Manual

I. Directivos- as de la administración pública y de empresas de 10 o más asalariados-as. Profesiones asociadas a titulaciones de segundo y tercer ciclo universitario.

II. Directivos- as de empresas con menos de 10 asalariados-as. Profesiones asociadas a una titulación de primer ciclo universitario. Técnicos-as o profesionales de apoyo. Artistas y deportistas.

III. a. Empleados- as de tipo administrativo y profesionales de apoyo a la gestión administrativa y financiera. Trabajadores- as de los servicios personales y de seguridad.

III.b. Trabajadores-as por cuenta propia

III.c. Supervisores-as de trabajadores-a manuales

b. Manuales

IV.a. Trabajadores- as manuales cualificados-as

IV.b. Trabajadores- as manuales semicualificados-as

V Trabajadores- as no cualificados-as

c. ¿Cuál? _____

P.2. ¿Cuál era el puesto de trabajo que tenía en su país? (NO LEER OPCIONES ASIMILAR RESPUESTA ABIERTA A LA OPCIÓN ADECUADA)

a. No Manual

I. Directivos- as de la administración pública y de empresas de 10 o más asalariados-as. Profesiones asociadas a titulaciones de segundo y tercer ciclo universitario.

II. Directivos- as de empresas con menos de 10 asalariados-as. Profesiones asociadas a una titulación de primer ciclo universitario. Técnicos-as o profesionales de apoyo. Artistas y deportistas.

III. a. Empleados- as de tipo administrativo y profesionales de apoyo a la gestión administrativa y financiera. Trabajadores- as de los servicios personales y de seguridad.

III.b. Trabajadores-as por cuenta propia

III.c. Supervisores-as de trabajadores-a manuales

b. Manuales

IV.a. Trabajadores- as manuales cualificados-as

IV.b. Trabajadores- as manuales semicualificados-as

V Trabajadores- as no cualificados-as

c. ¿Cuál? _____

P.3. ¿Cuál es/era el puesto de trabajo que tenía su padre, madre, tutor-a? (NO LEER OPCIONES ASIMILAR RESPUESTA ABIERTA A LA OPCIÓN ADECUADA)

a. No Manual

I. Directivos- as de la administración pública y de empresas de 10 o más asalariados-as. Profesiones asociadas a titulaciones de segundo y tercer ciclo universitario.

II. Directivos- as de empresas con menos de 10 asalariados-as. Profesiones asociadas a una titulación de primer ciclo universitario. Técnicos-as o profesionales de apoyo. Artistas y deportistas.

III. a. Empleados- as de tipo administrativo y profesionales de apoyo a la gestión administrativa y financiera. Trabajadores- as de los servicios personales y de seguridad.

III.b. Trabajadores-as por cuenta propia

III.c. Supervisores-as de trabajadores-a manuales

b. Manuales

IV.a. Trabajadores- as manuales cualificados-as

IV.b. Trabajadores- as manuales semicualificados-as

V Trabajadores- as no cualificados-as

c. ¿Cuál? _____

P.4. ¿Cuáles son sus condiciones laborales?

a. Trabajo estable

b. Trabajo precario

c. Ausencia de trabajo

c.1. ¿Cuántos meses lleva en paro?_____

P.5. ¿Cuál es su nivel de ingresos mensual?

a. Menos de 360€

b. De 361 a 600€

c. De 601 a 900€

d. De 901 a 1200€

e. De 1201 a 1800€

f. De 1801 a 3600€

g. De 3601 a 6000@

h. Más de 6000€

Religión

P.6. ¿Practica usted alguna religión?

a. Si

a.1. ¿Qué religión?.....

a.2. ¿Es usted practicante?

a.2.1. Sí

a.2.2. No

a.3. ¿Con qué frecuencia asiste a ceremonias religiosas al mes?.....

b. No

Género

P.7. ¿Quién realizaba las tareas domésticas cuando eras pequeño-a?

……

P.8. ¿Quién realiza las tareas domésticas en tu casa?

……

P.9. ¿Quién te cuidaba cuando eras pequeño-a?

……

P.10. ¿Quién cuida de los niños-as/ familiares enfermos/ padres, suegros…?

……

P.11. Si tiene hijos-as: ¿Quién toma las decisiones relacionadas con la crianza de los hijos-as (por ejemplo, el colegio que asistirán, la hora de llegada a casa…)?

……

P.12. ¿Quién toma las decisiones importantes en la casa, como las grandes compras (por ejemplo, un coche)?

……

Apoyo Social:

P.13. ¿Hay gente con la que puedo contar para que me ayude si realmente lo necesito?

a. No

b. Sí

c. ¿Quién? ……

P.14. ¿Hay gente que depende de mí para ayudarla?

a. No

b. Sí

c. ¿Quién? ……

P.15. ¿Hay gente que disfruta de las mismas actividades sociales que yo?

a. No

b. Sí

c. ¿Quién? ……

P.16. Si algo saliera mal, nadie vendría a ayudarme.

a. No

b. Sí

P.17. Siento un fuerte lazo emocional con al menos una persona.

a. No

b. Sí

c. ¿Con quién? ……

P.18. No existe nadie con quien me sienta a gusto hablando de mis problemas.

a. No

b. Sí

c. ¿Quién? ……

Aculturación:

P.19. (1) In general, what language(s) do you read and speak?

P.20. (2) What was the language(s) you used as a child?

……..……
…

P.21. (3) What language(s) do you usually speak at home?

……..……
…

P.22. (4) In which language(s) do you usually think?

……..……
…

P.23. (5) What language(s) do you usually speak with your friends?

……..……
…

P.24. (6) In what language(s) are the T.V. programs you usually watch?

……..……
…

P.25. (7) In what language(s) are the radio programs you usually listen to?

……
…

P.26. (8) In general, what language(s) are the movies, T.V. and radio programs you prefer to watch and listen to?

……

P.27. (9) Your close friends are

……
…

P.28. (10) You prefer going to social gatherings/parties at which people are

……
…

P.29. (11). The persons you visit or who visit you are

……
…

P.30. (12) If you could choose your children's friends you would want them to be

P.31. Si tienes pareja, ¿de qué nacionalidad es?

……
…

Valores

P.32. ¿Se sientes incómodo-a si alguien ocupa su espacio íntimo o personal?

a. No
b. Sí
c. Ni cómodo-a, ni incómodo-a

P.33. Cuando tiene éxito, ¿usualmente éste se debe a mis capacidades?

a. No
b. Sí
c. No lo sé

P.34. ¿Disfruta ser único-a y diferente en muchos aspectos de los demás?

a. No
b. Sí
c. No lo sé

P.35. ¿Cree que "Competir es una ley de la naturaleza"?

a. No
b. Sí
c. No lo sé

P.36. ¿Está cómodo-a en situaciones que implican competir con otros?

a. No
b. Sí
c. Ni cómodo-a, ni incómodo-a

P.37. ¿Podría sacrificar una actividad que disfrute mucho si mi familia no la acepta?

a. No
b. Sí
c. No lo sé

P.38. ¿Podría hacer algo que complaciera a mi familia, aún si detesto esa actividad?

a. No
b. Sí
c. No lo sé

P.39. ¿Frecuentemente sacrifica mi propio interés en beneficio de mi grupo social?

a. No
b. Sí

Orientación al logro

P.40. Cuando realiza alguna tarea, ¿prefiere hacerla rápidamente, aunque pueda equivocarse?

a. No
b. Sí
c. No lo sé

P.41. Cuando realiza alguna tarea, ¿prefiere gastar todo el tiempo (es decir, realizarla con calma) y asegurarse así el éxito en la misma?

a. No
b. Sí
c. No lo sé

Cuestionario sobre las variables sociodemográficas y culturales en personas de diferente procedencia

AHORA, HABLEMOS DE LAS SITTUACIONES DE ENTREVISTAS COMO ESTA, Y DE LA RELACIÓN CON OTROS PROFESIONALES

Relación con otros profesionales

P.42. ¿Has ido al psicólogo- a alguna vez?

a. No
b. Sí
c. ¿Cuántas veces?

P.43. ¿Con qué frecuencia sueles ver a profesionales de la medicina, trabajo social, psicología en un mes?

a. Ninguna
b. Una vez
c. De 2 a 4 veces
d. 5 o más

P.44.¿Te sientes tranquilo-a cuando asistes a una cita con el médico-a, trabajador-a social, psicólogo-a…?

a. No
b. Sí
c. Ni tranquilo-a, ni intranquilo-a

Situación de evaluación

P.45. ¿Te sientes cómodo-a en un espacio como este (íntimo y privado, aislado…)?

a. No

b. Sí

c. Ni cómodo-a, ni incómodo-a

Pruebas

P.46.¿Alguna vez has realizado una prueba psicológica?

a. No

b. Sí

P.47. ¿Alguna vez te han cronometrado al realizar una prueba psicológica?

a. No

b. Sí

P.48. ¿Cómo me siento cuando realizo test y pruebas psicológicas?

a. Tranquilo-a

b. Nervioso-a

c. Otros……..

P.49. ¿Crees que resultan útiles la información obtenida de las evaluaciones psicológicas?

a. No

b. Sí

c. ¿Por qué?

……

Personalidad

P.50. ¿Te resulta fácil hablar de asuntos personales ante desconocidos-as?

a. No

b. Sí

Código				/		
(a rellenar por el/la entrevistador/a)						

Cuestionario sobre las variables sociodemográficas y culturales en personas de diferente procedencia

PREGUNTAR AL FINALIZAR LA ENTREVISTA

P.51. ¿El tipo de lenguaje (formal-informal) empleado en la evaluación ha sido adecuado?

a. No
b. Sí

P.52.¿Te has sentido cómodo-a con las preguntas?

a. No
b. Sí

P.53. ¿Los materiales y tareas empleados resultan difíciles de entender?

a. No
b. Sí

Una vez haya finalizado la entrevista, señalar el índice de desarrollo Humano (IDH) del país de origen

P.54. IDH:

a. IDH Muy Alto

b. IDH Alto

c. IDH Medio

d. IDH Bajo

Anexo 2

Fasfous, A. F., Puente, A. E., Pérez-Marfil, M. N., Cruz-Quintana, F., Peralta-Ramírez, I., & Pérez-García, M. (2013). Is the Color Trails Culture Free?. *Archives of Clinical Neuropsychology*, *28*(7), 743-749.

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Is the Color Trails Culture Free?

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Abstract

Increasingly clinical neuropsychology has been addressing the effects of culture on neuropsychological functioning. However, that focus has been on comparing performance on standardized tests across two or more groups, often Hispanic. In this study, Arabic children were tested in Morocco using a "culture-free test," Children's Color Trails. Children of different ages and living in rural and urban centers were tested. The results suggest that the Color Trails Test scores from Arab children differed from U.S. norms available. Furthermore, the location of testing and the age of the child were of significance. The role of culture-specific tests was considered.

Keywords: Arab Children; Culture; Neuropsychology; Non-verbal test

Introduction

Culture is a critical issue in neuropsychological assessment, and a number of studies have emphasized the significant effect of culture on neuropsychological assessment (Ardila, 1995, 2005; Greenfield, 1997; Jacobs et al., 1997; Luria, 1976; Ostrosky-Solís, Ramírez, Lozano, Picasso, & Vélez, 2004; Puente & Ardila, 2000; Agranovich et al., 2011). Trying to address this influence, several neuropsychological tests have been developed under the label of "culture fair." However, most of these tests have only been tested in Anglo-Saxon or Hispanic samples of adults. For this reason, the main objective of this paper is to examine if the Children's Color Trails Test (CCTT) could be considered as a culture fair test using an Arabic children sample.

Two types of tests can be used in cross-cultural studies—the culture-free test and the culture-specific test. In this study, we utilized the Children's version of the CCT (D'Elia, Staz, Uchiyama, & White, 1996), which is presented as a culture-free version of the Trail Making Test (TMT A&B; Reitan, 1979). The TMT is one of the most often used neuropsychological tests in the USA (Rabin, Barr, & Burton, 2005) and is sensitive to cognitive impairment (Lezak, 1995; Mitrushina, Boone, & D'Elia, 1999; Reitan, 1979). Research has suggested that culture and language may have an effect on the TMT and the Children's TMT (Reitan, 1971), perhaps due to the usage of the English alphabetic letters (Dugbartey, Townes, & Mahurin, 2000; Lee, Cheung, Chan, & Chan, 2000; Leon-Carrion, 1989; Mok, Tsang, Lee, & Llorente 2008; Rosin & Levett, 1989). However, in a study using an Arabic Version of the Expanded TMT to compare healthy and brain-damaged adults from Sudan with healthy and brain-damaged adults from the USA, researchers found that the healthy Sudanese group scored similar to the North American brain-damaged group (Stanczak, Stanczak, & Awadalla, 2001).

The CTT was developed to reduce the effect of the language and culture on the TMT by using numbers and colors instead of numbers and alphabetic letters (D'lia et al., 1996). The CCTT (Llorente, Williams, Satz, & D'Elia, 2003) is a special version for children that is similar to the Children's TMT. The CCTT is functionally equivalent to the Children's TMT in distinguishing the difference between normal children and children with cognitive impairment in different countries, such as Korea (Koo & Shin,

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2008) and the USA (Llorente et al., 2003; Williams et al., 1995). The validity and reliability for the CCTT have been reported in different studies (Koo & Shin, 2008; Llorente et al., 2009; Williams et al., 1995).

Literature suggests that multiple variables such as age, gender, and IQ could have an impact on CCTT scores. Several studies show evidence that age is highly correlated with better performance on the CCTT (Koo & Shin, 2008; Llorente et al., 2003; Williams et al., 1995), whereas gender appears to have a smaller effect. Although Williams and colleagues (1995) found that girls were faster than boys in completing the CCTT2 and Llorente and colleagues (2003) found girls were faster in the CCTT1, more recent research has found no significant gender differences in CCTT scores (Mok et al., 2008). Another variable that seems to have an effect on CCTT performance is IQ, in that children with higher IQs tend to be able to complete the CCTT more quickly (Mok et al., 2008; Williams et al., 1995). Recently, in a study conducted among Chinese children from Hong Kong, Mok and colleagues (2008) found that the CCTT was influenced by children's language backgrounds, in that children with Chinese as their dominant language tended to perform better than both English-Chinese bilinguals and children with English as their dominant language.

Although the CCTT is widely used in neuropsychological assessment (Mok et al., 2008; Strauss, Sherman, & Spreen, 2006), only two cross-cultural studies to our knowledge have examined the effect of culture on the CCTT (Koo & Shin, 2008; Mok et al., 2008). Although normative data for the CCTT are provided for North American (Llorente et al., 2003) and Korean children (Koo & Shin, 2008), normative data and cross-cultural studies using the CCTT are not available in the Arab world.

The Arab world consists of 22 countries with more than 300 million inhabitants (League of Arab States, 2011). Clinical neuropsychology is not developed in these countries, and few studies have examined the effect of the Arab culture on the neuropsychological test in children (Sobeh & Spijkers, 2012) and adults (El-Sheikh, El-Nagdy, Townes, & Kennedy, 1987; Khalil, 2010; Stanczak et al., 2001). The aim of this study was to obtain preliminary CCTT data for Moroccan Arab children and also to examine the effect of culture on CCTT performance. We hypothesized that the results of normal Moroccan children ages 7, 9, and 11 will be different from those presented in the manual.

Method

Participants

Participants included a total of 154 school-aged children (76 boys and 78 girls) ages 7, 9, and 11 and from different grade levels were recruited from schools belonging to two different areas in the province of Chefchaouen. The children in the first group were recruited from a school located in the downtown area of Chefchaouen. This group consisted of 78 children (39 boys and 39 girls), including 26 second graders (13 boys and 13 girls), 26 fourth graders (13 boys and 13 girls), and 26 sixth graders (13boys and 13 girls). The children in the second group were recruited from a school located in the outskirts of Chefchaouen. This group consisted of 76 children (37 boys and 39 girls), including 24 second graders (11 boys and 13 girls), 26 fourth graders (13 boys and 13 girls), and 26 sixth graders (13 boys and 13 girls). According to teachers and parents interviews, all participants were free from any medical problems.

Approval was obtained from the Ethical Committee of the University of Granada (Spain) to conduct the study, and permission from the Delegation of Education in the province of Chefchaouen (Morocco) was obtained to conduct this study in the aforementioned schools. Informed consent was then obtained from a parent of each of the participants.

Instrument

The CCTT (Llorente et al., 2003). The CCTT measures speed of visual attention, sequencing, mental flexibility, and motor function among children ages 8–16. This test consists of two parts—Parts 1 (CCTT1) and 2 (CCTT2). Part 1 (CCTT1) is comprised of a page with 15 randomly arranged numbered and colored circles, with the even numbers printed in yellow circles and the odd numbers printed pink circles. The child uses a pencil to rapidly connect circles numbered 1–15 in sequence. Part 2 (CCTT2) is comprised of a series of colored circles, also numbered 1–15. Each number (from 2–15) is presented twice—once in a pink circle and once in a yellow circle. The child rapidly connects the numbered circles in sequence, alternating between pink and yellow circles. The examiner records the time needed to complete each trial and all errors committed. In this study, completion time for each trial and the interference score (CCTT1 − CCTT2/CCTT1) were used as variables for analysis.

Procedure

Initially, the senior author met with the directors of the respective schools to explain the objective and the process of the study. This meeting, as well as all other aspects of the research conducted in Morocco, was done so in Arabic (the native language of the senior

author). Each of the schools' directors verbally agreed (as is the custom) to allow their students to participate in the study. An empty classroom was provided in each school to conduct the study. Participants were then randomly selected from each school's list of students and assent to participate in the study was obtained from each participant (also, the custom). The CCTT was subsequently individually administered to the participants during the academic day. The CCTT was administrated according to the administration guidelines provided by the manual of the CCTT (Llorente et al., 2003). Completion time for each trial was recorded.

Statistical Analysis

Descriptive statistics regarding performance according to age, gender, and location (school) were initially obtained. Student's *t*-test was then used to study gender differences, and a one-way analysis of variance (ANOVA) was used to study age differences. Finally, eight estimated *t*-tests were conducted using the GraphPad software to test differences in CCTT performance between Moroccan and North American children (Llorente et al., 2003) according to age and gender.

Results

Descriptive Data From the Two Forms of the CCTT

Means and standard deviations for CCTT1 and CCTT2 completion time and the interference score were calculated according to age and gender (Table 1).

Table 1. Means and standard deviations of CCTT variables by age and gender

Age (years)	*n*		Time completion CCT1 (*M* [*SD*])		Time completion CCT2 (*M* [*SD*])		Interference (*M* [*SD*])	
	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls
7	24	26	82.9 (30.19)	78.67 (29.17)	137.87 (54.40)	134.56 (47.50)	0.81 (0.76)	0.83 (0.75)
9	26	26	59.98 (26.03)	54.03 (18.79)	90.99 (30.73)	87.11 (28.61)	0.64 (0.50)	0.70 (0.52)
11	26	26	45.07 (16.19)	36.75 (12.40)	73.33 (17.11)	58.54 (18.19)	0.77 (0.61)	0.68 (0.49)

Table 2. Results of a one-way ANOVA evaluating age differences in CCTT performance

Variables	7 years (mean [*SD*])	9 years (mean [*SD*])	11 years (mean [*SD*])	*F*-value	*p*-value
CCTT 1	80.72 (29.44)	57.01 (22.68)	40.91 (14.89)	38.52	<0.0001
CCTT 2	136.15 (50.43)	89.05 (29.46)	65.94 (19.01)	52.42	<0.0001
Interference	0.82 (0.75)	0.67 (0.51)	0.72 (0.55)	0.78	0.461

Gender Differences

Student's *t*-test was used to examine gender differences in CCTT performance. There was no statistically significant effect of gender on CCT completion time variables. Similarly, no gender differences were found in the interference index.

Age Differences

A one-way ANOVA was used to evaluate differences in CCTT performance according to age. Results indicated a statistically significant influence of age on the completion time of both the CCTT1, $F(2,151) = 38.52$, $p < 0.0001$, and CCTT2, $F(2,151) = 52.42$, $p < 0.0001$. No statistically significant age differences were found in the interference index, $F(2,151) = 0.78$, $p < .461$. A posteriori comparisons (Bonferroni) indicated that children aged 11 faster than children ages 9 and 7 in time completion for both CCTT trials, and no statistically significant differences were found between children aged 9 and 7 (Table 2).

Geographical Differences

Student's *t*-test was performed to evaluate differences in CCTT performance according to the geographical location. Results indicated no significant differences between children from the downtown area and children from the border area in CCTT1 completion time, CCTT2 completion time, or the interference score.

Table 3. Differences between North American children and Moroccan children in CCTT time to completion

Age	CCTT1						CCTT2					
	American boys (*M* [*SD*])	Moroccan boys (*M* [*SD*])	*p*-value	American girls (*M* [*SD*])	Moroccan girls (*M* [*SD*])	*p*-value	American boys (*M* [*SD*])	Moroccan boys (*M* [*SD*])	*p*-value	American girls (*M* [*SD*])	Moroccan girls (*M* [*SD*])	*p*-value
9	24.42 (11.70)	59.98 (26.03)	<0.0001	22.38 (11.70)	54.03 (18.79)	<0.0001	52.80 (18.90)	90.99 (30.73	<0.0001	51.95 (21.13)	87.11 (28.61)	<0.0001
11	21.41 (8.42)	45.07 (16.19)	<0.0001	15.82 (5.05)	36.75 (12.40)	<0.0001	49.27 (19.57)	73.33 (17.11)	<0.0001	35.82 (13.42)	58.54 (18.19)	<0.0001

Cultural Differences

To examine the effect of culture on CCTT performance, the Moroccan data obtained in the present study were compared with the North American data provided in the CCTT manual (Llorente et al., 2003). Results indicated significant differences between groups, in that the American children were much faster than the Moroccan children in completing both trials of the CCTT (Table 3).

Discussion

Normative data for psychological and neuropsychological tests are necessary for appropriate assessment and interpretation. The aim of the present study was to obtain preliminary CCTT data for Arabic children and also to examine the effect of culture on CCTT test scores. Results indicated that age has a potential effect on completion time for the two trials of the CCTT. No gender differences were found between boys and girls or between the two geographical areas identified in the CCTT performance.

Despite the CCTT being presented as a culture-free test by its authors, results indicated that completion times of the CCTT1 and CCTT2 for Moroccan children were higher than those provided in the professional manual for North American children (Llorente et al., 2003). In other words, Moroccan children were significantly slower than North American children in completing the two CCTT trials. In applying the North American norms to the Moroccan children (controlling for age and gender), we found all Moroccan children to be in the clinically impaired range; similar results were found when comparing the normally developing Moroccan children with North American children who have learning disabilities, mild neurological conditions, or learning disabilities with attention deficits (Llorente et al., 2003; Williams et al., 1995). These findings are consistent with those of Stanczak and colleagues (2001), who found that normal Sudanese adults perform similar to North American patients with brain damage on the Expanded TMT. The significant difference in CCTT performance between Moroccan and North American children as demonstrated in the present study may be due to the effect of cultural factors on cognitive functions; in other words, the test itself may not be truly "culture-free." Differences in the degree of importance placed on time in the Moroccan and North American cultures may have also impacted these differences in performance, particularly given that the CCTT is a timed test. In other words, American children may be more exposed to living with time constraints in their culture when compared with Arab children, who may not have received such exposure. Additionally, the educational system in Morocco is generally more flexible with time than is the American educational system. For example, Moroccan teachers design the day's schedule according to the ability of children in understanding the subjects; also, more time is often given to Moroccan children during their exams. Furthermore, the American culture may be more competitive in nature than the Arab culture. This may be the case in other cultures as well. A study conducted by Agranovich and Puente (2007) suggested that American adults performed better than Russian adults on the CCT and other timed tests due to the familiarity of the American participants with timed testing procedures. Another factor which may impact cultural differences may be familiarity with standardized testing and/or with this type of test. In fact, most of the children who participated in this study have not been exposed to testing. Some research has in fact indicated that familiarity with tests could be a cultural factor that has an effect on neuropsychological test performance (Ardila, 2005; Puente & Perez-Garcia, 2000).

Age had a significant effect on CCTT performance in the present study, as older age was associated with faster CCTT1 and CCTT2 completion time. This is most likely a result of the normal neurodevelopment in these children, particularly given that this finding is consistent with results from studies in the normative sample as well as in with other cultures (Koo & Shin, 2008; Llorente et al., 2003; Williams et al., 1995). Although previous research has suggested a small effect of gender on CCTT performance (Llorente et al., 2003; Williams et al., 1995), our results did not find any such differences to be statistically significant. This is in contrast with findings reported by Llorente and colleagues (2003), who found that girls complete the CCTT1 more quickly than boys, and also in contrast with those of Williams and colleagues (1995), who found that girls were faster than boys in completing the CCTT2. However, our results are in agreement with those of Mok and colleagues (2008), who found that the CCTT is not influenced by gender.

Finally, it is important to consider that in some variables the magnitude of the differences between the two groups is double. Although there are few studies about cultural differences among children, other studies revealed similar differences to the present results in the Children's TMT (Leon-Carrion, 1989) and other nonverbal tests (Rosselli & Ardila, 2003). Furthermore, differences between groups should consider standard deviations. Previous research has demonstrated that standard deviations in non-verbal tests are different across groups from different cultures (Rosselli & Ardila, 2003). For example, if the standard deviation of the Moroccans group in the CCTT1 is used, 9year-old Moroccans children scored 1.36 *SD* less than the U.S. sample. At the same time, when using the standard deviation of American children, the Moroccan group scored 3.03 *SD* less than the U.S. one. We hypothesize that cultural differences may be more robust in children than in adults. This could be because education can reduce such differences (Ardila, Ostrosky-Solis, Rosselli, & Gómez, 2000) or that the interface between culture and development

make differences more likely. This effect can also be seen in the present results. Differences in 11 years old Moroccan and American children are lower than those in 9-year-old groups.

The present study does have several limitations. First, the sample was collected only from the city of Chefchaouen, which is located in northern of Morocco and is generally considered a rural area. The generalizability of these findings to urban children or those living in other areas of the Arab world is not known. Secondly, variables such a socio-economic status and IQ that could conceivably affect CCTT performance were not measured or controlled for in the present study. Finally, this study was conducted among healthy children and does not include a clinical sample.

Nevertheless, this study is the first of its kind to provide data regarding CCTT performance in Moroccan-Arab children. Our results do suggest that cultural factors have an effect on CCTT performance, thus highlighting the need for further development of the CCTT before it is be considered to be truly the culture-free test. These findings also emphasize the need to consider culture-specific tests in clinical neuropsychology. Finally, this study further supports the need to consider culture as important as other demographic variables, such as age and education, in neuropsychological assessment.

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Conflict of Interest

None declared.

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Anexo 3

Fasfous, A. F., Hidalgo-Ruzzante, N., Vilar-López, R., Catena-Martínez, A., & Pérez-García, M. (2013). Cultural Differences in Neuropsychological Abilities Required to Perform Intelligence Tasks. *Archives of Clinical Neuropsychology*. doi:10.1093/arclin/act074

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Cultural Differences in Neuropsychological Abilities Required to Perform Intelligence Tasks

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Abstract

Different studies have demonstrated that culture has a basic role in intelligence tests performance. Nevertheless, the specific neuropsychological abilities used by different cultures to perform an intelligence test have never been explored. In this study, we examine the differences between Spaniards and Moroccans in the neuropsychological abilities utilized to perform the Beta III as a non-verbal intelligence test. The results showed that the Spaniard group obtained a higher IQ than the Moroccan group in the Beta III. Moreover, the neuropsychological abilities that predicted scores for the Beta III were dependent on the country of origin and were different for each subtest. Besides showing the cultural effect on non-verbal intelligence test performance, our results suggest that a single test may measure different functions, depending on the subject's cultural background.

Keywords: Culture; Non-verbal test; IQ; Cognitive functions; Moroccan; Spaniards

Introduction

Cultural differences in intelligence tests performance are widely accepted (Herrnstein & Murray, 1994; Kaufman, Mclean, & Reynolds, 1988; Neisser et al., 1996), and several studies have shown differences in the intelligence quotient (IQ) among different cultural groups (i.e., Rushton & Skuy, 2000). It is accepted that the concept of intelligence may differ for various cultures (Sternberg & Grigorenko, 2004; Sternberg & Kaufman 1998) and that to measure intelligence, we must understand it within its cultural context (Sternberg & Grigorenko, 2004).

On a related note, the fundamental role of culture in developing cognitive abilities is well known (Luria, 1973, 1976). The cognitive abilities developed may vary from one culture to another. Thus, people from different cultures may perform differently on the same cognitive test according to the importance of this specific cognitive ability in their own culture (Bakos, Denburg, Fonseca, & Parente, 2010; Ostrosky-Solís, Ramirez, & Ardila, 2004). Furthermore, recent studies show that cultural factors may not only influence cognitive functions, but also neural function (Gutchess, Welsh, Boduroglu, & Park, 2006; Park & Huang, 2010) and neuronal structure (Zilles, Kawashima, Dabringhaus, Fukuda, & Schormann, 2001).

Numerous studies have shown a positive correlation between IQ and neuropsychological performance; people with a high IQ tend to have higher performance on neuropsychological tests compared with people with a lower IQ (Diaz-Asper, Schretlen, & Pearlson, 2004; Tremont, Hoffman, Scott, & Adams, 1998). Nevertheless, there is a lack of consensus about what specific neuropsychological functions and/or tests are related to intelligence. Thus, processing speed (Neisser et al., 1996; Sheppard & Vernon, 2008), long-term memory (Unsworth, 2010), or working memory (Colom, Flores-Mendoza, & Rebollo, 2003; Conway, Cowan, Bunting, Therriault, & Minkoff, 2002; Kane, Hambrick, & Conway, 2005) have been related to fluid intelligence. As an example,

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the intelligence matrix test has been related with working memory (i.e., Conway et al., 2002), but the matrix subtest of the WAIS-III is included into the visual perceptive index (Wechsler, 1997).

Although the relationship between intelligence and performance in neuropsychological tests has been investigated in various studies (Conway et al., 2002; Diaz-Asper et al., 2004), researchers have not yet studied the cognitive abilities that people with different cultural backgrounds use to perform the same intelligence test or whether these abilities are different for each culture. Such studies could be of great interest and would reveal not only what intelligence tests are measuring in each culture but also whether the cognitive processes used to carry out these tests are the same in all cultures.

Thus, our objective is to study whether there are differences between the Spaniard and Moroccan groups in the neuropsychological abilities used to perform the same intelligence test. In accordance with previous studies mentioned above that have shown relation between neuropsychological and intelligence tests and the influence of culture on various cognitive areas (i.e., Rule, Freeman, & Ambady, 2013), we hypothesize that the cognitive processes will differ for participants based upon their cultural background.

Method

Participants

As this study was conducted in Spain, we selected a group of Spaniards and also a group of Moroccans because the Arab is one of the largest minorities in Spain (Instituto Nacional de Estadística - Spain, 2012). This group selection guarantees cultural differences, since both have different languages (Arabic vs. Spanish), religions (Muslim vs. Christian), traditions, and radically different geographies (Africa vs. Europe).

The study included 54 healthy adults with a mean age of 26.67 years (SD = 4.39 years). A total of 27 participants were from Spain, and 27 participants were Moroccan immigrants living in Spain. Most of Moroccan participants (77.8%) were University students that attend to classes taught in Spanish language. Also, according to the initial interview with the participants, 46.7% of the Moroccan group speaks Spanish since they were children, 55.6% speak Spanish at home, and 48.1% normally think in Spanish. Thus, Spanish language proficiency was quite high in this sample.

To select the participants, we considered the following inclusion criteria: a range between 18 and 55 years old; the ability to read and write in Spanish sufficient to understand the instructions and tests; and no history of mental disorders, neurological disorders, or substance abuse.

The participants received verbal and written information about the study objectives and details and provided informed consent to be included in the study. The confidentiality of personal information was guaranteed in accordance with Spanish legislation on personal data protection (Organic Law 15/1999, December 13). The Ethics Committee of the University of Granada approved the present study. The volunteers received €20 for participating in this study.

Instruments

The Beta III was selected to assess intelligence because it is a non-verbal test supposedly not influenced by language influences and minimally influenced by culture (Kellogg & Morton, 1999). To evaluate neuropsychological components, we used a comprehensive neuropsychological battery with instruments typically used in our laboratory because they are commonly used for the Spanish population. Most of these instruments are used internationally in neuropsychological cross-cultural studies (Agranovich & Puente, 2007; Bakos et al., 2010; Boone, Victor, Wen, Razani, & Pontón, 2007; Ostrosky-Solis, Gutierrez, Flores, & Ardila, 2007). All tests were administered in Spanish in the following order:

First, non-verbal intelligence test:

(i) Beta III (Kellogg & Morton, 1999) is a non-verbal intelligence test composed of five subtests: Coding, picture completion, clerical checking, picture absurdities, and matrix reasoning. The duration for the Beta III test is 20–25 min. Various studies have demonstrated the validity of Beta III as well as its correlation with WAIS-III and progressive matrices (Kellogg & Morton, 1999).

Second, neuropsychological tests: A comprehensive neuropsychological battery of tests was administered to all participants.

(ii) Hooper Visual Organization Test (Hooper, 1958, revised in 1983): This test evaluates the capacity of an individual to visually integrate information.

(iii) Color Trails Test (CTT-A&B; D'Elia, Satz, Uchiyama, & White, 1999): To assess motor function and cognitive flexibility.
(iv) Test of Attention (d2; Brickenkamp, 1962): This test concisely measures selective attention and mental concentration.
(v) Hopkins Verbal Learning Test (HVLT; Benedict, Schrotlen, Groninger, & Brandt, 1998): To measure learning and verbal memory capacity. We used the Spanish version by Bilbao and colleagues (2007).
(vi) Rey Complex Test and Figure Test and Recognition Trial (Meyers and Meyers, 1995): This test measures visual memory capacity.
(vii) Semantic Verbal Fluency Test (Valencia et al., 2000): This test was included to assess verbal fluency.
(viii) Ruff Figural Fluency Test (RFFT; Ruff, 1996): This test is for non-verbal fluency.
(ix) Backward Digit Span (WAIS-III; Wechsler, 1999): To evaluate working memory.
(x) Iowa Gambling Task (IGT; Bechara, Damasio, Damasio, & Anderson, 1994): This computerized test evaluates decision-making.

Procedure

The participants were recruited as volunteers from January 2009 to July 2011 from various non-profit organizations working with immigrants in Granada and among the University of Granada students. Assessments were conducted in Spanish, and the total duration of the evaluation was approximately 2 h 30 min per participant, including a 15-min break at the middle of the session and an initial interview to collect socio-demographic information and to guarantee the inclusion/exclusion criteria.

Statistical analysis

First, either the Student's *t*-test or contingency analysis (chi-squared) was performed as appropriate to compare the principal socio-demographic variables between the two groups.

Second, the Student's *t*-test was used to study whether the Moroccan and Spanish groups were different for the intelligence and cognitive variables.

Third, we analyzed whether the neuropsychological performance predicted the Beta III scores based on the country of origin. Thus, five regression analyses were performed, one for each Beta III subtest. Neuropsychological scores and their relationship with the country of origin variable were used as predictors, and the dependent variables were the Beta III subtest scores. The relationships were identified by multiplying the neuropsychological scores using a different constant for each group. Because the total score for Beta III is a linear sum of the subtest scores, this process was not performed for the total score. The level of significance was adjusted to 0.01 in accordance with the Bonferroni correction.

Finally, to understand the variance and predictors using the Beta III test, 10 regression analyses were performed—five for each country—using only the neuropsychological variables related to the country of origin variable as predictors for each subtest.

Results

First, we compare the socio-demographic variables between Moroccan and Spaniards participants. Results indicate no difference between groups in age, gender, education level, and monthly income (Table 1).

Table 1. Descriptive statistics and analysis for the different groups on the socio-demographic variables

Characteristics	Moroccan ($n = 27$)	Spaniards ($n = 27$)	χ^2/t	p-value
Men	48.1% (13)	48.1% (13)	0.074	.79
Women	51.9% (14)	51.9% (14)		
Age (years)	27.77 (5.1)	25.63 (3.33)	1.77	.08
Elementary education	14.8% (4)	0% (0)	4.53	.209
Secondary education	7.4% (2)	11.1% (3)		
Undergraduate education	44.4% (12)	55.5% (15)		
Graduate education	33.4% (9)	33.4% (9)		
Income/month <€360	37% (10)	48.1% (13)	0.216	.642
Between €361 and €900	51.9% (14)	51.9% (14)		

Note: The monthly income is low because the majority of participants are students.

Table 2. Differences between Moroccan and Spaniards groups in intelligence and neuropsychological tests

Tests	Spaniards *M* (*SD*)	Morrocan *M* (*SD*)	*t*	*p*-value	*d*
HVOT	26.72 (2.04)	18.30 (5.23)	−7.799	**<.001****	2.32
CTT -A	33.04 (10.28)	57.26 (30.31)	3.932	**<.001****	1.19
CTT-B	64.11 (12.32)	96.41 (38.06)	4.195	**<.001****	1.28
d2	472.56 (70.48)	419.07 (72.63)	−2.746	**.008****	0.75
HVLT	28.63 (3.96)	23.41 (3.90)	−4.883	**<.001****	1.33
RCFT-C	35.37 (1.08)	32.78 (3.93)	−3.303	**.002****	1.03
RCFT-DR	27.46 (4.43)	20.28 (6.67)	−4.663	**<.001****	1.29
RCFT-IR	26.59 (5.32)	20.17 (6.16)	−4.102	**<.001****	1.19
VFT-ANIMALS	25.23 (5.54)	12.22 (4.59)	−8.997	**<.001****	2.59
VFT-FRUITS	14.41 (3.12)	11.26 (3.35)	−3.367	**.002****	0.97
RFFT	100.22 (17.61)	95.41 (30.39)	−0.712	.480	0.2
BDS	7.04 (1.70)	5.52 (1.70)	−3.288	**.002****	0.89
IGT	24.74 (27.76)	6.37 (22.17)	−2.687	**.010****	0.74
Coding[a]	82.15 (12.57)	64.30 (18.13)	−4.205	**<.001****	1.16
Picture completion [a]	14.52 (3.53)	10.56 (2.72)	−4.616	**<.001****	1.27
Clerical checking [a]	41.70 (3.59)	35.96 (7.50)	−3.586	**.001****	1.04
Picture absurdities [a]	21.41 (2.33)	16.33 (4.37)	−5.329	**<.001****	1.52
Matrix reasoning [a]	21.07 (2.50)	16.15 (4.70)	−4.807	**<.001****	1.34
Beta - IQ	105.52 (11.48)	87.00 (11.82)	−5.980	**<.001****	1.59

Notes: HVOT = total scores in Hooper Visual Organization Test; CTT-A = completion time of Color Trails Test-A; CTT-B = completion time of Color Trails Test-B; d2 = d2 total score; HVLT = total scores in Hopkins Verbal Learning Test; RCFT-C = Complex Test and Figure Test and Recognition-copy: RCFT-DR = delayed recall; RCFT-IR = immediate recall; VFT = Verbal Fluency Test; RFFT = Ruff Figural Fluency Test; BDS = Backward Digit Span; IGT = total score in Iowa Gambling Task.
[a]Beta subtests.
**$p < .01$.

Table 3. Regression models to analyze whether neuropsychological test results predict IQ scores based on the country of origin

Beta III subtests	Interaction			Spaniards			Moroccan		
	Variables	Adj. R^2	*p*-value	Variables	Adj. R^2	*p*-value	Variables	Adj. R^2	*p*-value
Coding	Country d2 BDS **Int_BDS**	.661	**<.001****			**.018***	BDS	.357	**.001****
Picture Completion	Country CTTA d2 HVOT **int_CTTA** **int_CTTB** **int_HVLT**	.664	**<.001****	CTTA HVLT	.525	**.001****	CTTB	.315	**.014***
Clerical Checking	Country CTTA d2 **int_CTTB** **int_d2**	.558	**<.001****	CTTB	.204	**.016***	d2	.221	**.012***
Picture Absurdities	Educational Level HVOT	.532	**<.001****						
Matrix Reasoning	CTTA d2 BDS IGT **int_CTTA** **int_CTTB** **int_BDS** **int_HVOT** **int_IGT**	.786	**<.001****	CTTA	.409	**.011***	CTTB BDS IGT	.555	**.034*** **.003**** **.024***

Notes: Adj. = Adjusted; d2 = d2 total score; BDS = Backward Digit Span; int = interaction with country (i.e., int_BDS = interaction between country and BDS is significant); CTTA = completion time of Color Trails Test-A; HVOT = total scores in Hooper Visual Organization Test; CTTB = completion time of Color Trails Test-B; HVLT = Hopkins Verbal Learning Test; IGT = total score in Iowa Gambling Task.
*$p < 0.05$.
**$p < 0.01$.

Differences in Intelligence and Neuropsychological Tests Between Spaniards and Moroccans

The results showed significant differences in the Beta III subtests and the total score between both groups in favor of the Spanish group. Also, results indicate that the Spaniard group significantly outperformed the Moroccan one in all of the neuropsychological tests, with the exception of the Ruff Figural Fluency. Cohen's *d* was calculated to obtain the effect sizes (Table 2).

Which Neuropsychological Variables Predict Beta III Performance?

The results showed that the neuropsychological variables that predicted scores for the Beta III were dependent on the country of origin and were different for each subtest, except for subtest 4 (picture absurdities). The level of prediction for each variable was between 0.558 and 0.786 (Table 3). For Beta III subtest 1 (coding), the performance on backward digit span was a predictor for the Moroccan group's score, $t = 3.93$, $p = .001$. However, none of the neuropsychological tests were predictive of the Spanish group's score.

For subtest 2 (picture completion), performances on the CTT-A, $t = -2.54$, $p = .018$, and Hopkins Verbal and Learning Test, $t = 3.92$, $p = .001$, were predictive for the Spanish group, whereas performance on the CTT (A and B) was the predictor for the Moroccan group, $t = -2.65$, $p = .014$.

For Beta III subtest 3 (clerical checking), the CTT (trail 2) performance was a predictor for the Spanish group, $t = -2.60$, $p = .016$, and d2 was the predictor for the Moroccan group, $t = 2.70$, $p = .012$.

Finally, the CTT (trail 1) performance was a subtest 5 predictor (matrix reasoning) of performance for the Spanish group, $t = -2.79$, $p = .011$, whereas performance on the CTT (trail 2), $t = -2.27$, $p = .034$, backwards digit span, $t = 3.41$, $p = .003$, and IGT, $t = 2.43$, $p = .024$, were the three predictors of the matrix reasoning subtest for the Moroccan group (see Table 3).

Discussion

The present study aimed to explore differences between two different cultural groups (Spaniards and Moroccans) in non-verbal IQ (measured by the Beta III) and the cognitive skills used to perform this test for these two different cultures. The results showed significant differences between the Spanish and Moroccan groups for Beta III subtests and total IQ as well as for all of the cognitive tests except for the RFFT. The neuropsychological tests that predicted IQ were different for each cultural group.

Although the Spanish and Moroccan groups were similar in terms of age, sex, economic status, and educational level, the cognitive performance of the Spaniards was better than that of the Moroccans. This is the first study that compares these groups on a comprehensive neuropsychological battery, and the results support the vast literature demonstrating cultural differences on cognitive tests (Agranovich, Panter, Puente, & Touradji, 2011; Bakos et al., 2010; Boone et al., 2007; Rosselli & Ardila 2003). Also, total IQ for the Spanish group was significantly higher compared with the Moroccan group. These results are consistent with previous literature to confirm the cultural difference in IQ. And agree with certain studies conducted in the Netherlands, where Moroccan immigrants generated a lower IQ than the Dutch (te Nijenhuis & van der Flier, 1997, 2001). Our results are also consistent with another study that used the Raven test (a non-verbal test) to compare Spaniards living in Spain with Moroccans living in Morocco (Díaz, Sellami, Infanzón, Lanzón, & Lynn, 2012). Also, similar to other studies (Ardila, 2005; Agranovich & Puente, 2007; Rosselli & Ardila, 2003), our results emphasize the notion that non-verbal tests are not necessarily free of cultural influence.

The performance on various neuropsychological tests was correlated with the performance on intelligence tests, which is consistent with the results of previous studies (Colom et al., 2003; Diaz-Asper et al., 2004). However, the principal novelty for this study herein is that the neuropsychological test performances that predict Beta III scores (except for picture absurdities) differed between the Spaniard and Moroccan groups. For the Moroccan group, the cognitive tasks that predict performance on Beta III are Backward Digit Span (working memory), Color Trail Test-B (shifting), d2 (attention), and IGT (decision-making). In contrast, CTT-A and B (motor coordination, shifting) and HVLT (verbal memory) predicted Beta III scores for the Spanish group. Those differences could be due to familiarity with psychological tests and timed testing (Agranovich et al., 2011; Agranovich & Puente, 2007; Ardila, 2005; Puente, Perez-Garcia, Vilar-Lopez, Hidalgo-Ruzzante, & Fasfous, 2013). Processing of novelty stimulus has been related with an increased cognitive control and activation of prefrontal cortex (Barcelo, Escera, Corral, & Periáñez, 2006; Kishiyama, Yonelinas, & Knight, 2009; Løvstad et al., 2011). Thus, coping with unfamiliar task could require using more complex neuropsychological processes.

In our study, 80% of the Moroccan and 20% of the Spaniard participants never performed a psychological test, according to one of the questions included in the socio-demographic interview. This difference in familiarity may have impacted in the group performance (Díaz et al., 2012), so that Moroccans rely on more complex skills related to executive function compared with Spaniards to execute the same non-verbal intelligence task. This hypothesis is consistent with other studies that show differences

Differences in Intelligence and Neuropsychological Tests Between Spaniards and Moroccans

The results showed significant differences in the Beta III subtests and the total score between both groups in favor of the Spanish group. Also, results indicate that the Spaniard group significantly outperformed the Moroccan one in all of the neuropsychological tests, with the exception of the Ruff Figural Fluency. Cohen's *d* was calculated to obtain the effect sizes (Table 2).

Which Neuropsychological Variables Predict Beta III Performance?

The results showed that the neuropsychological variables that predicted scores for the Beta III were dependent on the country of origin and were different for each subtest, except for subtest 4 (picture absurdities). The level of prediction for each variable was between 0.558 and 0.786 (Table 3). For Beta III subtest 1 (coding), the performance on backward digit span was a predictor for the Moroccan group's score, $t = 3.93$, $p = .001$. However, none of the neuropsychological tests were predictive of the Spanish group's score.

For subtest 2 (picture completion), performances on the CTT-A, $t = -2.54$, $p = .018$, and Hopkins Verbal and Learning Test, $t = 3.92$, $p = .001$, were predictive for the Spanish group, whereas performance on the CTT (A and B) was the predictor for the Moroccan group, $t = -2.65$, $p = .014$.

For Beta III subtest 3 (clerical checking), the CTT (trail 2) performance was a predictor for the Spanish group, $t = -2.60$, $p = .016$, and d2 was the predictor for the Moroccan group, $t = 2.70$, $p = .012$.

Finally, the CTT (trail 1) performance was a subtest 5 predictor (matrix reasoning) of performance for the Spanish group, $t = -2.79$, $p = .011$, whereas performance on the CTT (trail 2), $t = -2.27$, $p = .034$, backwards digit span, $t = 3.41$, $p = .003$, and IGT, $t = 2.43$, $p = .024$, were the three predictors of the matrix reasoning subtest for the Moroccan group (see Table 3).

Discussion

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In our study, 80% of the Moroccan and 20% of the Spaniard participants never performed a psychological test, according to one of the questions included in the socio-demographic interview. This difference in familiarity may have impacted in the group performance (Díaz et al., 2012), so that Moroccans rely on more complex skills related to executive function compared with Spaniards to execute the same non-verbal intelligence task. This hypothesis is consistent with other studies that show differences

in cognitive processes for Western and Eastern people (Nisbett & Masuda, 2003; Nisbett, Peng, Choi, & Norenzayan, 2001). This could be explored in future studies, including groups from different cultures with different ranks of familiarity with neuropsychological testing.

Among the limitations herein, the sample size is small, which may limit the data's statistical power and generalization. However, the Cohen's *d* showed moderate to large effect sizes. Another limitation is that we are comparing an immigrant group with a non-immigrant, but the two groups had similar educational and economic levels. In the future, it would be interesting to study the relationship between neuropsychological and intelligence test performances for people from different cultures who reside in their country of origin.

Despite the limitations, this study is one of the first to investigate the cognitive processes used to perform an intelligence test in two different cultures. Also, the groups studied here are under-represented in the cross-cultural neuropsychology research, mostly dominated by the various ethnic groups that co-exist in the United States; we believe that studying other backgrounds will broaden our knowledge of the effect of culture on cognitive performance. In conclusion, besides showing the cultural effect on non-verbal intelligence test performance, our results suggest that a single test may measure different functions, depending on the subject's cultural background.

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Conflict of Interest

None declared.

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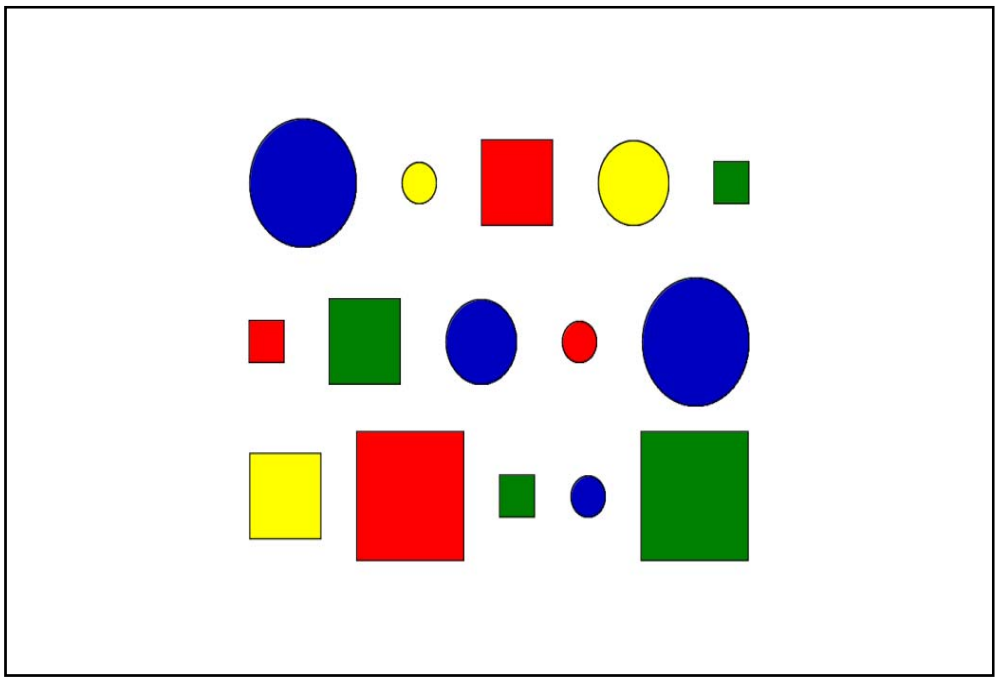
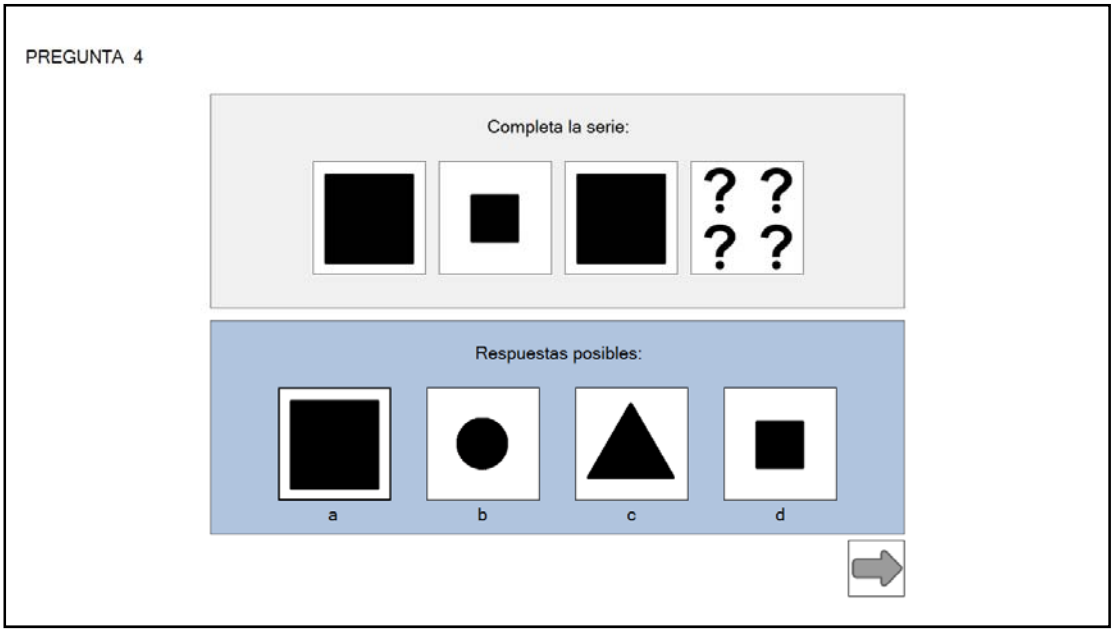
Anexo 4

Ejemplos de la Batería BENCI



Ejemplo de la ejecución de la prueba *Comprensión verbal con figuras*.

Ejemplo de la ejecución de la prueba *Comprensión verbal con imágenes*



Ejemplo de la ejecución de la prueba *Razonamiento abstracto*

Ejemplo de la ejecución de la prueba *Planificación*