NeuroRehabilitation xx (20xx) x–xx
DOI:10.3233/NRE-182579
IOS Press

The 5 Objects Test: Normative data from a Spanish community sample

Valentina Ladera*, M. Victoria Perea, Ricardo García, Gerardo Prieto and Ana R. Delgado
Universidad de Salamanca, Salamanca, Spain

Abstract.
OBJECTIVE: The objective of this study was to provide normative data for the 5 Objects Test in a large Spanish community sample, as well as some validity evidence.
METHODS: The sample was composed of 427 participants (of which 220 females, age 15 to 95 years old; educational level range: 2–17 years). Normative data are provided, as well as correlations with test scores from Benton Visual Retention test, Rey-Osterrieth Complex Figure and Mini Mental State Examination.
RESULTS: No association was found between delayed recall score and level of education, age or gender. Immediate recall score was correlated with age. Both immediate and delayed recall significantly correlated with the criteria, evidencing concurrent validity.
CONCLUSIONS: It is recommended that the 5 Objects Test be used for assessing persons in primary care, including those from different linguistic backgrounds or with limited language use. Delayed recall scores are especially recommended given the lack of association with demographic variables.

Keywords: 5 Objects test, delayed recall, immediate recall, normative study, visuospatial memory

1. Introduction

A main concern in the health field is finding those in a population that are at risk of developing cognitive impairment so that they can be adequately diagnosed and treated; applying potential preventive measures is also of interest. Neuropsychological assessment allows detecting cognitive disorders, evaluating their severity, defining their characteristics, qualitatively telling apart clinical presentations, and establishing precise correlates with functional brain systems (Holtz, 2011; Lezak, Howieson, Bigler, & Tranel, 2012; Luria, 1966).

Memory as a function is very sensitive to nervous system alterations. It can also be affected without a known organic cause, associated with diverse functional alterations (functional or psychogenic amnesia).

Memory problems can predict cognitive impairment in healthy subjects as well as possible progression to dementia in elders (Abner, Kryscio, Caban-Holt, & Schmitt, 2015).

Spatial memory amnesia can be due to a focal lesion, e.g., hippocampal (Kessels, Hendriks, Schouten, Van Asselen, & Postma, 2004), or parietal (Kessels, Kappelle, De Haan, & Postma, 2002) lesions. It is also found in neurodegenerative diseases such as Alzheimer's (Adelstein, Kesner, & Strassberg, 1992) or Parkinson's (Pillon et al., 1998). Visuoespatial memory plays a special role for spatial orientation and navigation, and is associated to the hippocampal formation (Maguire et al., 1998), that is both functionally and structurally altered in participants with mild cognitive impairment and Alzheimer's-type dementia (Da et al., 2014; Drago et al., 2011; Egli et al., 2014; Gainotti et al.,

*Address for correspondence: Valentina Ladera, Facultad de Psicología, Avda de la Merced 109-131, 37005 Salamanca, Spain. Tel.: +34654595931; E-mail: ladera@usal.es.

2013). Visuoespatial memory test performance helps to discriminate between those with mild cognitive impairment that will remain stable and those who will develop Alzheimer's-type dementia (Lee et al., 2014). Visuoespatial memory loss is present in the pre-clinical phase of dementia (Bird et al., 2010; Mitolo et al., 2013). There is empirical evidence for the discriminant power of visuoespatial memory tasks in the diagnosis of mild cognitive impairment (Mitolo et al., 2013).

Furthermore, spatial memory is susceptible to age-related cognitive decline (Cherry, Park, & Donaldson, 1993); impairment in test performance is larger for visuospatial working memory than for verbal memory (Casino et al., 2013).

Memory loss is a frequent complaint in primary care settings, especially among the elderly, and it is thought to be indicative of mild cognitive impairment even though it is not necessarily associated with objective memory impairment (Kurt, Yener, & Oguz, 2011). However, carrying out neuropsychological evaluations is not usual in this context because both time and qualified personnel would be required.

As to visual memory tests, many of them are available, e.g., the Benton Visual Retention Test(Benton, 1988) or the Rey Complex Figure Test (Rey, 1987). Even though both of them are frequently used for neuropsychological assessment, they are not usually applied in primary care because of lack of expert clinicians and of time. It is also the case that sociodemographic variables such as age, education, and gender have been demonstrated to influence performance on these neuropsychological tests (ej. Grant, & Adams, 2009; Lezak, Howieson, Bigler, & Tranel, 2012; Mitrushina, Boone, Razani, & D'Elia, 2005; Strauss, Sherman, & Spreen, 2006).

It is relevant to have normative data for neuropsychological tasks in order to reach a right diagnosis as well as a descriptive analysis for clinical practice (Arango-Lasprilla, 2015; Busch & Chapin, 2008; Rivera et al., 2015). Inferring the degree of cognitive decline from measurement of cognition on a single occasion can be compromised by various sources of variability among individuals, such as level of education, age and gender. A very brief memory screening test should be easy to administer, and make limited language demands, without being affected by factors such as those cited above (Papageorgiu, Economou, & Routsis, 2014). Considering that short, easy-to-use tests are more and more needed, tests such as the 5 Objects Test should start to be taken into account. This is a test that estimates the ability to recall spatial material by using both visual and the auditory approaches.

To characterize the relation between task performance and demographic variables in large groups of healthy participants is one of the best approaches in experimental neuropsychology; the information thus obtained is then used to inform analyses of patient assessment results (Fellows, 2012). Thus the objective of this study was to provide normative data for the 5 Objects test in a large Spanish community sample.

2. Method

2.1. Participants

Data from 427 participants (220 females) were analyzed. Information on demographic variables can be seen in Table 1.

To be enrolled, participants had to be (1) Spanish and have Spanish as their mother tongue, (2) older than 15, (3) without any clinically demonstrable psychopathological, neurological or neuropsychological disorders, and (4) obtain a Mini-Mental State Examination (MMSE; Folstein, Folstein, & McHungh, 1975) score over 26 (medium or high educational level subjects) or over 24 (low educational level subjects). Informed consent was required.

2.2. Instruments

The 5 Objects Test measures immediate and delayed recall of the locations of five everyday objects: a coin, a lighter, a watch, keys, and a pen. It is used to assess visuospatial memory ability and consists in hiding five objects in various places in front of the participant and in a fixed order: the coin inside a book, the lighter in the experimenter's pocket, the watch under the table, the keys in back of the participant's chair and the pen inside a little box. As the objects are being located, the experimenter says the name of the object and the place where it is being hidden (e.g. the coin inside the book; the lighter in my pocket ...). Participants are then asked about the objects and their locations (immediate recall). After a non-mnemonic interference task (approximately 15 minutes) the participant is asked again (delayed recall). One point is given for each object/location that has been correctly evoked. Thus the maximum score is 5 points for the immediate recall task, and 5 points for the delayed recall one.

Table 1
Descriptive data

	Immediate	Delayed	Age	Education	Benton	Rey	MMSE
Mean	4.22	4.76	51.46	9.29	6.17	18.22	28.32
SD	1.07	0.56	22.26	4.32	2.00	6.84	1.18
Min.	0	0	15	2	0	1.50	26
Max.	5	5	95	17	10	34.00	30

Table 2
Correlations between 5-objects scores, demographic variables, and other test scores

	Delayed	Gender	Age	Education	Benton	Rey	MMSE
Immediate	0.32*	0.01	–0.38*	0.08	0.40*	0.32*	0.25*
Delayed		–0.05	–0.12	0.11	0.25*	0.20*	0.19*
Gender			0.01	0.05	0.09	0.07	0.03
Age				–0.06	–0.62*	–0.48*	–0.33*
Education					0.35*	0.37*	0.42*

*Significant at least at *alpha* = 0.05 (Bonferroni corrected).

The Benton Visual Retention (maximum score = 10), the Rey-Osterrieth Complex Figure-memory (maximum score = 36), and the MMSE tests (maximum score = 30) were also conducted in order to obtain some validity evidence.

2.3. Statistical analyses

The relationship of the 5 Objects Test scores with both demographic variables and certain other neuropsychological test scores was examined.

3. Results

Descriptive data for the quantitative variables can be seen in Table 1.

Regarding the association between variables, it can be seen from Table 2 that no significant correlation (Bonferroni-corrected) was found between delayed recall scores and level of education, age or gender, and the only demographic variable associated with immediate recall was age. Notice that this is not the case with the three criterion variables, whose correlations with age and education are large and significant.

As expected, both immediate and delayed recall scores significantly correlated with the Benton Visual Retention test, the Rey-Osterrieth Complex Figure and the MMSE scores, evidencing concurrent validity. On visual inspection, the Pearson correlation coefficients of immediate recall scores with these three criteria (0.40, 0.32, and 0.25, respectively) are higher than the corresponding values for delayed recall scores (0.25, 0.20, and 0.19, respectively). However, after controlling for the effect of age on immediate recall scores by calculating partial correlation coefficients, the values are 0.23, 0.18 and 0.14, statistically significant but quite lower. Validity evidence is no better for immediate recall scores than for delayed recall ones.

Table 3
Percentile rank and percentiles for immediate recall (by age) and delayed recall scores

Percentile rank	Immediate (15–65)	Immediate (66–95)	Delayed recall
1	2	0	3
5	3	1	4
10	3	2	4
25	4	3	5
50	5	4	5
60	5	5	5

Finally, given the association between age and immediate recall, the sample was divided in two: those 65 years old or under and those over 65. This is the conventionally used cut point in order to tell apart early-onset dementia from late-onset one (McMurtray, Clark, Christine, & Mendez, 2006; Rossor, Fox, Mummery, Schott, & Warren, 2010). The mean difference in immediate recall for these groups was 0.79, t (223,78)=7.02, $p = 0.00$. Accordingly, percentile ranks for the delayed recall of the 5 Objects Test scores are provided for the whole sample (see Table 3), while normative data for immediate recall scores are divided by age: 15–65 and 66–95 years.

4. Discussion

Neuropsychological assessment instruments should include normative data from healthy subjects so that performance can be interpreted taking into account the usual sources of variability, such as educational level, age and gender. Especially relevant is the fact that most visual memory neuropsychological test scores are associated with educational level, e.g., the Benton Visual Retention Test (Carret et al., 2003; Eun et al., 2007) or the the Rey Complex Figure Test (Caffarra, Vezzadini, Dieci, Zonato, &Venneri, 2002; Rosselli &, Ardila, 1991). Our results indicate that the 5 Objects Test scores do not correlate with educational level.

Neither are the 5 Objects Test scores correlated with age, a variable that is usually found to affect memory tasks (Bäckman et al., 1990; Light, 1991;

Perea, & Ladera, 1995). An age-related decline in performance has been demonstrated in Rey Complex Figure Test (e.g., Caffarra et al. 2002; Machulda et al., 2007; Rosselli &, Ardila, 1991) and Benton Visual Retention Test scores(Coman et al., 1999).

In our study, the 5 Object Test immediate recall score correlated with age and therefore normative data have been provided for two age groups (15–65 and 66–95 years). The delayed recall score is not associated with any of the above-mentioned demographic variables and so very easy-to-use normative data are now available. Delayed recall tasks are the most sensitive to memory deficits in the early phases of Alzheimer disease (Wagner et al., 2012). Low visual memory task performance is considered as one of the first signs of Alzheimer disease, one that can be present years before the definite diagnosis (Kawas et al., 2003).

Gender was not associated with immediate or delayed recall of the 5 Objects Test. Some studies have found small or no sex-related differences in visual memory tasks such as the Rey Complex Figure (Berry, Allen, & Schmitt, 1991; Boone et al., 1993; Peña-Casanova et al., 2009), while some others found that male performance was better on both the copy and the drawing from memory (Gallagher & Burke, 2007) or on the delayed recall trial only (Caffarra et al., 2002). No gender effect on the Benton Visual Retention Test has been identified (Coman et al., 1999; Youngjohn, Larrabee, & Crook, 1993).

Given the above results, as well as the short application time and the low language demands of the 5 Objects Test, it could be used for assessing persons in both clinical neurology and primary care settings, including those from different linguistic backgrounds or with limited language use. The 5 Objects Test shows good psychometric properties, it is not related to educational level, and can be applied in clinical and research areas without copyright costs. Delayed recall scores are especially recommended given the lack of association with demographic variables, which makes interpretation really easy. The 5 Objects Test is a promising instrument for the study of visuospatial memory in Neuropsychological assessment practice.

Conflict of interest

None to report.

References

Abner, E. L., Kryscio, R. J., Caban-Holt, A. M., & Schmitt, F. A. (2015). Baseline subjective memory complaints associate with increased risk of incident dementia: the PREADVISE trial. *Journal of Prevention of Alzheimer's Disease*, *2*, 11-16. doi: 10.14283/jpad.2015.37

Adelstein, T. B., Kesner, K. P., & Strassberg, D. S. (1992). Spatial recognition and spatial order memory in patients with dementia of the Alzheimer's type. *Neuropsychologia, 30*, 59–67. doi: 10.1016/0028-3932(92)90014-D

Arango-Lasprilla, J.C. (2015). Commonly used Neuropsychological Tests for Spanish Speakers: Normative Data from Latin America. *NeuroRehabilitation, 37*, 489-491. doi: 10.3233/NRE-151276

Bäckman, L., & Larsson, M. (1992). Recall of organizable words and objects in adulthood: influences of instructions, retention interval, and retrieval cues. *Journal Gerontology Psychological Sciences, 47*, 273-278. doi: 10.1093/geronj/47.4.P273.

Benton, A.L. (1988). *Test de Retención Visual*. Madrid: TEA.

Berry, D. T., Allen, R. S., & Schmitt, F. A. (1991). Rey-Osterrieth Complex Figure: Psychometric characteristics in a geriatric sample. *The Clinical Neuropsychologist, 5*, 143-153. doi: 10.1080/13854049108403298.

Bird, C.M., Chan, D., Hartley, T., Pijnenburg, Y.A., Rossor, M.N., & Burgess, N. (2010). Topographical short-term memory differentiates Alzheimer's disease from frontotemporal lobar degeneration. *Hippocampus*, 20, 1154-1169. doi: 10.1002/hipo.20715.

Brauer Boone, K. B., Lesser, I. M., Hill-Gutierrez, E., Berman, N. G., & D'elia, L. F. (1993). Rey-Osterrieth complex figure performance in healthy, older adults: Relationship to age, education, sex, and IQ. *The Clinical Neuropsychologist, 7*, 22–28.

Busch, R.M., & Chapin, J.S. (2008). Review of normative data for common screening measures used to evaluate cognitive functioning in elderly individuals. *Clinical Neuropsychologist*, 22, 620-650. doi: 10.1080/13854040701448793.

Caffarra, P., Vezzadini, G., Dieci, F., Zonato, F., & Venneri, A. (2002). Rey-Osterrieth complex figure: Normative values in an Italian population sample. *Neurological Science*, *22*, 443–447. doi: 10.1007/s100720200003.

Carret, N., Rainville, C., Lechevallier, N., Lafont, S., Letenneur, L., & Fabrigoule, C. (2003). Influence of education on the Benton Visual Retention Test performance as mediated by a strategic search component. *Brain and Cognition*, *53,* 408-411. doi: 10.1016/S0278-2626(03)00155-6.

Cherry, K. E., Park, D. C., & Donaldson, H. (1993). Adult age differences in spatial memory: Effects of structural context and practice. *Experimental Aging Research*, *19*, 333–350. doi: 10.1080/03610739308253942.

Coman, E., Moses, J.A., Jr., Kraemer, H.C., Friedman, L., Benton, A.L., & Yasavage, J. (1999). Geriatric performance on the Benton Visual Retention Test: Demographic and diagnostic consederations. *The Clinical Neuropsychologist*, *13*, 66-77. doi: 10.1076/clin.13.1.66.1972.

Da, X., Toledo, J. B., Zee, J., Wolk, D. A., Xie, S. X., Ou, Y., & Davatzikos, C. (2014). Integration and relative value of biomarkers for prediction of MCI to AD progression: Spatial patterns of brain atrophy, cognitive scores, APOE genotype and CSF biomarkers. *NeuroImage: Clinical*, *4*, 164–173. doi: 10.1016/j.nicl.2013.11.010.

Drago, V., Babiloni, C., Bartrés-Faz, D., Caroli, A., Bosch, B., Hensch, T., & Frisoni, G. B. (2011). Disease tracking markers for Alzheimers Disease at the prodromal (MCI) stage. *Journal of Alzheimer's Disease*, *26*, 159–199. doi: 10.3233/JAD-2011-0043.

Egli, S. C., Beck, I. R., Berres, M., Foldi, N. S., Monsch, A. U., & Sollberger, M. (2014). Serial position effects are sensitive predictors of conversion from MCI to Alzheimer's disease dementia. *Alzheimer's & Dementia*, *10*, 420–424. doi: 10.1016/j.jalz.2013.09.012.

Eun, E.S., Dong, D.Y., Il, H.C., Jong., C.Y., Ki, W.K., Jin, H.J. & Jomg, I.W. (2007). Performance on the Benton Visual Retention Test in an educationally diverse elderly population. *Journal of Gerontology: Series B. Psychological Sciences and Social Sciences*, *62*, 191-193.

Fellows, L. K. (2012). Group studies in experimental neuropsychology. In H. Cooper, P. M. Camic, D. L. Long, A. T. Panter, D. Rindskopf, & K. J. Sher (Eds.), *APA handbook of research methods in psychology, Vol. 2. Research designs: Quantitative, qualitative, neuropsychological, and biological* (pp. 647-659). doi: 10.1037/13620-034.

Folstein, M. F., Folstein, S. E., & McHungh, P. R. (1975). A practical for grading the cognitive state of patients for the Clinician. *Journal of Psychiatric Research*, *12*, 189-98. doi: 10.1016/0022-3956(75)90026-6.

Gainotti, G., Quaranta, D., Vita, M. G., & Marra, C. (2013). Neuropsychological predictors of conversion from mild cognitive impairment to Alzheimer's disease. *Journal of Alzheimer's Disease: JAD*, *38*, 481–495. doi: 10.3233/JAD-130881.

Gallagher, C., & Burke, T. (2007). Age, gender and IQ effects on the Rey-Osterrieth complex figure test. *British Journal of Clinical Psychology, 46*, 35–45. doi: 10.1348/014466506X 106047.

Grant, I., & Adams, K.M. (2009). *Neuropsychological Assessment of Neuropsychiatric and Neuromedical Disorders* (3th ed). New York: Oxford University Press.

Holtz, J.L. (2011). *Applied Clinical Neuropsychology: An Introduction*. New York: Springer.

Kawas, C. H., Corrada, M. M., Brookmeyer, R., Morrison, A., Resnick, S. M., Zonderman, A. B., & Arenberg, D. (2003). Visual memory predicts Alzheimer's disease more than a decade before diagnosis. *Neurology*, *60*, 1089-1093. doi.org/10.1212/01.wnl.0000055813.36504.bf.

Kessels, R. P. C., Hendriks, M. P. H., Schouten, J., Van Asselen, M., & Postma, A. (2004). Spatial memory deficits in patients after unilateral amygdalohippocampectomy. *Journal of the International Neuropsychological Society*, *10*, 907–912. doi: 10.1017/S1355617704106140.

Kessels, R. P. C., Kappelle, L. J., De Haan, E. H. F., & Postma, A. (2002). Lateralization of spatial-memory processes: Evidence on spatial span, maze learning and memory for object locations. *Neuropsychologia*, *40*, 1465–1473. doi: 10.1016/S0028-3932(01)00199-3.

Kurt, P, Yener, G., & Oguz, M. (2011). Impaired digit span can predict further cognitive decline in older people with subjective memory complaint: a preliminary result. *Aging & Mental Health, 15,* 364-369. doi: 10.1080/13607863.2010.536133.

Lee, J. Y., Kho, S., Yoo, H. B., Park, S., Choi, J. S., Kwon, J. S., & Jung, H. Y. (2014). Spatial memory impairments in amnestic mild cognitive impairment in a virtual radial arm maze. *Neuropsychiatric Disease and Treatment*, *10*, 653–660. doi: 10.2147/ndt.s58185.

Lezak, M. D., Howieson, D. B., Bigler, E. D., & Tranel, D. (2012). *Neuropsychological Assessment* (5th ed.). New York: Oxford University Press.

Light, L.L. (1991). Memory and aging: Four hipothesis in search of data. *Annual Review of Psychology*, *42*, 333-376.

Luria, A.R. (1966). *Higher Cortical Functions in Man*. New York: Basic Books.

Machulda, M. M., Ivnik, R. J., Smith, G. E., Ferman, T. J., Boeve, B. F., Knopman, D., & Tangalos, E.G. (2007). Mayo's older Americans normative studies: Visual form discrimination and copy trial of the Rey–Osterrieth complex figure. *Journal of Clinical and Experimental Neuropsychology*, *29*, 377–384. doi: 10.1080/13803390600726803.

Maguire, E. A., Burgess, N., Donnett, J. G., Frackowiak, R. S. J., Frith, C. D., & O'Keefe, J. (1998). Knowing Where and Getting There: A Human Navigation Network. *Science*, *280*, 921–924. doi: 10.1126/science.280.5365.921.

McMurtray, A., Clark, D.G., Christine, D., & Mendez, M.F. (2006). Early-onset dementia: Frequency and causes compared to late-onset dementia. *Dementia and Geriatric Cognitive Disorders*, *21*,59-64. doi: 10.1159/000089546.

Mitolo, M., Gardini, S., Fasano, F., Crisi, G., Pelosi, A., Pazzaglia, F., & Caffarra, P. (2013). Visuospatial memory and neuroimaging correlates in mild cognitive impairment. *Journal of Alzheimer's Disease, 35*, 75-90. doi: 10.3233/JAD-121288.

Mitrushina, M., Boone, K.B., Razani, J., & D'Elia, L.F. (2005). *Handbook of normative data for neuropsychological assessment* (2nd ed.) New York: Oxford University Press.

Papageorgiu, S.G., Economou, A., & Routsis, C. (2014). The 5 Objects Test: a novel, minimal-language, memory screening test. *Journal of Neurology, 261*, 422-31. doi: 10.1007/s00415-013-7219-1.

Peña-Casanova, J., Gramunt-Fombuena, N., Quiñones-Úbeda, S., Sánchez-Benavides, G., Aguilar, M., Badenes, D., & Blesa, R. (2009). Spanish multicenter normative studies (NEURONORMAProject): Norms for the Rey–Osterrieth complex figure (copy and memory), and free and cued selective reminding test. *Archives of Clinical Neuropsychology, 24*, 371–393. doi: 10.1093/arclin/acp041.

Perea, M.V., & Ladera, V. (1995). Rendimientos neuropsicológicos: edad, educación y sexo. *Psicothema*, *7*, 105-112.

Pillon, B., Deweer, B., Vidailhet, M., Bonnet, A. M., Hahn-Barma, V., & Dubois, B. (1998). Is impaired memory for spatial location in Parkinson's disease domain specific or dependent on 'strategic' processes? *Neuropsychologia*, *36*, 1–9. doi: 10.1016/S0028-3932(97)00102-4.

Rey, A. (1987). *Test de Copia de la Figura Compleja*. Madrid: TEA.

Rivera, D., Perrin, P.B., Morlett-Paredes, A., Galarza-Del-Angel, J., Martínez, C., Garza, M.T., & Arango-Lasprilla, J.C. (2015). Rey-Osterrieth Complex Figure-copy and immediate recall: Normative data for the Latin American Spanish speaking adult population. *NeuroRehabilitation*, *37*, 677-698. doi: 10.3233/NRE-151285.

Rosselli, M., & Ardila, A. (1991). Effects of age, education, and gender on the Rey Osterrieth complex figure. *The Clinical Neuropsychologist*, *5*, 370–376. doi: 10.1080/13854049108404104.

Rossor, M.N., Fox, N.C., Mummery, C.J., Schott, J.M., Warren, J.D. (2010). The diagnosis of young-onset dementia. *The Lancet Neurology*, *9*, 793-806. doi: 10.1016/S1474-4422(10)70159-9.

Strauss, E., Sherman, E.M.S., & Spreen, O. (2006). *A compendium of Neuropsychological Tests. Administration, Norms, and Commentary*. New York: Oxford University Press.

Wagner, M., Wolf, S., Reischies, F. M., Daerr, M., Wolfsgruber, S., Jessen, F., & Wiltfang, J. (2012). Biomarker validation of a cued recall memory deficit in prodromal *Alzheimer Disease. Neurology*, *78*, 379-386. doi: 10.1212/wnl.0b013e318245f447.

Youngjohn, J. R., Larrabee, G. J., & Crook, T. H. (1993). New adult- and education-correction norms for the Benton Visual Retention Test. *The Clinical Neuropsychologist*, *7*, 155–160. doi: 10.1080/13854049308401517.