Journal of the International Neuropsychological Society (2008), **14**, 148–151.

DOI: 10.1017/S1355617708080168

BRIEF COMMUNICATION

Semantic memory as assessed by the Pyramids and Palm Trees Test: The impact of sociodemographic factors in a Spanish-speaking population

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(RECEIVED December 28, 2005; FINAL REVISION August 1, 2007; ACCEPTED August 13, 2007)

Abstract

The objective of this study is to obtain preliminary normative data on the performance the Pyramids and Palm Trees Test (PPT) for a Spanish-speaking population. The effects of age, gender, and educational level on the PPT test were also analyzed. A total of 234 healthy participants, with a broad range of age (18–80 years) and education (1–20 years) performed the three-picture version of the PPT. The mean performance was 51.1 out of 52 possible points ($SD = 1.3$). PPT performance did not vary with age or gender. However, subjects with less than 6 years of formal education scored significantly lower than those with more than 6 years of education though this effect was confounded with age because the group with lower education was also older. Given the ceiling effects of the PPT, further investigation is needed to determine if the visual PPT is sensitive to mild semantic memory impairment. (*JINS*, 2008, *14*, 148–151.)

Keywords: Adult, Cognition, Neuropsychological tests, Memory Disorders, Aging, Education

INTRODUCTION

The Pyramids and Palm Trees Test (PPT) was developed by Howard and Patterson (1992) to measure the capacity to access detailed semantic information about words and objects. In the PPT, subjects are shown a simple drawing or an oral word to be semantically matched to one or two probe drawings or words. This test was validated and normalized with a group of 60 healthy English-speaking subjects in which no subject made more than three errors on the test. Howard and Patterson (1992) consider as clinically significant more than five incorrect answers, although a rationale for this cut-point was not explained.

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Neuropsychological tests such as category fluency and confrontation naming and vocabulary tests, are traditionally used to assess semantic memory. These tasks are influenced by sociodemographic factors, such as age, gender, and education level. Research has shown age-related decreases on semantic memory tasks that assess word comprehension abilities and general knowledge (Nyberg et al., 2003), confrontation naming (Randolph et al., 1999) and fluency (Nyberg et al., 2003), which have been attributed to retrieval failures with preserved representations in semantic memory (Nyberg et al., 2003). Gender effects are category specific. Healthy females perform better than males in naming fruits (Capitani et al., 1999) and living categories (Laws, 1999), whereas males perform better in naming tools (Capitani et al., 1999), and non-living categories (Laws, 1999). This category specific gender difference has been explained by a familiarity effect (Albanese et al.,

2000). Number of years of education affects picture naming tasks (Randolph et al., 1999) and semantic fluency tests (Da Silva et al., 2004). Individuals with more years of education perform better on these tasks probably because of a richer pool of semantic information in comparison to lesser-educated individuals (Da Silva et al., 2004).

We have found no other normative data on PPT test performance except for those of Howard and Patterson (1992). The current study was designed to examine the effect of sociodemographic factors on the PPT in Spanish speakers, because this has never been done and these factors influence other semantic memory tasks, as noted earlier. These results will also provide preliminary normative data on the PPT for a Spanish-speaking population.

METHOD

Participants

A total of 260 healthy participants were recruited. All eligible subjects belonged to urban areas and were recruited either among the relatives of patients attending our memory clinic or from Senior citizen activity centers. Inclusion criteria were as follows: no impairment in daily living activities measured by the Spanish version of the Interview for Deterioration of Daily Living in Dementia (IDDD score <36) (Böhm et al., 1998) and absence of cognitive impairment measured by the Mini Mental State Examination (MMSE score >24) (Folstein et al., 1975). Exclusion criteria were history of central nervous system diseases with possible neuropsychological deficits (e.g., stroke, epilepsy, encephalitis, and head injury); history of alcohol or other psychotropic substance abuse; presence of non-compensated systemic diseases associated with cognitive impairment (e.g., diabetes mellitus, hypothyroidism, and others); history of psychiatric disease (major depression, schizophrenia); and presence of severe sensorial defects (loss of vision and/or hearing) that may affect performance of the test. Twenty-six subjects met some of these criteria and were excluded.

Therefore, the study population consisted of 234 subjects. There were 130 men and 104 women. The mean age was 45.5 years (standard deviation, SD 17.3 years), ranging between 20 and 80 years. The mean number of years of formal education was 12.6 (SD 4.8 years), ranging between 1 and 20 years. A total of 225 participants were right handed and only 9 left handed.

Ethical approval for the study including the study procol, written informed consents, and information for the subjects was granted by the IMAS Clinical Research Ethics Committee (CEIC-IMAS). The study was conducted in accordance with the Declaration of Helsinki and its subsequent amendments.

Procedures

The PPT test booklet pages are divided into two parts. The top half contains the stimulus, which can be presented either as a spoken word, a written word, or a picture. The bottom half contains two items: the target and a distracter presented either as written words or pictures. Subjects were instructed to select from the bottom half the item that was semantically related to that in the top half.

By combining the word and picture modalities, six different versions of the test can be administered. We used the same three picture version employed by Howard and Patterson (1992). A total of 52 triads are administered. The maximum score is 52 points. Items for which the subject remains hesitant are scored as 0.5 points as suggested by Howard and Patterson (1992).

Statistical Analysis

The Kolmogorov-Smirnov test was used to assess the distribution of age, years of formal education, and total score of the PPT test. Given that the PPT total score did not follow a normal distribution, non-parametric statistical comparisons were done. Age and number of years of formal education were transformed into categorical variables, resulting in the following three sub-groups: age (20–40 yrs, 41–60 yrs, 61–80 yrs) and education (1–5 yrs, 6–11 yrs, $\geq$ 12 yrs). Performance of the men and women was also compared. The Kruskal-Wallis test and the Mann-Whitney U test were used to assess the impact of age, years of formal education, and gender on the PPT performance. We performed an analysis of variance (ANOVA) and Tukey post hoc test to examine possible age differences across the three education groups. We also performed the same analysis to test possible education differences in the three age groups. Spearman correlation between age and education was calculated. Data analysis was performed with SPSS/PC version 11.5

RESULTS

The mean performance of the PPT test was 51.1 points ($SD = 1.3$). Mean performances in the different age, education and gender groups are shown in Table 1.

There were no significant differences in the performance of the PPT with regard to age (Kruskal-Wallis test; $\chi^2 = 2.520$, $p = 0.28$) or gender (Kruskal-Wallis test; $\chi^2 = 3.723$, $p = 0.54$). However, there was a significant effect of years of formal education (Kruskal-Wallis test, $\chi^2 = 17.736$, $p < 0.001$). The basic education group obtained significant lower total scores than the medium and high education groups (Mann-Whitney U test, $p < 0.001$). There were no significant differences between the medium and high education groups (Mann-Whitney U test, $p = 0.09$). However, there were significant differences in age among the education groups ($F_{(2,232)} = 40.245$, $p < 0.001$). The Tukey post hoc test revealed statistically significant differences in age between the basic and medium education groups, between the medium and high education groups, and between the basic and medium education groups ($p < 0.001$ for all comparisons). There were also significant differences in the number of years of formal education between the age groups

https://doi.org/10.1017/S1355617708080168

Table 1. Descriptive statistics of demographic variables and total performance in the Pyramids and Palm Trees Test (PPT) according to age, education and gender groups

		Demographics				Pyramids and Palm Trees Test		
		Education		Age				
	N	*Mean*	(*SD*)	*Mean*	(*SD*)	*Mean*	*SD*	*Min-Max*
Age groups								
20–40 years	97	15.40	(3.56)	28.63	(4.73)	51.29	.79	49–52
41–60 years	84	11.51	(4.40)	49.04	(6.38)	51.12	1.34	43–52
61–80 years	53	9.15	(4.60)	70.72	(5.71)	50.71	1.81	43–52
Education groups								
Basic (1–5 years)	28	3.68	(1.12)	66.18	(08.49)	49.82	2.42	43–52
Medium (6–11 years)	54	9.39	(1.35)	50.41	(15.20)	51.02	1.23	49–52
High (≥ 12 years)	152	15.37	(2.98)	39.93	(15.74)	51.36	1.80	49–52
Gender								
Male	130	12.71	(4.56)	45.10	(16.52)	51.24	1.09	49–52
Female	104	12.44	(5.15)	45.97	(18.26)	50.93	1.50	43–52

Note. *N* = number of subjects, X = mean, *SD* = standard deviation, Min-Max = minimum–maximum score.

($F_{(2,232)} = 33.318$, $p < 0.001$). Tukey post hoc test showed that there were differences in education between the young and middle-aged groups ($p < 0.001$), between middle-aged and elderly groups ($p < 0.01$), and between young and elderly groups ($p < 0.001$). There was a statistically significant inverse correlation between age and years of education ($r = -0.469$, $p < 0.001$).

DISCUSSION

This study presents preliminary normative data of the PPT performance for a Spanish-speaking population and has examined the effects of age, gender and education level on the PPT performance. The mean score obtained in our sample of 234 subjects, 98.3% of whom obtained a perfect score, is similar to that obtained by Howard and Patterson (1992) in the original study of the PPT in English speakers (60 subjects, 98% to 99% answered correctly). This similarity in the results provides evidence for the validity of the PPT test across cultures, although it was not possible to apply a confidence interval analysis to compare the results of both studies because of the lack of data on demographics in the study by Howard and Patterson (1992).

The present results indicate that the only sociodemographic variable that had a significant effect on performance of the PPT test was the education level. However we should be cautious interpreting our results, because there were significant differences in age between the three groups of education, and there were also significant differences in the number of years of education between the three age groups. Therefore, the independent effects of age and education cannot be determined because the group with the lowest education was also the oldest. Nevertheless, given that PPT total score showed a non-normal and extremely skewed distribution, our main statistical analysis was based on non-parametric tests. For this reason we were not able to explore the possible interaction between age and years of education.

The impact of education level on semantic memory measures has been previously reported (Randolph et al., 1999; Da Silva et al., 2004). It is likely that a lower level of education results in lesser opportunities to enrich semantic memory contents. In our study, the mean performance of the BE (<6 years) group differs significantly as compared with the ME (6–11 years) and HE (>11 years) groups.

Age had no effect on PPT performance, even though education was lower in the older groups. Some works showed no impact of aging on semantic memory tasks (Laver & Burke, 1993). However, other studies have reported an age-dependent decline of semantic fluency (Nyberg et al., 2003) and a worsening on picture naming tests (Randolph et al., 1999), because of age-related decline in rapid lexical retrieval, difficulties in search-strategies, and/or working memory decline (Eustache et al., 1998). The three-picture version of the PPT test does not seem to be influenced by naming and fluency abilities, although as far as we know no studies have addressed yet the cognitive components implicated in this version of the PPT.

There was no effect of gender on PPT performance. Gender differences have been reported only as a function of category in picture naming and semantic fluency tasks (McKenna & Parry, 1994; Capitani et al., 1999; Laws, 1999), and we did not examine category effects. In the three picture-version of the PPT test the subjects must match the two semantically related stimuli by pointing at them. Word retrieval is not needed. Thus, the gender by category interactions observed in other semantic memory tests requiring word retrieval are not to be expected in the PPT.

There are several limitations to our results. They may be influenced by the inclusion of bilingual (Catalan-speaking and Spanish-speaking) subjects, and this circumstance may affect comparisons with other Spanish-speaking popula-

https://doi.org/10.1017/S1355617708080168

tions, because bilinguals demonstrate better semantic fluency than monolinguals (Fabbro, 2001). In addition, our sample size for examining lower education was small, because there were almost no people under 50 years of age with less than 6 years of formal education in our area. However, given that the PPT test is used to detect semantic memory deficits in patients affected by neurodegenerative diseases, it is important to increase the number of subjects with basic education over 50 years old to test the validity of the PPT in less educated subjects. The possible interaction between age and education that could have an effect on PPT performance discussed earlier is another reason to use purported cutpoints cautiously.

Our data demonstrate a ceiling effect in the performance of healthy subjects on the PPT that coincides with the results of Howard and Patterson (1992). Further investigation is needed to determine if the PPT is sensitive enough to detect mild semantic memory impairments. In a previous study, Hodges and Patterson (1995) argue that the three-picture version of the PPT is a fairly sensitive and useful indicator of mild semantic memory impairments in the early stages of Alzheimer's disease. However, no other study has replicated that work, and the ceiling effect in our study argues against the sensitivity of the PPT test to assess mild deficits. Further research should explore the PPT's sensitivity to mild semantic memory deficits.

ACKNOWLEDGMENTS

This study was supported by a grant of Institut Municipal d'Assistencia Sanitaria (IMAS). The authors are grateful to Dr. Maribel Peró-Cebollero from Departament de Metodología, Facultat de Psicología, Universitat de Barcelona, for her statistical work and advices, to Dr. Joan Guardia-Olmos from Departament de Metodología, Facultat de Psicología, Universitat de Barcelona for helpful comments and critical review of the manuscript, to Erwin Villuendas Gonzalez for helpful comments, and to Marta Pulido, MD, for editing the manuscript and for editorial assistance.

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