Abstract

Figure copying and constructional abilities were examined in 15 healthy adult participants qualifying for illiteracy, following UNESCO criteria. A set of 14 figures was used for copying, 3 of them in perspective. Four figures of the same protocol were used to reproduce with sticks. Mean age of the sample was of 63.86 years old. They were matched for age and gender to schooled (6–7 years) controls. Illiteracy was due to social, cultural or economic factors. The most frequent and relevant findings were an inability to reproduce the perspective (13/15), unfolding (4/15) and unstructured copying (3/15). No errors were made on the stick construction task. None of these findings appeared in control subjects. The pattern is similar to that reported mostly in left-hemisphere lesion patients. Neglecting the cultural or academic background may, then, bias interpretation in these tasks.

Keywords: Illiterates; Transcultural; Perspective; Construction

1. Introduction

Iliterate persons become literate having learned and retained the ability to comprehend and generate written messages. Persons with functional illiteracy were once literate, but are no longer due to skill loss from disuse. One third of the world’s population is illiterate; within industrialized countries most of these are functionally illiterate (United Nations Children’s…

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It has been found in many studies that formal education and literacy influence results on neuropsychological tests, primarily on verbally loaded tasks but also when they are visuospatial or visuoconstructive in nature (see Ardila & Rosselli, 2002, for a review), and it can even be demonstrated with short screening batteries as the NEUROPSI made by Ostrosky, Ardila, and Rosselli (1999). Several authors have been interested in the performance of illiterate or low-schooled people on neuropsychological tests in American countries like Colombia, Mexico, Brazil, and U.S.A. (Ardila, Rosselli, & Rosas, 1989; Bornstein & Suga, 1988; Finlayson, Johnson, & Reitan, 1977; Heaton, Grant, & Mathews, 1986; Lecours, Parente, & Dehaut, 1989; Manly et al., 1999; Matute, Leal, Zaraboso, Robles, & Cedillo, 2000; Ostrosky, Ardila, Rosselli, Lopez-Arago, & Uriel-Mendoza, 1998; Rosselli, Ardila, & Rosas, 1990) and also in European countries (Castro-Caldas, Peterson, Reis, Stone-Elander, & Ingvar, 1998; Miceli et al., 1981; Tzavaras, Kaprins, & Gatzoyas, 1981).

This paper looks at design copy and strategies in a group of nonliterate persons with normal brains using the Mendilaharsu (1971) protocol especially designed to the diagnostic of hemispheric lesions and their laterality, and extensively applied in the same country where actual research was made (Acevedo de Mendilaharsu, Delfino de Cultelli, & Sapriza de Correa, 1971). Three 3D models are included in the protocol (a cube, a house and a table). The use of stick modeling teases out the pencil-using component, that is, if a simple lack of training in the use of that tool could explain the pattern found in some figures (especially loss of perspective or 3D). Being able to distinguish between what could be a constructional apraxia and what corresponds to school level – without pathological relevance – is a crucial move in neuropsychological evaluation, particularly in third world countries, where illiteracy rates are high. In clinical neuropsychology it is important to obtain reliable criteria that allows to avoid bias when illiterate patients are explored.

2. Method

A sample of 15 (10 women and 5 men) healthy, right handed illiterate adults was studied. Mean age for N = 15 is 63.86 years old (31–79 years old). Volunteers (from Primary Care Systems) must fill UNESCO requirements for the condition of illiterate to qualify for the study (UNESCO, 1978; UNESCO, 1985). Specifically, a person is considered literate, if she/he can, with understanding, both read and write a short simple statement on his everyday life, otherwise she/he is considered illiterate. A mere competence for writing their own name, a signature, or isolated words, was not enough to exclude from the sample since criteria are still fulfilled. Functional illiteracy is also included. Inclusion criteria established an institutional education (Primary School) of no more than 3 completed years. Only 5 cases lacked of any school education, the other 10 ranging from 1 to 3 years of institutional education (mean of 1.13 years). All the participants were independent for the adequate accomplishment of their daily activities (related to their own social and cultural environment), either personal, social, familial and working for self-maintenance. This way it was improbable that lack of school was due to other factors rather than social, economical or cultural (geography in Uruguay is not
A functional questionnaire was individually administered by a clinical neurologist and a social worker to rule out academic or medical (neurological) causes of illiteracy. Additionally, the Mini-Mental State was applied (Folstein, Folstein, & McHugh, 1975), following norms by Crum, Anthony, Basset and Folstein (1993) for 0–4 years of school. In all cases, values were above cognitive decline cutting-edge respective to age (mean = 22.05 points, DS ± 2.03).

Given the low rate of illiteracy in Uruguay (World Bank—World Development Report, 1996), and the strict inclusion criteria, the sample is small and it therefore allows mostly qualitative considerations, but a closer pattern analysis. Objectives of the study and the type of tasks are explained to the participants in the first interview. After they give their informed consent to participate in the research, the figure copying test of Acevedo de Mendilaharsu et al. (1971) was administered according to standard instructions. Participants are told by a trained psychologist to copy each figure down the model, one by one, and it is not allowed to erase what has been drawn, so study of the different trials can be done easily. Next the construction of four models using sticks (the triangle, the diamond, the cube and the house), was done. To evaluate their performance on this procedure, each stick was numbered following the constructional order, which gives a key to understanding their probable organizational strategy and mental representation of the figure. Each case was matched with a literate, right-handed control of the same age and gender having 6–8 years of institutional education (mean of 6.93 years).

3. Results

Results in relation to controls are shown in Table 1. Type of errors or, otherwise, pattern of realization in comparison to literate participants of the same age and gender, is defined in a footnote to Table 1. Inability to reproduce the perspective of 3D designs (including not only an abstract figure as the cube but also the house and the table), was the most frequent finding (observed in 13 out of the 15 cases, see Fig. 1a and b). With caution, a chi-square analysis was tentatively made outside the research team, with a confidence of 92% in the final results, with \( p = 0.0000016 \) for lack of 3D. Taking only the representative models (the house and the table) it is obtained just 12 out of 15, so the difference is salient at least in this small sample. Less frequently it appears unfolded (4/15) with \( p = 0.031 \) (see Fig. 1c). It was found that, when perspective is not achieved in the house, it is not reproduced in the table. But to interpret the pattern, one must always keep in mind that the loss of topological relations should not be reduced to misplacement of one or two elements without taking into account other components, the final result and even other figures. Those examples of details misplacement, although close to what is observed in unstructured copies, do not complete the features described in cases of right or bilateral hemispheric lesions (Gainotti & Tiacci, 1970; Griffiths, Cook, & Newcombe, 1988; Mendilaharsu & Acevedo de Mendilaharsu, 1971). Finally, a piecemeal approach could be identified in 4 out of 15 cases (\( p = 0.031 \)).

Other features are more infrequent. Unstructured copy was found in 3/15 subjects (\( p = 0.067 \)). For instance, in one case only a subject used part of the model to draw the copy, that was finally unfolded (see Fig. 1d). So isolated findings should be interpreted in relation to other figures, other neuropsychological tasks and even the global accomplishment of the
Fig. 1. Examples of copying in illiterates: (a) loss of perspective in a cube; (b) loss of perspective in the house; (c) unfolding, unstructured copy of the cube; (d) utilization of the model, then unfolding.
Table 1
Results: pattern of realization and errors found in the illiterate sample

<table>
<thead>
<tr>
<th>Feature</th>
<th>Number of cases (N=15)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Loss of perspective</td>
<td>13</td>
</tr>
<tr>
<td>Unfolding</td>
<td>4</td>
</tr>
<tr>
<td>Piecemeal approach</td>
<td>4</td>
</tr>
<tr>
<td>Unstructured copy</td>
<td>4</td>
</tr>
<tr>
<td>Isolated omissions</td>
<td>3</td>
</tr>
<tr>
<td>Micrography</td>
<td>2</td>
</tr>
<tr>
<td>Macrography</td>
<td>1</td>
</tr>
<tr>
<td>Two-faced cube</td>
<td>1</td>
</tr>
<tr>
<td>Gross omissions with simplification</td>
<td>1</td>
</tr>
<tr>
<td>Model utilization</td>
<td>1</td>
</tr>
<tr>
<td>Overdrawing</td>
<td>0</td>
</tr>
<tr>
<td>Closing-in</td>
<td>0</td>
</tr>
</tbody>
</table>

* Feature and pattern of performance definition. (1) Two-face cube: inability to reproduce parallel oblique lines. (2) Additionally: inability to use proportion differences to simulate distance. (3) Unfolding: loss of adjacency relations among the constituent planes of a figure displaying them over the 2D surface of the paper. (4) Unstructured copying: inability to reproduce proximity, separation, ordering or continuity relations and the location of each detail (or feature) in corresponding place (topological relations). If there is also an unfolding, it is considered as unstructured copying. (5) Isolated omissions: absence of one or two details of the figure preserving the general gestalt. The figure is clearly identifiable. (6) Gross omissions with simplification: same as previous but the figure loses complexity (gross components are missing, like entire surfaces). Only minimal features are preserved. (7) Micrography: size reduction of the copy if the contour rounded by a square has a difference of at least three millimeters (four sides). (8) Macrography: same procedure as previous case but the square has difference of more than three millimeters from the model. (9) Piecemeal approach: Each part is drawn in a separate fashion following a sequential procedure without a defined pattern or proximity relations of the represented space (figures with perspective only). (10) Model utilization: begin drawing from one part of the model, adjacent to it, and taking that part as a component of the copy. (11) Overdrawing: drawing on the same lines of the model, generally many times. (12) Closing-in: drawing on the same model (inside, around it, trying to follow some of its features).

4. Discussion

Although the size of the sample is small, the pattern of difficulties in reproducing certain aspects of the figures, their extent, and qualitative analysis of procedures, serve to document...
that literacy and school are variables to take into account in neuropsychological assessment of constructional abilities. Every illiterate subject (and none of the controls) showed at least some of the type of errors or abnormal defined patterns, especially loss of 3D—then unfolding and unstructured copy. In every case, the pattern was not seen when using sticks for the same models, although a piecemeal procedure was registered in the illiterate (compared to schooled controls). There are many reports showing that these abilities are influenced by the level of formal education (Ardila & Rosselli, 2002; Ardila et al., 1989; Castro-Caldas et al., 1998; Lecours et al., 1989; Manly et al., 1999; Matute et al., 2000; Ostrosky et al., 1998; Rosselli et al., 1990), and even culture beyond literacy (Roselli & Ardila, 2003).

The pattern found in this sample may be confounded with a so-called “constructional apraxia” in almost every case (Benton, 1984). The sole defective copying of the cube was considered as apraxic by Critchley (1953). Some researchers report that diagnostic errors may be made in healthy literate adults too (Arrigoni & De Renzi, 1964; Griffiths et al., 1988). In the paper of Griffiths et al. (1988) the lack of 3D is notorious in brain-damaged people, even comparing with figure models of similar quantitative complexity but representing a 2D design. No sound difference was found in the present report between copying abstract figures (e.g.: the cube) or representative figures (e.g.: the house or the table), and it was neither added significant elements to nonsense figures as in the papers cited above. Freeman and Janikoun (1972) have mentioned a difficulty tracing oblique parallels, a fact also identified in previous research (Mendilaharsu & Acevedo de Mendilaharsu, 1971; Mendilaharsu, Delfino, & Sapriza, 1970). A correct copy of oblique parallels in figures like the diamond (without perspective), is not related to a correct copy of the cube, as it is observed in the present study. Otherwise, in a stick construction task, Matute et al. (2000) find more disturbances in illiterates if the model has perspective, something that was not documented in this paper. Lack of 3D per se on figure copying can be taken as a sign mainly of a left hemisphere lesion, while piecemeal approach and unstructured copy is often associated to right hemisphere lesions (Gainotti & Tiacci, 1970; Hécaen & Assal, 1970; Lezak, 1995; Mendilaharsu & Acevedo de Mendilaharsu, 1971). But even when some 3D reproduction is obtained in the final result (as in stick construction of a cube or a house, for instance), the illiterate subject follows a piecemeal approach. That sort of strategy raises doubt about individual capacity of extracting features of 3D from a 2D image, a mechanism close to what has also been described as being absent in a case of associative agnosia by Kawahata and Nagata (1989). Impossibility of 3D reproduction and coordinate relations then, linked to schooling, may reflect undeveloped abilities in the interaction between graphic production and the encoding of coordinate and categorical spatial relations on the spatiotopic mapping (Guérin, Ska, & Bellevile, 1999). This could be misinterpreted as a consequence of brain damage.

Given the size of the sample, further research must be done to have a more reliable quantitative analysis and to prove replication of the findings. These findings were obtained from Spanish speaking Uruguayan citizens, but may generalize to other populations. Further cross-cultural replication of this difficulty and these error types is a worthwhile pursuit. Finally, these error types could be confounded as signs of neurocognitive visuoconstructional deficits (specially left-hemisphere lesions), if literacy, school or culture are not taken into account.
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References


