

NOTE

OPTIC APHASIA WITH PURE ALEXIA: A MILD FORM OF VISUAL ASSOCIATIVE AGNOSIA? A CASE STUDY

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ABSTRACT

A single-case study is reported of a naming disorder selective to the visual modality. The patient showed intact access to structural knowledge of objects and letters, but impaired access to complete semantic knowledge of objects and alphabetical knowledge of letters from visual input. The impairment was most striking when the patient had to discriminate between semantically similar objects or within a given symbolic repertoire, i.e. letters. The co-occurrence of a partial deficit of visual recognition for objects and for letters indicated features of optic aphasia and pure alexia. This symmetric performance between object and letter processing may also constitute a mild form of visual associative agnosia.

Key words: optic aphasia, pure alexia, associative agnosia

INTRODUCTION

In 1889, Freund first reported a case of “optic aphasia” which resulted in the inability to name visually presented objects whilst the patient could still name objects on tactile presentation. Optic Aphasia, as defined by Freund, might relate to either a visual recognition deficit (“visual agnosia”), or to a general naming impairment commonly observed in aphasia. Following the detailed description of another case by Lhermitte and Beauvois (1973), optic aphasia became a widely accepted syndrome. Their patient, JF, showed a naming impairment confined to the visual presentation of objects, but his deficit was neither agnostic, since he produced correct pantomimes of the objects he did not name, nor aphasic, since he could name objects from tactile or verbal inputs. Thus, optic aphasia was defined, in negative terms as a deficit in visual confrontation naming, without visual recognition or perceptual and intellectual disorders.

However, the interpretation of optic aphasia is not easy. The main reason is probably due to the fact that classical models of visual naming (e.g. Seymour, 1979; Warren and Morton, 1982) cannot account for a modality-specific aphasia such as optic aphasia (see Shallice, 1988; Farah, 1990; Bruyer, 1994). Based on Marr’s computational theory (e.g. Marr, 1982), these models generally include four successive stages: (1) perceptual processing; (2) access to structural representation; (3) access to semantic knowledge and (4) access to the object’s name. The perceptual processes permit the detection of salient visual features from which the observer is assumed to automatically construct an episodic form representation of the perceived object. The episodic representation crucially depends on contextual conditions, such as viewpoint, and it must be compared to an abstract structural representation which stores visual attributes specific to an object in memory. At the structural level, the same object can be recognised from different viewpoints (e.g. canonical and non-canonical views). The semantic attributes of an object are identified in

the third stage. Finally, following access to semantic knowledge, object naming is accomplished by accessing the lexical representation that matches the object. Most cognitive models of object naming (e.g. Seymour, 1979; Warren and Morton, 1982) suppose that access to the object's name entails an activation of the entire semantic representation attached to it. For example, the complete semantic representation of a hammer should specify the categorical (e.g. tool), functional (e.g. used to drive in), and associative (e.g. a nail) attributes. Some authors (e.g. Warren and Morton, 1982; Snodgrass, 1984) presume that the semantic system is amodal, in that the access to semantic information is independent of the input modality.

The error analysis of visual object naming in optic aphasic patients reveals a majority of semantic errors (for an extensive review, see Iorio et al., 1992). These semantic paraphasias observed on visual presentation only can hardly be explained by classical models involving amodal semantic representation. Other models of object naming have been proposed (e.g. Lhermitte and Beauvois, 1973; Ratcliff and Newcombe, 1982; Riddoch and Humphreys, 1987a; Coslett and Saffran, 1989) in order to account for the behavioural pattern of optic aphasics. These different models challenge (1) the idea of a single semantic representation for objects (semantic representation being rather multiple, such as visual vs. verbal semantics in Lhermitte and Beauvois, 1973, or left vs. right hemisphere semantics in Coslett and Saffran, 1989; De Renzi and Saetti, 1997), (2) the uniqueness of the semantic route in visual naming (e.g. Ratcliff and Newcombe, 1982), or (3) the necessity to access complete semantic information in naming (e.g. Riddoch and Humphreys, 1987a, 1987b; Hillis and Caramazza, 1995). The last two models dispute the integrity of visual object recognition in optic aphasia. In other words, patients diagnosed optic aphasics should be reinterpreted as cases of visual associative agnosia (Lissauer, 1890). For example, in a recent case study reported by Hillis and Caramazza (1995), DHY, "labelled optic aphasic", failed to access detailed semantic knowledge in non-verbal association semantic tasks, casting some doubt on the integrity of his visual recognition processes. Moreover, most cases of optic aphasia (for a review, see Davidoff and De Bleser, 1993) and associative agnosia (for a review, see Farah, 1991) presented a co-occurrence of visual anomia for objects and letters. Two questions then arise, whether the object and letter visual naming disorder shares a common mechanism, and whether optic aphasia has to be considered as a mild form of visual associative agnosia.

In this paper, we report the detailed investigation of a patient, CN, who, following left occipito-temporal infarction, showed the pattern of performance labelled as *optic aphasia*, as well as a *pure alexia*.

CASE REPORT

CN is a right-handed 67-year-old retired boiler maker with an eight grade of education. He was admitted to the hospital in February 1995 for generalised seizure episodes probably secondary to a stroke that occurred in 1979 in the territory of left posterior cerebral and left anterior choroidal arteries. His past medical story was an arterial hypertension and an ischemic heart disease. A general neurological examination revealed a right spastic hemiplegia and hemianesthesia, as well as a dense right homonymous hemianopia. Magnetic Resonance Images (MRI; see Figure 1) indicated a left posterior cerebral artery infarction, with damage to the left lingual, fusiform and parahippocampal gyri. The lesion extended into the posterior portion of the internal capsule and thalamus on the left side. In addition, there was a paracallosal lesion. In the occipital portion, where this lesion was larger, it seemed to completely interrupt the intra-hemispheric part of callosal fibers.

A general neuropsychological assessment (Boller and Hécaen, 1979) was given by the time of the current experimental study (March 1996). Testing excluded global deterioration, as demonstrated by his performance on most tests of verbal and non-verbal intelligence, attention and visuo-spatial capacities (see Table I). His spontaneous language did not reveal syntactic and morphologic disorders, except for occasional word-finding pauses. Word-finding difficulties were more obvious in visual naming.



Fig. 1 – Representative horizontal MRI cross-sections of patient CN.

TABLE I
CN's Performance in General Neuropsychological Assessment

	Accuracy score	Judgement
Intellectual and executive functions		
WAIS similarities	9/12	–
Raven Progressive Matrices	34/36	–
Mini Mental State (MMS)	24/30	++
Simple and complex orders	17/20	–
Attention		
Letters barring	33/33	–
Memory		
Story recall (Wechsler)	11/24	++
Digit span	4	–
Spatial span (Corsi)	3	+
Verbal evocation		
Morphologic and semantic contraries	5/6	–
Automatic series: numbers and months	4/4	–
Gnosis		
Body parts	4/5	–
Colours	2/10	+++
Famous faces (photographs)	8/10	+
Complex pictures (photographs)	5/5	–
Visuo-spatial capacities		
Space orientation		–
Left-right orientation		–
Constructive apraxia		–

Note: normal performance: –; mild deficit: +; moderate deficit: ++; severe deficit: +++
(All the tests mentioned are described in Boller and Hécaen, 1979)

In picture naming of different objects, the accuracy score was about 67% (10/15) and error analysis mainly indicated confusions in the semantic domain (e.g. mask → *a cowl*; sugar tongs → *nutcracker*). However, errors in picture naming were not present for very frequent objects (accuracy scores: 5/5 high frequency objects; 3/5 middle frequency objects; 2/5 low frequency objects). Picture recognition of the same objects among distractors on spoken-name presentation was perfect (15/15).

On visual confrontation with common use objects, his responses, although roughly correct (accuracy score: 9/10), revealed a problem in lexical access (e.g. knife → “I can say it... It’s something, one tooth, teeth... One thing made for this”). Naming of the same real objects from palpation was perfect (10/10).

As far as written language was concerned, CN matched the diagnosis of pure alexia. He was totally unable to read words, non-words and sentences. His reading deficit also affected written language comprehension. However, spontaneous writing or writing from dictation were relatively preserved except for some perseverative phenomena (e.g. /courtyard/: /cour/ → *cowr*). Writing from copy was servile: he copied each letter, feature-by-feature, as if he were drawing a picture. Furthermore, CN was unable to read what he had correctly written, as is typical forms of pure alexia.

CN’s spelling was relatively spared, except for some irregular words (e.g. /oursin/ → *O.U.C.I.N*) and his repetition was normal.

Abnormalities in colour processing were noticed: (1) in colour naming from visual presentation: 2/5, (2) in colour designation from verbal order (e.g. “Show me the red...”): 1/5 and (3) in colour designation from name of objects (e.g. “Show me the colour of blood...”): 1/5. However, CN correctly named the colour of the same objects from verbal description (e.g. What is the colour of blood?): 5/5.

Although CN was not prosopagnosic, he was impaired in naming photographs of famous faces (accuracy score = 2/5) though knowing their profession (e.g. Jean Gabin → *an actor*) and in matching them with their spoken name (accuracy score: 2/5).

EXPERIMENTAL STUDY

An experimental study was conducted to identify the nature of CN’s visual naming disorder and to determine whether object and letter processing deficits shared a common mechanism.

Object Processing Assessment

In this section, we focus on CN’s performance on tasks designed to identify the cognitive mechanism underlying naming from visual stimuli. This analysis involved 4 types of tasks: (1) naming tasks; (2) assessment of elementary visual perception; (3) access to structural representation from vision (or “recognition of visual attributes”) and (4) access to semantics from vision (or “recognition of semantic attributes”). Detailed analysis of object naming errors were provided in a separate paper (see Teixeira Ferreira et al., 1997).

Naming Tasks

Naming assessment included: (1) object naming from the visual modality; (2) object naming from the tactile modality; (3) object naming from a verbal description of their function (by the experimenter) and (4) pantomime of object use (by the patient). Although pantomime is not a linguistic task, it was grouped together with naming tasks, since it may be viewed as a gestural counterpart of the lexical label of a given manipulable object. The same 36 objects were used for all tasks, except for pantomimes, since some objects lacked gestural specificity. As shown in Table II, the deficit observed in visual naming was significantly more marked than that in tactile naming (Chi-square = 6.25, $p < .02$), in naming from verbal description (Chi-square = 4.96, $p < .03$), and in miming (Chi-square = 9.94, $p < .002$). Errors made in visual naming included perseverations (59%),

TABLE II
CN's Performance in Object Processing Assessment

	Accuracy score	Judgement or %
Object naming and gesturing		
Visual input	19/36	53%
Tactile input	29/36	81%
Verbal description	28/36	78%
Pantomime	18/19	95%
Elementary visual perception		
Colours vision (Ishihara; Farnsworth)	13/13; 15/15	–
Line orientation judgment (Benton et al.)	26/30	–
Identical shapes matching (PEGV; Agniel et al.)	10/10	–
Overlapping shapes matching (PEGV; Agniel et al.)	12/12	–
Access to structural representation		
Different-views object matching	25/26	–
Different-views face matching (Benton et al.)	47/54	–
Access to semantic representation		
Functional matching (PEGV; Agniel et al.)	10/10	–
Categorical matching (PEGV; Agniel et al.)	10/10	–
Semantic association (from Howard et al.)		
Visual input	6/12	++
Verbal input	10/12	–

Note: normal performance: –; slight deficit: +; moderate deficit: ++; severe deficit: +++.

circumlocutions (29%) and semantic confusions (12%) (for more details, see Teixeira Ferreira et al., 1997).

In conclusion, CN's profile does not fit the conventional definition of anomia as his naming of tactually and auditory presented objects is better than that of visually presented objects. Also, CN cannot be classified strictly as an agnosic patient since he often gives correct gestures for objects he cannot name. Thus, CN has been shown to have a modality-specific naming impairment in conjunction with a relatively spared ability to make the correct gesture for a given object, and according to Lhermitte and Beauvois (1973), he should be labelled as an optic aphasic.

Elementary Visual Perception

To exclude a possible deficit in elementary visual perception that might explain CN's visual-specific naming deficit, the following tasks were used: (1) two colour vision tests (Ishihara, 1982; Farnsworth, 1957); (2) line orientation judgement test (Benton et al., 1983); (3) identical shapes matching test (Protocole d'Evaluation des Gnosies Visuelles or PEGV; Agniel et al., 1993) and (4) overlapping shapes matching test (PEGV; Agniel et al., 1993).

Colour Vision. Ishihara test consists of colour classification with isochromatic cards. Only isochromatic cards without digits were proposed because of CN's alexia. His performance on that subtest was perfect (13/13). Farnsworth test is similar but a finer discrimination of colour shades is required. CN correctly named the 15 colours of that test.

Line Orientation Judgement. CN was asked to select orientation of the target line from among fan-shaped lines. CN's accuracy score (26/30) was slightly above the normal mean (24.3).

Identical Shapes Matching. The aim of this tests was to determine the capacities to discriminate the identical shape target from among visually similar geometric shapes. CN's shape discrimination was perfect (10/10).

Overlapping Shapes Matching. The test assesses shape discrimination abilities and capacities to extract some elements included in a complex pattern of 3 overlapping shapes. CN was asked to select one target from among 8 shapes belonging to the same category. He did not make any error: 12/12.

Comment. Perfect performance on these tasks indicate that perceptual processes were spared.

Access to Structural Representation

Structural representation is assumed to be stored in long term memory (LMT) and to involve visual features that are independent of viewpoint. This supposes storage of canonical description of objects, along with mapping procedures so that object's representation can be accessed from several viewpoints. One component process in "visual object recognition" then, is the ability to perceive that an object's representation is constant across changes in viewpoint (see Warrington and Taylor, 1978). Object constancy was tested in CN using a different-views matching test for objects and faces.

Different-view Object Matching. CN was given three pictures: one of an object taken from a canonical view, one of the same object taken from a non-canonical view and one of a morphological distractor. He was required to choose which of two pictures represented the same object. His performance was almost perfect (25/26).

Different-view Face Matching (Benton et al. 1983). CN was shown photographs of faces and asked to select the two depicting the same face from different views and lighting. CN's correct responses (47/54) fell within the normal range (41-54).

Comment. CN's spared ability to identify two different views of the same object provides evidence that his difficulties in visual naming of objects occur in spite of correct access to the structural representations of these objects in LTM. Faulty processes are therefore likely to concern later stages, namely, the semantic representation of objects.

Access to Semantic Representation

CN's ability to access semantic knowledge was tested using three tasks: (1) a functional matching test (PEGV, 1993); (2) a categorical matching test (PEGV, 1993) and (3) a semantic association test (drawn from "Pyramid/Palm-tree association", Howard and Orchard-Lisle, 1984; see also Goldblum et al., 1994).

Functional Matching. CN was shown three object pictures (e.g. *stamp*, cube, stairs) and had to select one of them as presenting a functional relationship with an other object picture (e.g. envelope). The two functionally associated objects could not be matched on the basis of visual information because they were selected so as to be visually dissimilar. Access to semantic knowledge (or, at least, to some semantic attributes) is necessary to pass the test. CN did not make any errors (accuracy score = 10/10).

Categorical Matching. The principle of the categorical matching task is the same as that of functional matching, except that CN was required to select categorically related objects (e.g. *carrot*, *salad*, hammer, aeroplane). His performance was perfect (10/10).

Semantic Association. This test was given in a visual version (i.e. object pictures) and a verbal version (i.e. spoken names) using identical objects. To avoid learning effects, one week interval separated the two versions. CN was presented with three objects or words (e.g. *palm-tree*, *pyramid*, fir) and asked to select the two that were most closely related (associative or functional relationship). Such semantic association is normally found to be stronger than the semantic relationship that refers to co-ordinates in a category (e.g. two trees). Compared to prior tests, this association test required the extraction of more detailed semantic information. In the visual version, CN's accuracy score was at a random level (50%), while his performance was well above chance (83%) in the verbal version. For comparison purposes, a non-brain-damaged, age-matched control scored 11/12 (92%) correct in both the visual and verbal versions of the same test. The across-subject difference was significant in the visual version (Chi-square = 5.04, $p < .03$) but not in the verbal version (Chi-square = 0.38, $p = .5371$). Results indicate that the access to detailed semantic information from visual input was disrupted in CN whereas it seemed to be preserved from verbal input.

Comment. CN performed well on visual tasks in which functional or categorical matching was required, but was poor when more detailed semantic information was required (i.e. the pyramid/palm-tree association). More to the point is the fact that he was particularly disrupted in processing detailed semantic information in the visual version as opposed to the verbal version of the task. This result is consistent with the argument that CN had impaired access to detailed semantic knowledge from vision, accessing only general categorical information.

In summary, object processing in CN may be featured as follows: (1) the object naming deficit is selective to the visual modality; (2) elementary visual perception is intact; (3) “structural recognition” on visually presented objects is spared and (4) “semantic recognition” is preserved when tested with miming and tests tapping functional and categorical knowledge, but fails when more detailed semantic knowledge is required. This analysis confirms the conventional definition of optic aphasia according to Lhermitte and Beauvois (1973). Furthermore, results seem to lend support to a breakdown in visual access to semantic knowledge (Riddoch and Humphreys, 1987) as the underlying mechanism of CN’s visual naming deficit.

In the following section, CN’s ability in visual letter processing will be considered. We will examine whether visual letter naming deficit might be due to a partial deficit in accessing alphabetical information from vision. In other words, may the visual naming deficit relative to objects and letters be explained by a common underlying mechanism, namely a partial deficit in visual recognition?

Letter Processing Assessment

This section aims at identifying the nature of CN’s naming deficit on visually presented letters. Visual letter naming is often assumed to involve processing stages similar to those of visual object naming, namely: (1) elementary perception; (2) access to structural representation (i.e. stored representation of visual salient features that are independent of viewpoint); (3) access to alphabetical representation (i.e. stored representation that is related to our knowledge of letters) and (4) retrieval of letter names.

Table III presents CN’s performance on tests designed to assess letter processing. These tasks included: (1) letter naming in several sensory modalities; (2) assessment of access to letter structural representations from visual input and (3) assessment of access to alphabetical representations from visual or verbal inputs. Evaluation of elementary visual perception is not described here (see *supra* Table II).

Naming Tasks

By analogy to CN’s performance with objects (see *supra*), we expected his letter naming disorder to be selective to the visual modality. This prediction was tested by comparing the patient’s letter naming performance in various sensory modalities.

Letter Naming from Visual Input. CN was successively presented the 26 letters of the French alphabet and was required to name each letter. As indicated in Table III, CN presents a severe deficit in visual letter naming (accuracy rate = 46%). Errors consisted of substitutions within the alphabet, i.e. no number name or symbol name was produced.

TABLE III
CN’s Performance in Letter Processing Assessment

	Accuracy score	Accuracy rate (%)
Letter naming		
Visual input	12/26	46
Somesthetic input	11/26	42
Alphabet series	24/26	92
Kinesthetic assistance	19/26	73
Access to structural representation		
Letter decision task	94/104	90
Access to alphabetical representation		
Letter verbo-visual matching		
Across-category task	20/20	100
Within-category task	12/20	60
Allographic letter matching		
Across-category task	20/20	100
Within-category task	11/20	55

Letter Naming from Somesthetic Input. The experimenter drew with a pencil a letter in the left palm of the subject. The patient, his eyes closed, was asked to name each letter. CN's performance for somesthetic letter naming was as bad as in the visual letter naming test (from visual input: accuracy rate = 46%; from somesthetic input: accuracy rate = 42%; Chi-square = .08; $p = .7801$, non significant). However, no consistency was observed in the errors, different letters being involved in erroneous responses in the visual and in the somesthetic modality.

Visual Letter Naming with Kinesthetic Assistance. The patient, his eyes opened, was asked to let the experimenter move his left index and draw by passive movements the shape of a letter that he had to name. As shown in Table III, CN made significantly less errors in kinesthetic naming (accuracy rate = 73%) than in visual (Chi-square = 3.91, $p < .05$) and somesthetic conditions (Chi-square = 5.04, $p < .03$).

Naming of Letters from Alphabet Series. CN was asked to recite all the letters of the French alphabet. Although his recitation was slow, CN succeeded in producing all the letters, except for two of them ("N" and "V"). He did not seem to be conscious of his two omissions and made significantly less errors in this test (accuracy rate = 92%) than in visual (Chi-square = 13.00, $p < .0003$) and somesthetic conditions (Chi-square = 14.77, $p < .0001$).

Comment. CN's behaviour in letter naming tasks can be summarised as follows.

First, spared letter naming from alphabet series rules out an impairment of alphabetical representations or a disruption of letter names. Another source of evidence for the sparing of the phonological representations of letters comes from CN's normal performance on spelling (see CN's general neuropsychological assessment).

Second, the passive writing of a letter facilitated the naming performance compared to the letter naming on strictly visual presentation. Such facilitation of visual naming by a kinesthetic assistance suggests a disruption of a mechanism specific to the visual modality.

Third, CN made as many errors when he had to name letters from a somesthetic input as in visual naming. In the somesthetic condition, CN's errors could be explained by the unusual nature of the task. Also, it is likely that letter naming from somesthetic input requires information transcoding to spatial and visual representations as well as visuo-spatial memory processing.

Fourth, the error analysis of the patient in overall visual naming tasks indicates an absence of "consistency" across tasks, which seems to evoke and impaired access to alphabetical representations from visual input rather than a loss of alphabetical representations themselves (Shallice, 1988).

In conclusion, the analysis of CN's performance on letter naming tasks reveals that his difficulties affected preferentially letter naming from vision. The following section aims at determining which level of visual letter processing was impaired in CN. The lower perceptual processing stages were not formally assessed because, as mentioned in prior data about objects, CN did not appear impaired at this level.

Access to Structural Representation

Letter Decision Task. CN was asked to discriminate between line drawings of letters and pseudo-letters. Pseudo-letters were constructed by substituting a part of a letter with that of another letter (Figure 2). This task can be performed on the basis of stimulus

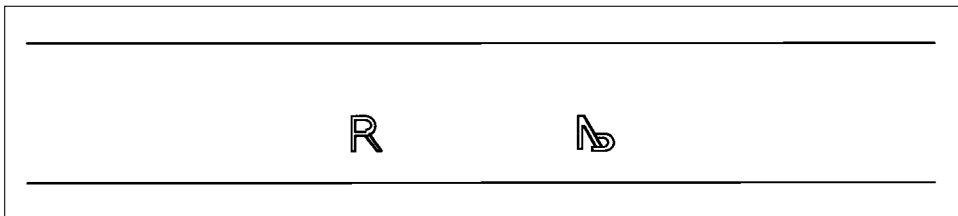


Fig. 2 – Examples of stimuli used in letter decision task.

familiarity only and does not require access to stored knowledge about letter attributes (e.g. vowel vs. consonant), not letter names.

The stimuli (26 letters and 26 pseudo-letters) were presented individually on a computer screen in random order. CN was instructed to decide whether or not the stimulus was a real letter. Two blocks were given; they differed only in stimuli order presentation. CN's accuracy rate was about 90% on the letter decision task: he accepted 51 stimuli among the 52 letter (98%) and dismissed 43 among the 52 pseudo-letters (83%). For comparison purposes, the same test was given to a non-brain-damaged, age matched control who scored 51/52 (98%) correct on letters and 47/52 (90%) correct on pseudo-letters. The across-subject difference did not reach significance (for letters: Chi-square = 0, $p = 1$; for pseudo-letters: Chi-square = 1.32, $p = .2505$).

Comment. Despite his massive problem on visual letter naming, CN performed correctly in discrimination between letters and pseudo-letters, suggesting that he could access structural representations of visually presented letters. Similarly to object processing, CN suffers neither from disorders of elementary perceptual processing, nor from deficit of access to structural representation from visual input.

Access to Alphabetical Representation

Two tasks were proposed to evaluate visual access to alphabetical representations: (1) letter verbo-visual matching and (2) allographic letter matching.

Letter Verbo-Visual Matching. CN was asked to point among alternatives to the letter named by the examiner. Two versions of the task were given.

In the across-category task, distractors were digits (e.g. "6") and geometrical shapes (e.g. "♦"). Each trial comprised: a target (e.g. "G"); a digit visually close to the target (e.g. "6") and a shape visually distant from the target (e.g. "♦"). Out of 20 trials, CN did not make any error in this task (accuracy rate = 100%).

In the within-category task, all alternatives were letters. Each trial comprised: a target (e.g. "G"); a distractor visually close to the target (e.g. "C") and a distractor visually distant from the target (e.g. "T"). On 20 trials, CN's accuracy rate was 60%. This performance was poorer than that obtained in across-category task (Chi-square = 10.00, $p < .002$).

Allographic Letter Matching. CN was asked to indicate which of 4 visual stimuli were allographic forms of the same letter upper-case vs. lower-case letter; e.g. "G" and "g").

In the across category task, the target letters (e.g. "G" and "g") and the two distractors belonged to different symbolic categories: one was a digit distractor (e.g. "6") and the other was a geometrical distractor (e.g. "♦"). Moreover, one of the two distractors (e.g. "6") and the upper-case letter target (e.g. "G") were visually similar whilst the other distractor was visually dissimilar (e.g. "♦"). In this way, the success of the choice could not rely on strictly visual information. On 20 trials, CN did not make any error (accuracy rate = 100%).

In the within-category task, all the 4 visual stimuli were letter. Two were 2 allographic forms of the same letter. The distractors included an upper-case letter (e.g. "T") and a lower-case letter (e.g. "c"); one of 2 distractors was selected to be visually similar to one of the 2 allographic targets. On 20 trials, CN's accuracy rate was 55%. This performance was poorer than that obtained in across-category task (Chi-square = 11.61, $p < .0007$).

Comment. CN was selectively impaired in both tests when the targets were all letters, but was not impaired when he had to discriminate letter from pseudo-letters. These results indicate that he could not access detailed alphabetical representation from visual input.

In sum, the pattern of CN's letter naming deficit is consistent with a partial deficit of visual recognition as already mentioned in the analysis of object processing.

DISCUSSION

CN presents a visual-specific object naming impairment that matches the classical definition of optic aphasia, since he can perform accurate gestures to the visually presented objects he names incorrectly. The detailed investigation of CN's naming impairment yields to main findings: (1) CN suffers neither from a deficit in elementary perceptual processing,

nor from a deficit in accessing to stored structural knowledge of objects from visual input. (2) CN is selectively impaired on tasks requiring the retrieval of detailed semantic information on visually presented objects. In fact, CN's deficit consists of an impairment in discriminating semantically close objects on visual input.

The finding that semantic knowledge is impoverished in optic aphasics has been reported in others studies (Riddoch and Humphreys, 1987; Hillis and Caramazza, 1995; De Renzi and Saetti, 1997). Like JB (Riddoch and Humphreys' patient, 1987), DHY (Hillis and Caramazza's patient, 1995) and Luciano (De Renzi and Saetti's patient, 1997), CN meets all the criteria for a diagnosis of optic aphasia when assessed with classical tasks, but performs poorly on tests that require an access to detailed semantic knowledge from visual input (within-category tasks).

Two alternative accounts for the faulty recognition (from visual input) evidenced by patients with so called optic aphasia are given in the recent literature. The first is proposed by Hillis and Caramazza (1995; for a somewhat similar account, see also Riddoch and Humphreys, 1987). These authors explain the pattern of performance of optic aphasics by an impaired access to complete, amodal semantic representation from a structural representation. The syndrome would thus result from a partial disconnection between pre-semantic (i.e. perceptual and structural) processes carried out by the right hemisphere, and semantic processes carried out by the left hemisphere. Semantic representation is assumed to be exclusively located in the left hemisphere and access to this representation from visual input is only possible via the corpus callosum as visual input cannot originate from the damaged left occipital cortex. The second alternative is proposed by De Renzi and Saetti (1997). In this account, the right hemisphere has a certain degree of semantic competence and optic aphasia could be explained by a disconnection between right-hemisphere processing and refined semantic processing of the left hemisphere. According to these authors, inter-subject variations in the semantic capacities of the right hemisphere explain why similar lesions may induce either optic aphasia or associative agnosia. In this conception, associative agnosia would correspond to cases with particularly limited semantic capacities in the right hemisphere. In the absence of convincing anatomical evidence from lesion-based studies (see De Renzi and Saetti's argumentation, 1997), it is difficult to determine which account is the most appropriate. Functional neuroimaging techniques have recently provided a new line of evidence concerning the neural substrates of object-based semantic processes. Among these studies, some described an involvement of right hemispheric regions (Martin et al., 1996) and others did not (Vandenberghe et al., 1996). Further studies are needed to disentangle the question of the participation of the right hemisphere in semantic tasks.

However, we concur with De Renzi and Saetti's view that there is a continuum between optic aphasia and associative agnosia. Optic aphasia, manifested by CN, could be considered as a mild form of associative agnosia. Three pieces of evidence seem in favour of the existence of an agnosic deficit in CN.

First, CN performs poorly on visual tasks that require fine-grained discrimination (within-category semantic association). The better performance in gesturing than in naming visually presented objects could be explained by the fact that less specific semantic characteristics are required in gesturing (for a similar argument, see Ratcliff and Newcombe, 1982).

Second, his letter processing shows problems that are relatively similar to those observed with objects: impairment on visual tasks that require within-category discrimination, despite spared perceptual and structural abilities. In particular, CN is able to visually access rough alphabetical representation (i.e. to discriminate a letter from a pseudo-letter) whilst unable to access more detailed alphabetical information (i.e. to discriminate a letter from other letters).

Finally, while a semantic disorder deficit should result in asymmetric performance between visual object and letter naming (see Caramazza et al., 1990), the absence of an asymmetric in CN's performance seems to point to a pre-semantic, i.e. agnosic, deficit.

In conclusion, these findings suggest that visual object as well as letter recognition are not completely preserved in CN and that optic aphasia with pure alexia can be considered as the manifestation of a mild form of associative agnosia. It is noteworthy that most cases of optic aphasia (for a review, see Davidoff and De Bleser, 1993) and visual associative

agnosia without prosopagnosia (for a review, see Farah, 1991) seem to present alexic difficulties. The question, then, remains whether a common mechanism actually explains visual object naming and reading deficits in optic aphasia. Further investigations should assess the possibility of such a parallelism between visual-specific naming and reading impairment in optic aphasia.

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REFERENCES

- AGNIEL, A., JOANETTE, Y., DOYON, B. and DUCHEIN, C. Protocoles d'Évaluation des Gnosies Visuelles (PEGV). In J.L. Nespoulous, Y. Joanette and A.R. Lecours (Eds.), *Les Protocoles Montreal-Toulouse Neurolinguistique et Neuropsychologique*. Isbergues: L'Ortho Edition, 1993.
- BENTON, A.L., HAMSHER, K., VARNEY, N.R., and SPREEN, O. *Contributions to Neuropsychological Assessment*. New York: Oxford University Press, 1983.
- BOLLER, F., and HÉCAEN, H. L'évaluation des fonctions neuropsychologiques: examen standard de l'Unité de recherches neuropsychologiques et neurolinguistiques (U-111), INSERM. *Revue de Psychologie Appliquée*, 29: 247-266, 1979.
- BRUYER, R. Partie 2: Les agnosies visuelles. In X. Seron et M. Jeannerod (Eds.), *Neuropsychologie Humaine*. Liège: Pierre Margada, 1994.
- CARAMAZZA, A., HILLIS, A.E., RAPP, B.C., and ROMANI, C. The multiple semantics hypothesis: multiple confusions? *Cognitive Neuropsychology*, 7: 161-189, 1990.
- COSLETT, H.B., and SAFFRAN, E.M. Preserved object recognition and reading comprehension in optic aphasia. *Brain*, 112: 1091-1110, 1989.
- DAVIDOFF, J., and DE BLESER, R. Optic aphasia: a review of past studies and reappraisal. *Aphasiology*, 7: 135-154, 1993.
- DE RENZI, E., and SAETTI, C. Associative agnosia and optic aphasia: qualitative or quantitative difference? *Cortex*, 33: 115-130, 1997.
- FARAH, M.J. *Visual Agnosia: Disorders of Object Recognition and What They Tell Us about Normal Vision*. Cambridge: The M.I.T. Press, 1990.
- FARAH, M.J. Patterns of co-occurrence among the associative agnosias: Implications for visual object representation. *Cognitive Neuropsychology*, 8: 1-19, 1991.
- FARNSWORTH, D. *Manual The Farnsworth-Munsell 100-Hue Test*. Baltimore: Munsell Color Co. Inc., 1957.
- FREUND, D.C., 1889. Über optische Aphasie und Seelenblindheit. *Archiv für Psychiatrie und Nervenkrankheiten*, 20: 276-297, quoted by Davidoff, J., and De Bleser, R., 1993.
- GOLDBLUM, M.C., CHANOINE, V., ROSENTHAL, V., and PONCET, M. Les noms et le choses: étude comparative de deux cas d'anomie progressive. *Revue de Neuropsychologie*, 4: 187-221, 1994.
- HILLIS, A.E., and CARAMAZZA, A. Cognitive and neural mechanisms underlying visual and semantic processing: implications from "Optic Aphaisa". *Journal of Cognitive Neuroscience*, 7: 457-478, 1995.
- HOWARD, D., and ORCHARD-LISLE, V.M. On the origin of the semantic errors in naming: Evidence from the case of a global aphasic. *Cognitive Neuropsychology*, 1: 163-190, 1984.
- IORIO, L., FALANGA, A., FRAGASSI, N.A., and GROSSI, D. Visual associative agnosia and optic aphasia. A single case study and a review of the syndromes. *Cortex*, 28: 23-37, 1992.
- ISHIHARA, S. *Ishihara's test for Color Blindness*. Tokyo: Kanehara, 1982.
- LECOURS, A.R., and LHERMITTE, F. Phonemic paraphasias: Linguistic structures and tentative hypotheses. *Cortex*, 5: 193-228, 1969.
- LHERMITTE, F., and BEAUVOIS, M.F. A visual-speech disconnexion syndrome: report of a case with optic aphasia, agnosic alexia and colour anomia. *Brain*, 96: 695-714, 1973.
- LISSAUER, H. Ein Fall von Seelenblindheit nebst einem Beitrage zur Theorie derselben. *Archiv für Psychiatrie und Nervenkrankheiten*, 21: 22-270, 1980. (English translation by M. Jackson, *Cognitive Neuropsychology*, 5: 157-192, 1988).
- MARR, D. *Vision*. San Francisco: Freeman, 1982.
- MARTIN, A., WIGGS, C.L., UNGERLEIDER, L.G., and HAXBY, J.V. Neural correlates of category-specific knowledge. *Nature*, 379: 649-652, 1996.
- RATCLIFF, G., and NEWCOMBE, F. Object recognition: Some deductions from the clinical evidence. In A.W. Ellis (Ed.), *Normality and Pathology in Cognitive Functions*. New York: Academic Press, 1982.
- RIDDOCH, M.J., and HUMPHREYS, G.W. Visual object processing in optic aphasia: a case of semantic access agnosia. *Cognitive Neuropsychology*, 4: 131-185, 1987a.

- RIDDOCH, M.J., and HUMPHREYS, G.W. A case of integrative visual agnosia. *Brain*, 110: 1431-1462, 1987b.
- SEYMOUR, P.H.K. *Human Visual Cognition*. New York: St Martin's Press, 1979.
- SHALLICE, T. *From Neuropsychology to Mental Structure*. Cambridge: Cambridge University Press, 1988.
- SNODGRASS, J.G. Concepts and their surface representation. *Journal of Verbal Learning and Verbal Behavior*, 23: 3-22, 1984.
- TEIXEIRA FERREIRA, C., GIUSIANO, B., CECCALDI, M., and PONCET, M. Optic Aphasia: evidence of the contribution of different neural systems to object and action naming. *Cortex*, 33: 499-513, 1997.
- VANDENBERGHE, R., PRICE, C., WISE, R., JOSEPHS, O., and FRACKOWIACK, R.S.J. Functional anatomy of a common semantic system for words and pictures. *Nature*, 383: 254-256, 1996.
- WARREN, C., and MORTON, J. The effects of priming on picture recognition. *British Journal of Psychology*, 73: 117-129, 1982.
- WARRINGTON, E.K., and TAYLOR, A.M. Two categorical stages of object recognition. *Perception*, 7: 695-705, 1978.

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