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Proper name anomia in poststroke aphasics: evidence from a multiple-case study

Paolo Vitali^{a,b}, Isabelle Rouleau^{c,d}, Yan Deschaintre^{a,b}, Diana Mina^e, Marthyne Brazeau^e, Sylvain Lanthier^{a,b},
Maxime Montembeault^{f,g} and Simona Maria Brambati^{f,g*}

^aFaculty of Medicine, Université de Montréal, Montréal, Canada; ^bDivision of Neurology, Department of Medicine, Centre hospitalier de l'Université de Montréal (CHUM), Montréal, Canada; ^cDepartment of Psychology, Université de Québec à Montréal, Montréal, Canada; ^dService of Neuropsychology, Centre hospitalier de l'Université de Montréal (CHUM), Montréal, Canada; ^eService of Speech-and-Language Pathology, Centre hospitalier de l'Université de Montréal (CHUM), Montréal, Canada; ^fCentre de recherche de l'Institut universitaire de gériatrie de Montréal, Montréal, Canada; ^gDepartment of Psychology, Université de Montréal, Montréal, Canada

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We aimed to characterize difficulties in famous face naming in three poststroke aphasic patients with a lesion limited to the left mid-posterior temporal language regions, sparing the anterior temporal lobe. The patients did not present semantic deficits specific to known people. Nonetheless, they showed difficulties naming famous buildings in addition to famous faces, but they were comparable to healthy controls in generating proper names. Our results support the critical role of the mid-posterior temporal language regions in the lexical retrieval of proper names, namely from pictorial stimuli, in absence of semantic impairments.

Keywords: poststroke aphasia; famous face naming; lexical retrieval of proper names; person-related semantics; semantic variant of primary progressive aphasia

Designating people by their name is a fundamental human social skill, which may have had an adaptive role in hominid phylogenesis. Under the effects of social pressure, humans' evolving brains may have developed a neural system that more efficiently processed individuals' names (Semenza, 2011). Some evidence supporting the partial anatomical segregation of the processing of individuals' names and common nouns comes from clinical studies of brain-damaged patients with naming difficulties. These studies have reported a double dissociation in naming difficulties (also referred to as anomia) between common concepts and known people (McKenna & Warrington, 1978; Miceli et al., 2000; Semenza & Zettin, 1988, 1989; Tranel, Damasio, & Damasio, 1997).

Evidence from both poststroke and neurodegenerative anomic patients indicate an association between damage in the anterior temporal lobes (ATLs) and naming impairments for known people (Damasio, Damasio, Tranel, & Brandt, 1990; Damasio, Grabowski, Tranel, Hichwa, & Damasio, 1996; Damasio, Tranel, Grabowski, Adolphs, & Damasio, 2004; Gorno-Tempini, Dronkers, et al., 2004; Joubert et al., 2003; Tranel, 2006; Tranel, Logan, Frank, & Damasio, 1997). This anatomic-clinical association could be driven by the key roles of the ATLs in the semantic system. In fact, according to one of the most prominent cognitive models of ATL function, these bilateral structures would support conceptual knowledge, combining

information from sensory-, motor-, and language-specific areas (Patterson, Nestor, & Rogers, 2007). In this framework, difficulty naming known people in ATL-damaged patients could be the result of a lack of recognition of the known individuals rather than a lexical-retrieval impairment regarding their names. By contrast, other authors propose that the bilateral ATLs serve as “convergence zones,” that is, intermediary brokering sites between the retrieval of conceptual knowledge and the retrieval of names (Damasio et al., 2004). According to this view, naming difficulties in ATL-damaged patients would be determined by defects in the earlier stages of lexical processing involving intermediate representations between semantic and phonological levels. Although the two theories propose different roles for the ATLs in a network supporting the recognition and name retrieval of known people, both views seem to agree that the ATLs are mainly involved in the prelexical stages of naming known people.

Moreover, recent functional neuroimaging evidence in young healthy participants seems to suggest that the posterior language areas, including the posterior middle temporal gyrus (MTG) and the temporoparietal junction, are involved in the retrieval of the names of known people. In fact, greater activation in the dominant posterior temporal gyrus has been observed while processing known people whose names are correctly recalled compared to known people whose names are not correctly recalled. This finding seems to suggest that within the broader temporal

*Corresponding author. Email: simona.maria.brambati@umontreal.ca
The present work is in memory of Jean-Maxime Leroux, who died prematurely.

network sustaining the naming of known people, the left posterior temporal areas are more involved in name retrieval processes (Gesierich et al., 2012). Evidence supporting this hypothesis comes from patients with primary progressive aphasia (PPA), a neurodegenerative syndrome involving a progressive loss of language functions (Gorno-Tempini, Dronkers, et al., 2004; Gorno-Tempini et al., 2011; Grossman et al., 1996; Mesulam, 1982; Mesulam & Weintraub, 1992). Consistently, patients with the logopenic variant of PPA are characterized by left posterior temporal and parietal damage and manifest anomia but no multimodal semantic deficits (Gorno-Tempini et al., 2008; Henry & Gorno-Tempini, 2010). However, confirmation from patients with aphasia due to vascular posterior left perisylvian damage has yet to be reported. This can be explained by the fact that there are no detailed studies on naming and recognition of known people in poststroke aphasia patients, particularly in acute phases. Nonetheless, unlike neurodegenerative patients, poststroke aphasic patients can manifest spontaneous or therapy-induced reorganization and recovery of language functions (Brownsett et al., 2014; Jarso et al., 2013) that could mask some face-naming difficulties in group studies. In the present multiple single-case investigation, we tested the hypothesis that patients with damage to the mid-posterior temporal language areas and who manifest persisting difficulties in naming known people in chronic phases show name retrieval difficulties rather than more generalized semantic deficits. To this aim, patients were selected based on the presence of famous face anomia and underwent three experimental tasks that aimed to explore (1) whether their naming difficulties reflected person-related semantic deficits; (2) whether their naming difficulties were restricted to the visual modality, that is, face presentation (also referred to as prosopagnosia; Semenza, Sartori, & D'Andrea, 2003), or were generalized; (3) and whether they were limited to known people or generalized to "semantically unique items," that is, items with a unique semantic and lexical association.

Methods

Case subjects

We identified case subjects from a retrospective analysis of a database of aphasic patients. Ischemic stroke patients evaluated in 2010 and 2011 by a speech-and-language pathologist were eligible if they had aphasia secondary to a single stroke limited to the posterior language regions (sparing the anterior temporal pole). Lesion location and extent were determined for each patient on the basis of a detailed visual inspection of the head computerized tomography (CT) scan by consensus between a vascular neurologist and a neuroradiologist.

The study was approved by the ethics committee of the Centre de Recherche de l'Hôpital Notre-dame du CHUM.

Selection of patients with difficulties naming famous faces

To be eligible, case subjects also had to show difficulties in naming famous people at a formal screening test. In the famous face-naming task, colored pictures of 24 famous faces (from categories including politics, show-business, and sports) were visually presented for an indefinite period of time on a computer screen via Eprime software, and vocal responses were recorded. If subjects were able to retrieve the family name corresponding to the famous face, then a correct answer was scored by the investigator. Nonetheless, participants were also asked to state the profession of the person shown so as to verify the correct identification of the famous person. A face was considered to be correctly identified if the profession was correctly stated. Naming performance was calculated as the proportion of correctly named faces out of the total of correctly identified faces, to exclude naming errors caused by a lack of knowledge of the famous person. Subjects with a performance of 2 standard deviations (*SDs*) at or below the mean of the control group were eligible (Damasio et al., 2004).

Controls

A group of 14 healthy participants matched by age and education were enrolled as a control group for the famous face-naming task as well as for the experimental tasks (except for the semantic priming task). They were recruited from a database of senior volunteers who had agreed to participate in research projects on aging. The control group underwent a screening cognitive evaluation to verify the absence of mild cognitive impairments or dementia-related symptoms.

A different group of 13 healthy adults, who were matched by age and education and have been previously described (Predovan et al., 2014), served as a control group specifically for the semantic priming task (see the "Implicit semantic task: semantic priming during recognition of famous names" section).

General exclusion criteria for both aphasics and the control group were as follows: first spoken language other than French, left-handedness (as measured by the Edinburgh Handedness Inventory), developmental learning disabilities, history of neurodegenerative disease, past psychiatric disorder, history of traumatic brain injury, history of alcoholism or drug abuse, untreated medical or metabolic conditions and uncorrected hearing and vision problems. Case subjects and controls were excluded if signed study consents were not obtained.

Neuropsychological and language profiles

Case subjects underwent a prospective evaluation of their cognitive and language profiles.

The neuropsychological evaluation included a battery of standardized tests testing the following cognitive domains: general cognitive functioning (Mini-Mental State Examination, Clock drawing), nonverbal intelligence (Raven Colored Progressive Matrices), attention and visual exploration (Bells Test), executive functions (D-KEFS Stroop Test, Trail Making Test Part A and B), and ideomotor apraxia. These tests have been previously successfully employed to characterize the cognitive profiles of left hemisphere brain-damaged patients. The control group was evaluated with a shorter battery of tests.

Language abilities were characterized by means of a battery of standardized tests. Given prior written approval from the participants, the language sessions were recorded. This allowed for better off-line analysis of some test responses and an inter-rater reliability evaluation of language measures. All vocal responses provided by the participants during the tasks were double-checked independently by two investigators.

The battery of standard tests investigated the following domains: picture naming (Boston Naming Test-30 items), explicit semantics (Visual Pyramid and Palm Tree Test, Mill Hill Synonymous judgment, Word-to-picture matching), motor speech (buccofacial apraxia, Montréal-Toulouse Aphasia Battery – MT-86), verbal fluency (phonemic and semantic), oral verbal comprehension (Token Test-short form), written syntactic comprehension (Chapman-Cook Test), and oral repetition (BDAE Sentence Repetition Test, ODEDYS Word and Pseudoword Repetition Test).

Anatomic characterization of the brain lesions in the selected patients

To characterize the common lesion extent and location in the case subjects, we manually traced on their head CT scan the anatomical regions-of-interest (ROIs) corresponding to the infarct tissue, using the MRIcron package (www.mricron.com) (Rorden & Brett, 2000). The identified ROIs were then transformed into volumes of interest and subsequently spatially normalized to the Montreal Neurological Institute standard stereotactic space using SPM8 software (<http://www.fil.ion.ucl.ac.uk/spm/software/spm8/>) and an age-specific CT brain template (Rorden, Bonilha, Fridriksson, Bender, & Karnath, 2012). Patients' normalized lesion mappings were rendered on the CT brain template using MRIcron. Overlapping voxels were plotted using a color-coded bar.

Experimental task 1

To determine whether naming difficulties with famous faces reflected person-related semantic deficits, we

compared the performance of case subjects and controls in both explicit and implicit semantic tasks requiring knowledge of famous people.

Explicit semantic tasks: famous-proper-name-to-face matching task and semantic categorization based on profession

Participants were asked to match a verbally presented proper name with the corresponding face in an array of four black-and-white pictures consisting of three famous people and an unknown distracter (famous-proper-name-to-face matching task). The test comprised 26 items. For each item, even when not correctly matched, subjects were asked to specify the profession and provide some biographical details about the target (semantic categorization based on profession). The experimenter scored the item as correct when it was correctly recognized.

Implicit semantic task: semantic priming during recognition of famous names

Semantic system integrity was assessed by using a semantic priming paradigm, which does not require explicit access to lexical and semantic information. The expression “semantic priming effect” refers to the facilitation in stimulus processing induced by the prior presentation of a semantically associated stimulus. Specifically, it has been shown that it takes less time to decide whether a target proper name belongs to a famous person when it is preceded by the name of a famous person sharing the same profession (prime word) (e.g., “Marlon Brando-Paul Newman”; “Mick Jagger-John Lennon”).

In the present task, each trial began with a 500-ms presentation of a central fixation cross, followed by the prime name for 300 ms. Afterwards, a blank screen appeared for 50 ms (with a stimulus onset asynchrony of 350 ms). Then, the target stimulus was displayed on the screen until a response was given, with a maximal response time of 3000 ms. Two underscored lines surrounded the targets to distinguish them from the primes. The interval between trials was 1500 ms. Both primes and targets were presented at the center of the screen and consisted of white letters strings printed in Arial 18 font on a black background.

Each trial showed two serial presentations of a name (either identical or different) on the screen. The experimental task required participants to judge, as quickly and as accurately as possible, whether the target stimulus was the name of a famous person. Participants had to respond by pushing the predetermined keys “yes” or “no” on the keyboard, respectively, with the index or middle finger of the left (nonparetic) hand. The semantic priming condition was “related” when target and prime names belonged to

famous persons with the same profession or “unrelated” when the prime name or the target name belonged to common people. Each target word was presented in a “related condition” or in an “unrelated condition.” In the related and unrelated conditions, the prime names were matched for number of letters. The stimuli were delivered and responses were recorded using the Eprime software.

Reaction times (RT) and accuracy were used as the dependent variables. Consistent with previous studies of semantic priming, only RT for “yes” (i.e., famous name target) correct responses were included in the analysis (Chertkow et al., 1994; Duong, Whitehead, Hanratty, & Chertkow, 2006; Giffard, Desgranges, Kerrouche, Piolino, & Eustache, 2003; Giffard et al., 2001). To avoid the possibility that the mean RT for each condition was influenced by extreme scores, the RTs that were 2 *SDs* above or below the mean of each condition were excluded from the analysis, and the mean was recalculated. A priming effect index was calculated based upon differences in response times between “related” and “unrelated” items and was expressed as a percentage for each participant. In particular, the effect index was calculated as follows: Priming Effect Index = [(mean RT “unrelated” – mean RT “related”)/mean RT “unrelated”] × 100. This index produces a measure of the priming effect that is not biased by a general cognitive slowing effect that can be associated with brain damage (Brambati, Peters, Belleville, & Joubert, 2012; Giffard et al., 2003; Predovan et al., 2014).

To verify whether the proposed experimental semantic tasks were capable of detecting person-specific semantic deficits, the tests were also administered to a 54-year-old right-handed gentleman with the semantic variant of primary progressive aphasia (svPPA) (Gorno-Tempini, Dronkers, et al., 2004; Hodges, Patterson, Oxbury, & Funnell, 1992; Neary et al., 1998), a neurodegenerative syndrome characterized by isolated semantic deficits and atrophy in the left ATL sparing posterior temporal regions (see Supplementary material for the details of the svPPA patient’s neuroimaging and neuropsychological evaluation).

Experimental task 2

Name fluency for famous people

To determine whether famous face-naming difficulties were restricted to visual stimuli (prosopagnosia Semenza et al., 2003), or more generalized, we compared the performance of case subjects and controls in a 1-min name-fluency task for famous people, that is, the spontaneous generation of the names of known people, organized in different categories.

Participants were asked to list as many family names of famous people as possible belonging to each of the following four categories: politics, show-business, sports, and music. The number of names provided for each

category was summed to obtain a global score for proper name fluency.

Experimental task 3

Famous building-naming task

To determine whether naming difficulties were limited to known people or more generalized to “semantically unique items” (i.e., items with a unique semantic and lexical association), we compared the performance of case subjects and controls in the naming of famous buildings. Participants were asked to overtly name visually presented colored pictures of 21 famous buildings. If participants were able to retrieve the commonly used proper name of the famous building, then a correct answer was scored by the investigator. Correct building identification, regardless of name code retrieval, was also tested by asking the participants which country the presented building was from. Full identification was scored only when the right country was provided. Naming performance was expressed as the percentage of the fully identified pictures, which were also correctly named. This ensured that the naming performance was not biased by the participant’s general knowledge of buildings.

Results

Case subjects

A total of six poststroke aphasic patients met the anatomical inclusion criterion and were screened for famous people-naming difficulties. As a group, the poststroke aphasia patients showed significantly lower performance in the famous face-naming task compared to controls (control group’s performance: mean = 75%, *SD* = 14; poststroke aphasia group’s performance: mean = 57%, *SD* = 15, $t(18) = -2.5$, $p < .05$). Only patients with major naming difficulties, that is, participants with a performance of 2 *SDs* at or below the mean of the control group, were included in the multiple-case investigation (Damasio et al., 2004).

Three of our patients met the anomia inclusion criterion, showing a performance equal to or below the established cutoff on the famous face-naming task, and were retained in the present study (control group’s performance: mean = 75%, *SD* = 14; performance cutoff = 47%. Case subjects’ performance: patient 1 = 43%; patient 2 = 47%; patient 3 = 44%). Demographic and anatomical characteristics for the three case subjects are reported in Table 1.

Case subjects’ neuropsychological and language profiles

Case subjects’ scores in the language and neuropsychological evaluations are reported in Tables 2 and 3. Based upon published norms, patients revealed no persistent

Table 1. Demographic, anatomical, and naming characteristics of the case subjects.

Case	Sex	Age at testing	Formal education (year)	Infarction-test delay (months)	Lesion location	Early language assessment	Famous face naming (%)
1	F	66	11	5	Temporo-insular	Severe sensory transcortical aphasia	43
2	M	61	15	24	Wernicke area, posterior insula, temporoparietal operculum, parietal	Normal functional range	47
3	F	64	18	17	Temporoparietal	Wernicke aphasia evolving toward conduction aphasia	44

language or neuropsychological deficits. Defective performance was observed only in cases 1 and 3 in the Token Test. No deficits were observed either in common object naming or in the semantic tasks.

Lesions anatomical characterization

The normalized lesions' renderings on the CT brain template showed an overlap in the left mid-posterior temporal regions (Figure 1). No damage was observed in the left anterior temporal regions, as per the inclusion criteria.

Experimental task 1

Explicit semantic tasks: famous-proper-name-to-face matching task and semantic categorization based on profession

Case subjects

When asked by the investigator to choose between four pictures and to point to the target corresponding to the name of a famous person, case subjects showed a performance comparable to the control group (case 1: accuracy = 88.5%; case 2: accuracy = 100%; case 3: accuracy = 96.2%; control group: accuracy = 96.4%, $SD = 5.5$; Mann–Whitney U test, $p = .536$) (Figures 2a and b). Further investigation of target recognition was performed using a semantic categorization task based upon profession. The results showed ceiling performance in the case group, comparable to the control group (case 1: accuracy = 100%; case 2: accuracy = 100%; case 3: accuracy = 100%; control group: accuracy = 98.9%, $SD = 1.8$; Mann–Whitney U test, $p = .304$).

svPPA patient

At the early stages of the disease, the svPPA patient showed extremely low performance in both famous-proper-name-to-face matching (accuracy = 38.5%, performance 10 SD below the mean of the control group) and semantic categorization (accuracy = 30.8%, performance 38 SD below the mean of the control group) tests.

Implicit semantic task: semantic priming during famous person recognition

Case subjects

No differences were observed between the case subjects and controls in terms of the total percentage of responses excluded (controls: $10.0\% \pm 6.1$, aphasics: $7.75\% \pm 1.85$, two-sample t -test (16) = 0.80, $p = n.s.$) (Figure 3).

We found no differences between case subjects and controls in terms of either the number of errors (cases 1, 2, and 3: number of errors = 1; control group: number of errors = 2.5, $SD = 1.2$; Mann–Whitney U test, $p = .54$; trend towards less errors in the aphasic group) or in terms of the semantic priming effect index (case 1: semantic priming effect index (PEI) = 5.0%; case 2: semantic PEI = 6.9%; case 3: semantic PEI = 10.4%; control group: semantic PEI = 4.3%, $SD = 6.5$; Mann–Whitney U test, $p = .253$). Actually, both aphasic patients and controls showed a facilitation effect when the target famous name was preceded by a prime sharing the same profession.

svPPA patient

The svPPA patient showed no facilitation effects in the semantic priming task. On the contrary, the familiarity judgment task was slowed when the target famous name was preceded by a prime sharing the same profession (semantic PEI = -24%, performance 4.4 SD s below the means of controls).

Task 2

Name fluency for famous people

Considering the four profession categories of the famous people together, aphasic patients were able to generate a number of names comparable to that of the control group (case 1: fluency = 24; case 2: fluency = 34; case 3: fluency = 33; control group = 38.2, $SD = 11.5$, Mann–Whitney U test, $p = .313$) (Figure 4).

Table 2. Neuropsychological profile of the case subjects.

Case	Clock drawing (max = 10)			D-KEF's Stroop Test (standard scores)					Trail Making Test A			Trail Making Test B			Apraxia		
	MMSE (max = 30)	Command	Copy	RCPM (max = 36)	Bells test (max = 35)	Color naming	Word reading	Inhibition	Inhibition/switching	Sec.	Errors	Sec.	Errors	Sec.	Errors	Ideomotor	Buccofacial
1	28	9	10	29	34	10	11	7	10	26	1	99	1	99	1	No	No
2	30	10	10	34	34	10	11	12	14	33	0	79	0	79	0	No	No
3	29	9	10	35	31	1	10	5	10	53	2	84	0	84	0	No	No

Note: MMSE = Mini-Mental Status Examination; RCPM = Raven Colored Progressive Matrices.

Table 3. Language profile of the case subjects.

Case	1-min fluency			ODEDYS						Mill Hill	
	Phonological	Semantic	BNT (max = 30)	Token Test (max = 62)	BDAE Sentence Repetition (max = 16)	Word Repetition (max = 16)	Pseudoword Repetition (max = 20)	VPPTT (max = 52)	CCT Syntactic Comprehension	RPT Word-to-picture matching (max = 10)	Synonymous judgment (max = 44)
1	6	18	26 (86.67)	48*	13	16	19	49	6	9	34
2	14	17	26 (86.67)	59	15	16	19	50	20	10	39
3	20	26	27 (90)	49*	15	16	11	50	13	10	39

Note: VPPTT = Visual Pyramid and Palm Tree Test; BNT = Boston Naming Test; CCT = Chapman-Cook Test; RPT = Repeat and Point Test.

*Defective performance based on published norms.

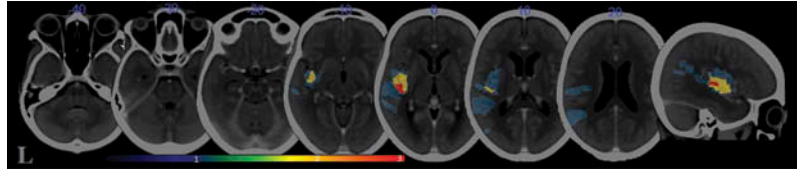


Figure 1. Case subjects' rendering of the lesion overlay map on a CT brain template. Commonly damaged region is in the mid-posterior language regions sparing the anterior temporal lobe.

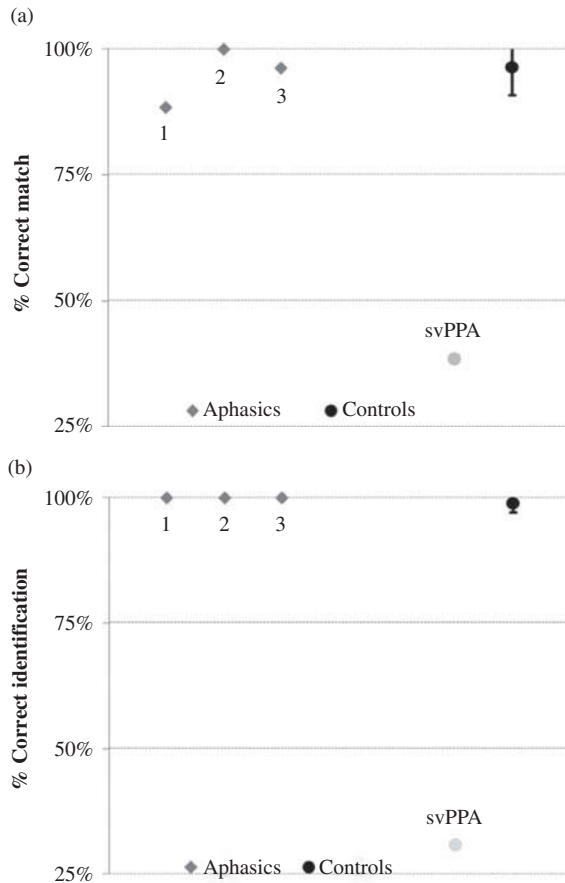


Figure 2. (a) Results of the famous-proper-name-to-face matching task. (b) Results of the famous people categorization task based upon profession.

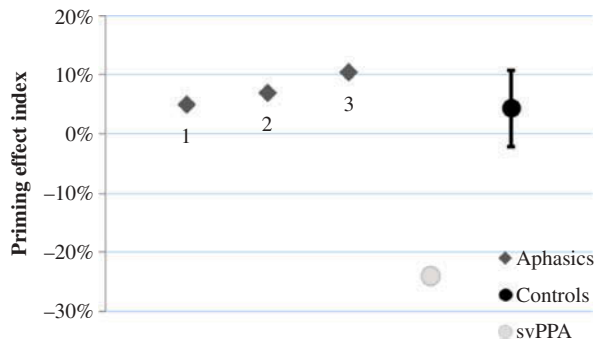


Figure 3. Results of the semantic priming task of famous names.

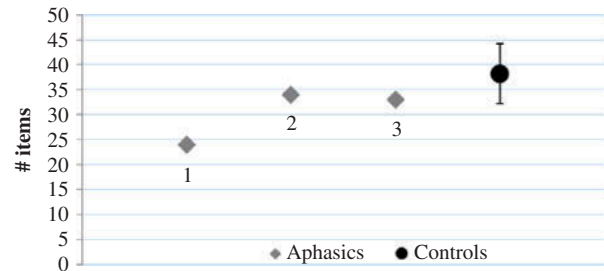


Figure 4. Results of the name fluency task for famous people.

Task 3

Famous building-naming task

Aphasic patients showed lower performance than controls in the famous building-naming task (case 1: famous building-naming task = 86%; case 2: famous building-naming task = 90%; case 3: famous building-naming task = 75%; control group = 92.6%, *SD* = 6.5, Mann–Whitney *U* test, *p* = .04) (Figure 5). No differences were observed in famous building recognition.

Discussion

Our multiple-case study showed that famous people-naming difficulties in the case subjects could be ascribed to difficulties retrieving the lexical codes from pictorial material of semantically unique items in the absence of global semantic deficits. These results seem to provide

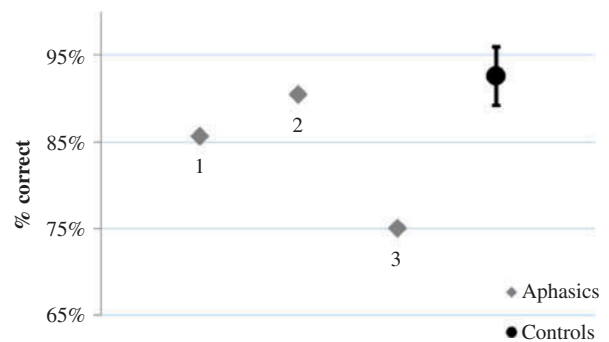


Figure 5. Results of the famous building-naming task.

evidence that, within the left temporal network sustaining the processing of semantically unique items, the posterior temporal regions could be involved in the retrieval of proper name codes.

Our group of six poststroke patients with damage in the posterior language areas showed a significantly lower performance in the famous face-naming task compared to controls. However, in order to achieve our research goal, only patients with a performance of 2 *SDs* at or below the mean of the control group were included in the study. Several explanations could account for the fact that only three out of six chronic patients met our severe inclusion criteria for persisting famous face anomia. One of the hypotheses is that there was a ceiling effect on the inclusion/exclusion criteria and that if harder tests of face naming had been provided, perhaps all persons with the appropriate lesions would have performed worse than controls. Another possible explanation is that the three excluded patients may have manifested spontaneous or therapy-induced reorganization and recovery of language functions, as described by numerous previous studies (Brownsett et al., 2014; Jarso et al., 2013). Further detailed studies on naming and recognition of known people in acute poststroke aphasia patients are necessary to support this latter hypothesis. Interestingly, the three cases selected for the present study were characterized by difficulties in naming the faces of famous people in the context of global successful language recovery, particularly common objects naming. In fact, patients showed normal performance on the Boston Naming Test administered in the language evaluation, in accordance with previous patient studies suggesting that famous face-naming abilities can be selectively impaired in brain-damaged patients (McKenna & Warrington, 1978; Miceli et al., 2000; Semenza & Zettin, 1988, 1989; Tranel, Damasio, et al., 1997). Remarkably, task 3 revealed that naming difficulties also involved famous buildings in absence of recognition difficulties. Although the deficits were not as severe as in famous face naming, this result suggests that name retrieval difficulties can be expanded to other proper name categories and may reflect more generalized difficulties in naming “semantically unique items.” However, the patients showed no impairments in the famous people fluency task (task 2). This finding, based on our three cases, suggests that mid-posterior temporal language areas would be implicated in the core ability to retrieve a proper name associated with a picture, rather than subserving a more general ability to generate proper names.

The absence of semantic difficulties accounting for the naming difficulties in our case subjects was verified using both explicit measures, which have been previously used as experimental measures of the semantic knowledge of famous people (Gorno-Tempini, Rankin, et al., 2004), as well as implicit measures, that is, semantic priming. Because the semantic priming paradigm does not

explicitly require that participants process the relationship between the prime and target stimuli, this effect has been explained as resulting from automatic spreading of the activation of the semantic network from the node represented by the prime word to the node represented by the target word. Therefore, this effect is expected to be absent or reduced in patients with degraded person-specific semantic information but not in patients with defective access to semantic information or lexical-retrieval difficulties. The semantic priming paradigm used in the present study has been demonstrated to successfully detect semantic system abnormalities in patients with very subtle deficits – which are sometimes not even noticeable through explicit testing – such as mild cognitive impairment and early Alzheimer’s disease (Brambati, et al., 2012; Predovan et al., 2014). The results of the present study confirm the integrity of the semantic representations in our case subjects. This finding suggests that the naming difficulties manifested by our case subjects are probably not secondary to global person-specific semantic deficits. Importantly, the svPPA patient showed severe deficits in all semantic tests, further confirming that the proposed semantic tests can detect person-specific semantic impairments.

The characterization of the brain network implicated in recognizing and naming known individuals and the elucidation of specific roles for the different regions have been subjects of a longstanding debate. The recent functional Magnetic Resonance Imaging study on healthy subjects by Gesierich et al. (2012) has proposed that the left ATL would be more involved in the processing of semantic (biographical) information, while the more posterior temporal regions would be involved in the processing of lexical (people’s names) information (Gesierich et al., 2012). While several patient reports and neuroimaging studies of healthy subjects have suggested the semantic role of the left ATL (Brambati, Benoit, Monetta, Belleville, & Joubert 2010; Brambati et al., 2006; Gorno-Tempini, Dronkers, et al., 2004; Joubert et al., 2010; Mummery, Patterson, Hodges, & Price, 1998), the role of the posterior temporal language areas is less clear.

Some evidence for the role of the posterior temporal language areas in name retrieval comes from a case study characterizing object naming abilities in a patient with a lesion in the left posterior MTG (Raymer et al., 1997). The authors reported impaired naming across modalities, along with relatively intact semantic/conceptual processing. Moreover, a voxel-based lesion symptom mapping study of a group of brain-damaged patients revealed that overall performance on the Boston Naming Test was associated with the left mid-posterior MTG and underlying white matter, when controlling for deficits in visual recognition and motor speech (Baldo, Arévalo, Patterson, & Dronkers, 2013). The data seem to confirm the importance of this region in lexical retrieval for common objects. However, face-naming abilities were not tested in either of the

aforementioned patient studies. The present study seems to provide some evidence for the role of the mid-posterior temporal language areas in retrieving proper names as well. Although this region has been also implicated in the retrieval of common object names (Raymer et al., 1997), we have shown that damage in this zone may result in persistent selective proper name retrieval difficulties in the context of excellent language recovery. This may be because the linking of proper names with their reference is notoriously more fragile than that of common nouns with their reference and may require a larger amount of metabolic resources (Semenza, 2009).

In summary, the present case reports provide some clinical support to recent functional neuroimaging findings in healthy subjects regarding proper name processing.

Disclosure statement

No potential conflict of interest was reported by the authors.

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Supplementary material

Supplementary content is available via the 'Supplementary' tab on the article's online page (<http://dx.doi.org/10.1080/13506285.2014.959974>).

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