

Syntactic mediation is not obligatory during lexical access: Evidence from a single-case study of Welsh Aphasia

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Abstract

Current models of word production assume the existence of functionally distinct lexical-syntactic and word-form representations. However, there are competing hypotheses about whether prior access to syntactic properties of words is obligatory during lexical retrieval. In this paper we report preliminary evidence from the single case study of a Welsh-speaking patient with a lexical access deficit. We examined the patient's ability to access word forms and to retrieve information about the grammatical gender of Welsh nouns. The data show no correlation between the retrieval of word-form and grammatical gender information. This pattern of performance is inconsistent with hypotheses postulating obligatory syntactic mediation in lexical production.

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1. Introduction

The specification of the syntactic properties of words (e.g., word class, grammatical gender), and their phonological and orthographic forms (or word forms), seems to involve functionally distinct levels of representation in language production (e.g., Butterworth, 1989; Dell & O'Seaghdha, 1992; Garrett, 1980; Levelt, 1999; Roelofs, 1997). Support for this proposal has come from studies of speech errors in normal speakers (e.g., Fay & Cutler, 1977), information retrieval during tip-of-the-tongue (TOT) states (e.g., Caramazza & Miozzo, 1997), repetition priming (e.g., Wheeldon & Monsell, 1992) and brain electrical potentials (e.g., van Turennout, Hagoort, & Brown, 1999). Evidence has also come from studies of lexical access disorders in some brain-damaged patients (e.g., Badecker, Miozzo, & Zanuttini, 1995; Henaff-Gonon, Bruckert, & Michel, 1989; Miozzo & Caramazza, 1997; Rapp & Caramazza, 1997). For example, Badecker et al. (1995) reported the case of an Italian patient who had difficulty producing spoken names of objects, but who was able to retrieve information about the grammatical gender of the same nouns, showing that lexical-syntactic and word-form knowledge may dissociate following brain damage.

Despite evidence for the distinct representation of lexical-syntactic features and word-form knowledge, there is continuing debate about the functional organisation of these representations. One view is that access to word-forms is mediated by prior access to lexical-syntactic representations (e.g., Dell, 1990; Roelofs, 1997)—an assumption that has been referred to as the Syntactic Mediation hypothesis (Caramazza, 1997)—see Fig. 1a.

However, some recent results seem to challenge this assumption. For example, Caramazza and Miozzo (1997) have found that the retrieval of word phonology during TOT states in neurologically normal Italian speakers does not reliably predict retrieval of grammatical gender as might be expected under the Syntactic Mediation hypothesis. These data have motivated an alternative model of lexical access—the “Independent Networks” hypothesis (Caramazza, 1997)—see Fig. 1b. On this account word-form representations can receive activation directly from semantics, without syntactic mediation. Thus, the retrieval of (at least some) word phonology (or orthography) may occur in the absence of activation of a lexical-syntactic node (or lemma).

In this paper we present new cross-linguistic evidence about the functional organisation of lexical-syntactic and word-form representations in word production.

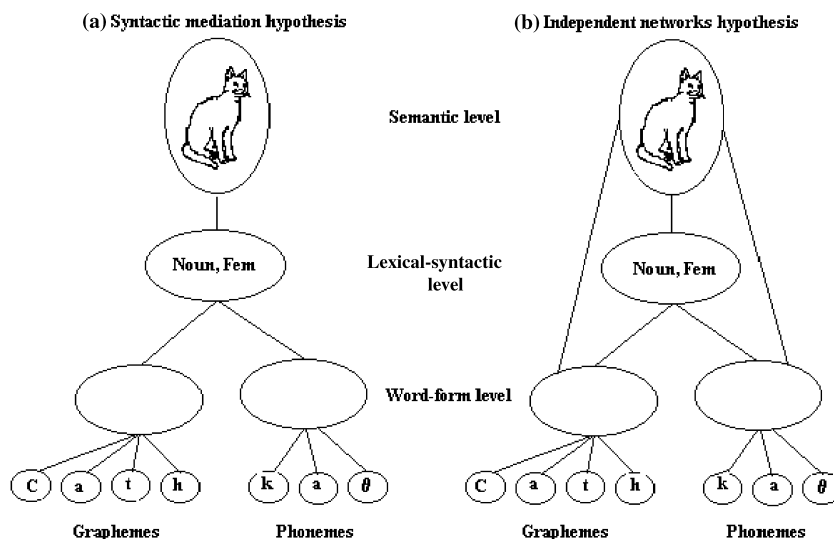


Fig. 1. A schematic illustration of the (a) Syntactic Mediation (b) Independent Networks hypotheses (after Caramazza, 1997). The figures show the selection of the spoken and written forms of the Welsh feminine noun *cath* (cat). For simplicity, several processes are left unspecified (e.g., morphological and phonetic encoding, syllabification, articulation—see Levelt, 1999).

This evidence comes from the study of acquired language production deficits in Welsh—one of the Celtic group of languages (Thorne, 1993). Like the Romance languages (and unlike English), Welsh has a grammatical gender system: nouns are marked as either masculine or feminine. In contrast to many other gender marking languages, the Welsh gender system is not expressed in articles (e.g., as in the French *le*, *la* distinction), but through a system of mutation—a pattern of sound exchanges affecting word-initial consonants. Gender mutation affects feminine *singular* nouns when they occur in constructions involving the definite article *y(r)* or the numeral *un* “one.” In these contexts, feminine noun gender triggers so-called soft mutation in which, for example, word-initial voiceless stops such as /p/ /t/ and /k/ mutate to their voiced counterparts /b/ /d/ and /g/, while the voiced stop /b/, and the nasal /m/, mutate to the fricative /v/. To illustrate, the feminine noun *cath* (“cat”) mutates to *y gath* (“the cat”) following the definite article. In addition, adjectives, such as *mawr* (“big”), undergo mutation when they follow feminine singular nouns (e.g., *gath fawr*). In contrast, masculine nouns, such as *ci* (“dog”) and adjectives which modify them, do not undergo mutation (e.g., *Y ci mawr*, “the big dog,” and not *Y gi fawr*).

We exploited these properties of the Welsh language in order to investigate the functional organisation of lexical-syntactic and word form representations in a single case study of VJS—a native Welsh speaker, with a lexical access impairment. The paper focuses on VJS’s retrieval of grammatical gender and word-form information about Welsh nouns, to examine contrasting predictions of the Syntactic Mediation and Independent Networks hypotheses.

2. Case report

2.1. Neuropsychological background

VJS is a 66 year old, right-handed woman, educated to high school level, who had worked as a hospital laundry worker. She suffered a stroke in April 1999, 12 months prior to testing. CT showed an area of decreased attenuation in the region of the right posterior temporal-parietal junction, with no associated mass effect. Neurological examination diagnosed a sub-arachnoid haemorrhage. VJS is a Welsh/English bilingual, who acquired Welsh as an L1 language, and English as L2. Initial clinical examination showed a left sided hemiplegia, and expressive language problems, most notably word-finding difficulties [Boston Naming Test 9/59 (15%), Welsh]. Auditory comprehension appeared intact. Her expressive language impairment, right-handedness, and apparent right-hemisphere language dominance are consistent with a crossed-aphasia.

The remainder of the case report is organised as follows: (1) We first present more detailed data on VJS’s language comprehension and production, showing that her spoken production deficit stems from a lexical access impairment. (2) We contrast VJS’s ability to retrieve the spoken forms of Welsh nouns and information about their grammatical gender.

2.2. Language comprehension

Comprehension was assessed using the word–picture and sentence–picture matching tasks from the PALPA (Kay, Lesser, & Coltheart, 1992). Welsh versions of the tests were developed for the study. (1) *Sentence–picture*

matching. VJS was presented with arrays containing a spoken or written target sentence (e.g., Mae'r dyn yn cicio'r iar—"The man's kicking the chicken"), and three pictorial scenes: one corresponding to the target, and two distracters (e.g., "The man's kicking the dog," "The man's holding the chicken"). VJS was asked to read the sentence to herself and point to the matching picture. Written Welsh and English versions of the test were administered in a counterbalanced order. VJS performed well in both Welsh: written 42/44 (95%), spoken 43/46 correct (93%), and English: written 42/50 (84%).

(2) *Single word–picture matching.* VJS was presented with arrays containing line drawings of five objects: a target (e.g., parachute) and four distracters: close semantic (e.g., balloon), distant semantic (e.g., aeroplane), visual (e.g., umbrella), and unrelated (e.g., puddle). The task was to match a word (either written or spoken) to the appropriate picture. So far, VJS has only been tested in English on this task. She scored 40/40 with both written and spoken input.

2.3. Language production

(1) *Picture naming* was assessed using items from the naming sub-test of the BORB (Riddoch & Humphreys, 1993). In one version VJS had to orally name line drawings of common objects. In another version she had to write their names. Testing was carried out in Welsh and English counterbalanced over several sessions. In Welsh, VJS correctly named only 25/54 (46%) objects in oral naming, and 6/24 (25%) in written naming. She performed slightly better in English: oral naming 32/54 (59%), written naming 16/24 (58%) [$\chi^2 = 0.43$, $df = 1$, n.s.]. Her pattern of performance in oral naming was similar across languages. Most of her errors were failures to respond, despite encouragement to do so (i.e., "don't know"): English 12/22 (54%) errors, Welsh 23/29 (79%). In these cases, VJS showed little facilitation with phonemic cueing: English 5/22 (23%), Welsh 1/29 (3.5%). She also made visual/semantic errors (e.g., necklace → "bracelet"): English 5/22 (23%), Welsh 5/29 (17.5%). The remainder were mainly circumlocutions (e.g., kite → "My grandson plays with one"): English 3/22 (14%), Welsh 1/29 (3.5%), and, in English, 2/22 (9%) responses involving phonemic errors (giraffe → "k-iraffe"; owl → "will"). VJS made no phonemic errors in Welsh.

The small number of phonemic errors in VJS's naming responses suggests that her word production difficulties do not stem from a post-lexical impairment—that is, non-word specific difficulties in selecting or producing speech sounds (e.g., Tainturier, Moreaud, David, Leek, & Pellat, 2001). This was further explored using tests of reading aloud.

(2) *Reading* (i) VJS was asked to read aloud the 40 target words from the English written-word picture

matching sub-test of the PALPA (Kay et al., 1992). She scored 40/40, without making a single phonemic error.

(ii) English spelling–sound regularity reading task (PALPA, Kay et al., 1992). VJS scored 29/30 (96%) correct with regular words (error, cult → "salt"), and 23/30 (77%) with exception words (errors, routine → "routyne," colonel → "col-on-el," bouquet → "buck-et," gauge → "gorge," sure → "don't know," mortgage → "mortage," quay → "queue").

In summary, VJS's comprehension of spoken and written Welsh and English seems well preserved. However, she is impaired at picture naming in both languages. In naming, VJS makes no phonemic errors in Welsh, and very few in English. VJS also made no phonemic errors in reading aloud English words, suggesting that her spoken language production problems do not stem from a post-lexical impairment. In addition, VJS shows no evidence of left neglect in reading aloud, as might be expected from the locus of her brain damage: none of her errors in reading occurred on word-initial phonemes. We conclude that VJS shows a pattern of performance consistent with a lexical access disorder.

3. The retrieval of grammatical gender and word-form information in VJS

As noted in Section 1, the Welsh language has a grammatical gender system. Noun gender is marked through a system of sound exchanges, known as mutations, affecting word-initial consonants when they occur in certain syntactic contexts. One such context involves the mutation of word-initial consonants of feminine singular nouns, and modifying adjectives, in constructions involving the definite article *y(r)*. In view of VJS's apparent lexical access deficit, described above, we also examined her ability to retrieve Welsh noun gender and word-form information. This was done using a novel oral naming and forced choice gender selection task.

4. Method

4.1. Materials

Each trial involved a mixed word–picture array (see Fig. 2) containing: a definite article, a line drawing

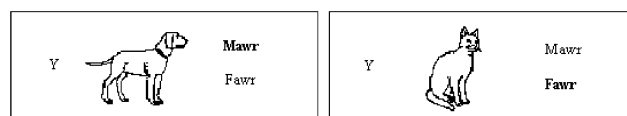


Fig. 2. A trial from the Welsh gender selection test. VJS had to orally name the pictured object, and then select the appropriate form of the adjective for the given sentential context. Correct responses (Y ci mawr, Y gath fawr) are shown in bold (for illustrative purposes only).

depicting a common object, and the mutated and unmutated forms of an adjective.

4.2. Design and procedure

There were 40 trials, consisting of 20 masculine and 20 feminine nouns. For each gender, there were 10 high- and 10 low-frequency items selected from the frequency lists provided for Test 14 of the BORB (Riddoch & Humphreys, 1993). The same set of 20 common adjectives was used on the masculine (unmutated adjective) and feminine (mutated adjective) trials (as illustrated in Fig. 2). VJS was asked to first orally name the pictured object, and then point to the appropriate adjective for the sentence context. A pointing response was used for adjective selection so that we could obtain a measure of VJS's knowledge of grammatical gender without requiring her to make a verbal response. Trial procedure was illustrated to VJS using five practice trials. The test was administered over two sessions, each involving 10 masculine and 10 feminine noun trials. No adjective was presented twice in the same session. During each session the presentation of trial order was randomised.

5. Results

In naming VJS made 19/40 (48%) correct responses [10/20 (50%) with masculine nouns, 9/20 (45%) with feminine nouns]. Overall, she scored 14/20 (70%) correct with high frequency, and 5/20 (25%) with low frequency noun trials [$\chi^2 = 6.42_{\text{cor}}$, $df = 1$, $p < .01$]. Naming errors involved predominantly “don't know” responses—18/21 (86%); that is, were VJS failed to articulate any phonemes related to the target name. On trials where VJS produced a correct naming response which involved feminine noun trials with mutable word-initial consonants, she always produced the unmutated noun form (e.g., “bwch” (cow) instead of the mutated form “(y) fwch”; “cath” (cat) instead of the mutated form “(y) gath”). On 3/21 (14%) errors, where VJS was unable to produce the correct Welsh noun, she produced the correct English counterpart.

In adjective selection, VJS made 16/40 (40%) correct responses overall [chance level 20/40]. She scored 7/20 (35%) correct on high frequency noun trials, and 9/20 (45%) on low frequency noun trials [$\chi^2 = 0.42_{\text{cor}}$, $df = 1$, n.s.]. We also analysed the distribution of correct gender assignments (i.e., cases where the correct form of adjective was selected) as a function of naming accuracy. The results showed that in only 5/19 (26%) trials where VJS produced a correct naming response, did she also select the correct form of adjective. This level of performance was significantly different from the score predicted under the assumption that access to word forms

necessarily entails successful retrieval of grammatical gender [$\chi^2 = 22.17$, $df = 1$, $p < .001$].¹ This finding suggests that access to spoken word forms does not reliably predict retrieval of correct grammatical gender information in VJS.

6. General discussion

We have presented preliminary data from the case study of VJS, a first language Welsh/English bilingual. To our knowledge, this is one of the first reported case studies of aphasia in Welsh speakers since Pilcher (1976). VJS has relatively preserved auditory comprehension in both languages as shown by her good performance in spoken and written word–picture matching. However, she is impaired in oral and written naming in Welsh and English. The small number of phonemic errors in naming (and reading aloud) suggests that VJS's language production problems do not stem from a post-lexical impairment, but rather arise from a lexical access deficit (e.g., Tainturier et al., 2001). Further testing showed that VJS is impaired at accessing word forms, and at retrieving information about Welsh noun gender: were VJS able to access grammatical gender information about nouns, she should have been able to select the correct forms of adjectives, on the basis of the word-initial mutation, in the gender selection task. In addition, VJS tended to produce the unmutated forms of feminine singular nouns when naming objects in the gender selection task. This is also consistent with a failure to retrieve information about noun gender.

It should also be noted that VJS's poor performance in the Welsh gender selection task cannot be explained by a left neglect disproportionately affecting mutable word-initial consonants of letter strings. As noted above, VJS showed no signs of left neglect in reading aloud; that is, she never made errors on word-initial letters.

This pattern of performance suggests that VJS has impairments both at the level of lexical-syntactic and word-form representations. However, VJS does sometimes produce correct responses in naming, indicating a partial, rather than complete, inability to retrieve

¹ VJS's level of performance is also lower than might be expected by chance. That is, were VJS simply guessing between the mutated and unmutated forms of adjectives, we might predict performance closer to 50% correct. However, VJS only selects the feminine mutated forms of adjectives in 26% of cases where she produces the correct noun. Interestingly, however, her level of performance is consistent with the distribution of feminine and masculine nouns in the Welsh language: only approximately 25% of nouns have feminine grammatical gender (e.g., Thorne, 1993). This might reflect the use of implicit knowledge of the distribution of Welsh noun gender in VJS's responses.

spoken word forms. In view of this we also examined whether successful name production reliably predicts retrieval of correct noun gender. According to the Syntactic Mediation hypothesis (see Fig. 1), retrieval of word forms is mediated by prior access to lexical-syntactic representations. If this were the case, we might expect to find a correlation between access to word forms and the retrieval of grammatical gender. That is, when VJS does produce a correct naming response, she should also have accessed correct gender information for that item. Contrary to this prediction the results showed that when VJS produces a correct Welsh noun, she is no better than chance at selecting the correct form of adjective. That is, successful name production does not reliably predict retrieval of noun gender information. This finding is inconsistent with the Syntactic Mediation hypothesis.

In contrast, these data can be accounted for by the Independent Networks hypothesis (Caramazza, 1997—see Fig. 1b). On this account word-form representations may be accessed solely on the basis of activation from the semantic/conceptual level, without obligatory syntactic mediation. Direct activation of word-form representations might explain those cases where VJS is able to produce correct word forms, while failing to retrieve information about grammatical gender. The current data also converge with evidence from studies of neurologically normal subjects reported by Caramazza and Miozzo (1997). They found that the retrieval of word phonology during TOT states in Italian speakers does not reliably predict the retrieval of grammatical gender. Our patient, VJS, shows a pattern of performance that is consistent with this finding.

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