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Comprehension of wh-questions in a case of mixed dementia

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ABSTRACT

We investigated processing of wh-questions and declarative sentences with differing syntactic complexity in a case of mixed dementia (FA). FA was impaired in her ability to understand syntactically complex declarative sentences and syntactically complex wh-questions beginning with *which* but not complex *who* questions. This profile, novel in dementia, is similar to that reported for people with agrammatic aphasia and discerns a "fault line" of the language system along a syntactic/semantic parameter.

1. Introduction

The term dementia refers to neuropsychiatric syndromes of progressive nature, which impair linguistic and non-linguistic cognitive functioning. Prevalent types of dementia are Alzheimer's disease (AD), vascular dementia (VaD) and mixed dementia (MD), the focus of this paper. The characterisation of these syndromes is based on the neurobiological changes that occur in the brain. AD pathology is attributed to amyloid plaques and neurofibrillary tangles, whereas VaD is due to vascular pathology, e.g. cerebral infarctions (Roman, 2003). The two conditions often co-occur, giving rise to MD (American Psychiatric Association, 1994; Roman, 2003). Many people with AD have a vascular pathology (Korczyn, 2002; Langa, Foster, & Larson, 2004; Neuropathology Group of the Medical Research Council Cognitive Function and Ageing Study, 2001) and the vascular element in AD is considered an important aetiological factor by some researchers (Casserly & Topol, 2004; de la Torre, 2002; Korczyn, 2002).

The linguistic deficits in dementia are often described as aphasia (Bayles & Tomoeda, 2007; Frattali, Grafman, Patronas, Makhlouf, & Litvan, 2000; Maxim & Bryan, 2006). Aphasia usually defines a non-

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progressive language deficit following brain damage (a definition we use here). One aspect of language that has been investigated in dementia (in particular AD) is syntactic comprehension, and particularly, the so-called subject/object asymmetry. Difficulties understanding reversible, object-extracted (non-canonical) structures, e.g. *the boy that the girl is kissing is tall*, in comparison with subject-extracted (canonical) sentences, e.g. *the boy that is kissing the girl is tall* are not uncommon in AD (Emery, 2000; Grober & Bang, 1995; Grossman et al., 1996; Grossman & Rhee, 2001; Kempler, Almor, Tyler, Andersen, & MacDonald, 1998). Exceptions to this pattern have been reported (Kempler, Curtiss, & Jackson, 1987; Rochon, Waters, & Caplan, 2000). Deficits with complex syntactic structures have been reported in other types of dementia such as fronto-temporal degeneration (e.g. Grossman et al., 1996; Holland, McBurney, Moosy, & Reinmuth, 1985) and primary progressive aphasia (Grossman & Moore, 2005). These patterns are similar to those reported in aphasia (e.g. Bastiaanse & Edwards, 2004; Caramazza & Zurif, 1976; Edwards, 2005; Grodzinsky, 2000). The sentence comprehension deficits in AD have been attributed to a genuine syntactic deficit (Grober & Bang, 1995), working memory limitations that interfere with sentence interpretation (Kempler et al., 1998; Rochon et al., 2000; Waters, Rochon, & Caplan, 1998), slow information processing restricting the timely realisation of sentence structure and limitations in inhibitory processing of canonical sentence structure (Grossman & Rhee, 2001). We return to these accounts in the discussion.

The majority of sentence processing research that has been carried out in dementia has focused on declarative sentences. Understanding of wh-questions (questions beginning with *who* and *which*) in subject- and object-extracted positions has not been investigated.[1] The aims of this paper are: (i.) to document the syntactic abilities in a patient with mixed dementia by investigating understanding of wh-questions and declarative sentences; (ii.) to discuss this profile with reference to accounts for the understanding of wh-questions and three accounts of sentence processing that have been postulated in AD, a related type of dementia to MD.

We will first consider some relevant properties of wh-question constructions and their processing. The most salient observation is that the restriction in terms of referent selection in *who* questions are more open-ended while in *which* questions they are more fixed. The referents for a *who* question can be (but are not required to be) non-specific, while in *which* questions they are specific as evidenced by their relative acceptability in existentials – *Who is there in the garden?* vs. **Which boy is there in the garden?* Furthermore, *who* is compatible with singular, plural and list responses. Q: *Who wants pizza?* A1: *Bill*, A2: *the girls*, A3: Bill, *the girls, the man in the odd hat and me*. The options for response to *Which x* is restricted by the properties of the *x*. A different view relates *who* and *which* question to discourse. According to Pesetsky (1987), *which* phrases refer to a set of referents that have been established in discourse among speakers (hence discourse-linked). *Who* phrases, on the other hand, do not refer to pre-established referents and are therefore non-discourse-linked. This distinction has prompted recent debates in aphasia (Avrutin, 2000; Balogh & Grodzinsky, 2000; van der Meulen, Bastiaanse, & Rooryck, 2002; Neuhaus & Penke, 2008; Salis & Edwards, 2008; Thompson, Tait, Ballard, & Fix, 1999). As a group, and withstanding individual variation, aphasic speakers understand subject-extracted *who* questions, e.g. *who has kissed the boy?* and their object-extracted counterparts, e.g. *who has the boy kissed?* (Avrutin, 2000; Salis & Edwards, 2008). One aspect of the debate is whether there is indeed a discourse basis for the difficulties people with aphasia have with non-canonical questions.

The well-known subject/object asymmetry, common in declarative sentences, does not hold for *who* but holds for *which* questions. Object-extracted *which* questions, e.g. *which boy has the girl kissed?*, are more likely to be impaired than subject-extracted ones, e.g. *which boy has kissed the girl?*. In the discourse account object-extracted *which* questions are costly in a processing sense because *which* needs a discourse interpretation that is more difficult to achieve than a non-discourse interpretation as in non-canonical *who* questions (Avrutin, 2000). A different view based on set theory and semantic features of phrases, the set partition hypothesis, has been suggested by Salis and Edwards (2008). The aspect of their account relating to *wh*-questions is that *which* phrases impose set partitioning demands, in other words, they call for the establishment of restrictive sets of features. This does not occur in *who*

[1] There is some limited evidence that processing of wh-questions is impaired in posterior cortical atrophy, a type of dementia related to AD (Salis, 2009).