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# "W" is for bath: Can associative errors be cued?

Maya Soni, Matthew A. Lambon Ralph, Anna M. Woollams*

*Neuroscience and Aphasia Research Unit, School of Psychological Sciences, Zochonis Building, University of Manchester, Brunswick Street, Manchester M13 9PL, UK*

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ABSTRACT

Semantic aphasia (SA) refers to a condition in which the control processes associated with the use of semantic information become compromised. This condition compromises patients' abilities to accurately name pictures, and they produce semantic errors in the form of co-ordinate items, such as "shower" for BATH. Previous research has demonstrated that these patients are sensitive to phonemic cues during picture naming, whether they promote the correct response (e.g., /b/) or the incorrect semantically related response (e.g., /sh/). A similar pattern is observed in normal participants when asked to perform tempo picture naming, in which the timing constraints undermine semantic control processes. SA patients are also known to produce associative errors in picture naming, such as "water" for BATH. In this study, we extended previous work on phonemic cueing in SA patients and in normal participants in two ways: firstly, by using associative miscues to promote associative errors (e.g., /w/), and secondly, to confirm miscueing effects still hold when assessed relative to a neutral condition of an unrelated phoneme rather a simple beep. The results revealed that associative miscues are effective in reducing accuracy and promoting semantic errors in SA patients. Correlations between associative cueing effects and executive tests showed that the impact of associative miscues was more pronounced in those with greater semantic control impairment. Associative miscueing was also seen for normal participants during tempo picture naming, including a latency cost. Both the associative and also the co-ordinate miscueing effects were still apparent when the neutral condition consisted of an unrelated

* Corresponding author. Tel.: +44 161 306 0453; fax: +44 161 275 2873.
*E-mail address:* anna.woollams@manchester.ac.uk (A.M. Woollams).

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phoneme. The implications of these results for models of speech production and semantic representation are outlined.


## 1. Introduction

Semantic memory is made up of two components: representations, by which meanings are stored in the brain; and semantic control, which allows stored information to be manipulated for the task in hand. These two elements can be independently impaired, as shown by the contrasting patterns of performance in semantic dementia (SD) and semantic aphasia (SA). Patients of both types are impaired in picture naming, but there are some important differences. These patient groups differ in their susceptibility to positive and negative cueing (Jefferies, Patterson, & Lambon Ralph, 2008; Noonan, Jefferies, Corbett, & Lambon Ralph, 2010; Soni et al., 2009), such that SA patients show improved performance with correct phonemic cues and additional impairment when misleading cues are given, whereas SD patients are minimally affected by phonemic cueing. Another qualitative difference is the presence of associative errors in SA but not SD naming (Jefferies & Lambon Ralph, 2006), where the erroneously named item has a semantic relationship to the target but is from a different category, for example "nuts" for SQUIRREL. These two features combine to suggest that it should be possible to miscue associative errors in patients with SA: a major goal of the first experiment of this study was to explore this hypothesis. If an associative miscue effect is found, it would challenge the recent proposals that representational frameworks for concrete items do not include associative relationships (Crutch, Connell, & Warrington, 2009; Crutch & Warrington, 2005). If associative cues reduce accuracy and even promote specific associative errors, this would indicate that associative relationships are integral to the semantic representations of concrete items, as well as the co-ordinate relationships previously demonstrated (Soni et al., 2009).

Associative errors form a sizeable proportion of all semantic errors in SA naming, 27% of semantic errors compared with 1% for the SD group (Jefferies & Lambon Ralph, 2006). The production of an associative error indicates that the core representation has been reached (e.g., knowledge of squirrels is essential to make the connection to nuts), but an incorrect element has been selected. Associatively related errors require detailed semantic knowledge concerning the target, and hence cannot be accounted for by proposing that representations have become degraded, in contrast to the co-ordinate errors often observed in SD naming (Woollams, Cooper-Pye, Hodges, & Patterson, 2008). Associative naming errors could, however, be explained by postulating impaired control processes in the presence of relatively preserved semantic representations, which we suggest is a defining characteristic of SA. Consistent with this account, SA patients' ability to produce correct responses varies according to the requirements of the task, demonstrating that a particular representation may be successfully accessed given appropriate contextual support, such as a correct phonemic cue (Jefferies et al., 2008; Noonan et al., 2010; Soni et al., 2009). In addition, strong correlations were obtained in Soni et al. (2009) between the cueing effects in accuracy and performance on measures of executive functioning (overall cueing effect and WCST: $\rho = .824$, $p = .011$; positive cueing effect and Brixton: $\rho = .883$, $p = .004$; negative cueing effect and TEA without distraction: $\rho = .670$, $p = .050$). Such correlations expose the connection between poor executive function and impaired semantics in these patients, and suggest that although representations are relatively intact, manipulation and selection of semantic material is impaired.

The patients included in the above and current studies have all suffered lesions in frontal and/or temporoparietal areas (see Table 1 and Appendix A), leading to the hypothesis that a fronto-parietal network of brain regions is responsible for the manipulation and control of semantic information, separate to the storage of semantic representations (Jefferies, Baker, Doran, & Lambon Ralph, 2007; Jefferies & Lambon Ralph, 2006; Jefferies et al., 2008; Noonan et al., 2010; Soni et al., 2009). The idea of a distributed network is supported by Berthier's (2001) study of transcortical sensory aphasia (TSA) patients with both temporoparietal and frontal lesions, including Broca's area. Using language scores from the Western Aphasia Battery or WAB (Kertesz, 1982), he compared three groups of TSA