Cohesive and coherent connected speech deficits in mild stroke

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Megan S. Barker, Breanne Young, Gail A. Robinson *

Neuropsychology Research Unit, School of Psychology, The University of Queensland, St Lucia, Brisbane, Australia

A R T I C L E I N F O

A B S T R A C T

Spoken language production theories and lesion studies highlight several important prelinguistic conceptual preparation processes involved in the production of cohesive and coherent connected speech. Cohesion and coherence broadly connect sentences with preceding ideas and the overall topic. Broader cognitive mechanisms may mediate these processes. This study aims to investigate (1) whether stroke patients without aphasia exhibit impairments in cohesion and coherence in connected speech, and (2) the role of attention and executive functions in the production of connected speech. Eighteen stroke patients (8 right hemisphere stroke [RHS]; 6 left [LHS]) and 21 healthy controls completed two self-generated narrative tasks to elicit connected speech. A multi-level analysis of within and between-sentence processing ability was conducted. Cohesion and coherence impairments were found in the stroke group, particularly RHS patients, relative to controls. In the whole stroke group, better performance on the Hayling Test of executive function, which taps verbal initiation/suppression, was related to fewer propositional repetitions and global coherence errors. Better performance on attention tasks was related to fewer propositional repetitions, and decreased global coherence errors. In the RHS group, aspects of cohesive and coherent speech were associated with better performance on attention tasks. Better Hayling Test scores were related to more cohesive and coherent speech in RHS patients, and more coherent speech in LHS patients. Thus, we documented connected speech deficits in a heterogeneous stroke group without prominent aphasia. Our results suggest that broader cognitive processes may play a role in producing connected speech at the early conceptual preparation stage.

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1. Introduction

Connected speech is a continuous sequence of utterances produced by a speaker to meaningfully convey thoughts and ideas (Crystal, 1980). In connected speech, meaning is conveyed via propositions, the smallest idea unit derived from an utterance containing a subject, verb and modifiers (Mozeiko, Lé, & Coelho, 2010). Propositional speech is connected speech in which the speaker links together propositional units in order to communicate thoughts or ideas that are novel to a specific context (Jackson, 1874).

1.1. Conceptual preparation processes in connected speech

1.1.1. Conceptual preparation
Existing models of speech production emphasise three distinct stages: prelinguistic conceptualisation, linguistic formulation, and articulation and monitoring of the verbal message (Dell, Chang, & Griffin, 1999; Frederiksen & Stemmer, 1993; Garrett, 2000; Jakobson, 1980; Levelt, 1989; Sherratt, 2007). Levelt (1989, 1993, 1999) posited a prelinguistic stage of conceptual preparation, during which a communicative intention is generated (see Sherratt, 2007 for a similar account). At this stage, a speaker attends to the current topic or focus, shifts their attention to new topics as the communicative context demands, and monitors conversation. The result of conceptual preparation is a preverbal message that is not yet linguistic but contains the necessary conceptual structure required for linguistic formulation and articulation. During this stage, macrolinguistic processes organise conceptual information into appropriate propositions by use of linguistic and conceptual-semantic links that connect speech with preceding ideas and the general topic as a whole (Marini, Andreetta, Del Tin, & Carlomagno, 2011). The effective production of meaningful connected speech depends largely on intact macrolinguistic abilities. Such processes include the connection of sentences by means of *cohesion* and *coherence,* which will be the two conceptual processes investigated in the current study (see Fig. 1).

* Corresponding author at: School of Psychology, The University of Queensland, St Lucia, Brisbane, QLD 4072, Australia.
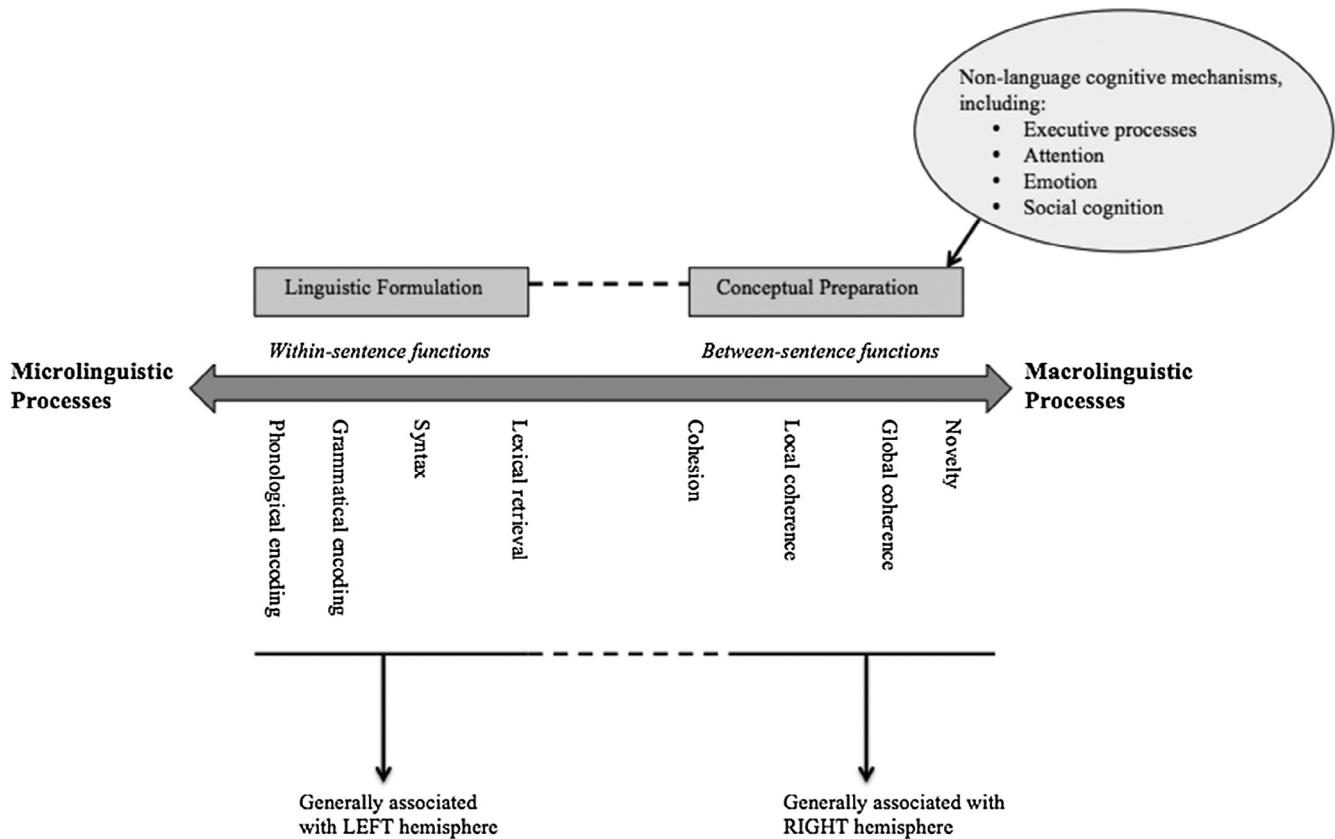 *E-mail address:* g.robinson@psy.uq.edu.au (G.A. Robinson).

Fig. 1. Schematic representation of key idea generation mechanisms for connected speech production: high level processes. NB This figure does not represent a full model of spoken language production as articulation stages are omitted.

1.1.2. Cohesion

Cohesion is accomplished by the use of *cohesive devices*: linguistic markers that serve to form the structural and semantic connectivity between elements of speech (Halliday & Hasan, 1976). Originally, Halliday and Hasan (1976) described five categories of cohesive devices: reference, conjunctive, ellipsis, substitution and lexical. However, this study will investigate only the three most common cohesive ties in normal narrative speech, which are reference, conjunctive and lexical ties (Mentis & Prutting, 1987) (see Appendix B). A word is considered a cohesive marker if its meaning cannot be adequately interpreted without understanding its relation to some other preceding element of speech (Tanskanen, 2006). A text is considered cohesive if the elements are linked together, but coherent if the sum of the links results in meaningful communication. A text can be cohesive (i.e., accurately linked) but not necessarily coherent (i.e., conveying meaning). Consider the example: The man went to *church* | *Church* rhymes with *birch* | The *birch* tree grew tall and wide. These utterances are cohesively linked but do not form a coherent whole.

1.1.3. Coherence

The ability to maintain thematic unity by integrating propositions or idea units into a coherent representation is often quantified at two levels: local and global (Kintsch & Van Dijk, 1978). *Local coherence* refers to the abstract conceptual links between contiguous utterances that maintain meaning within connected speech. It may be disrupted when there are abrupt changes in topic or missing or erroneous use of reference, for example, the incorrect use of pronouns (Marini, Andreetta et al., 2011). *Global coherence* reflects the degree to which propositions are organised or struc-

tured with respect to the overall goal, theme or topic. It involves establishing conceptual links between distal utterances (Marini, Andreetta et al., 2011). Problems maintaining global coherence may manifest as tangential, repetitive or irrelevant speech, or utterances that are conceptually incongruous to the overall topic or story (Christiansen, 1995; Marini, Andreetta et al., 2011; Sherratt & Bryan, 2012).

1.2. Supervisory executive processes and the conceptualisation of connected speech

The link between cognition and language functions has a relatively long history. Almost a century ago, Head (1926) argued for two components of language: the formulation of thought and its skilful expression. The emphasis on "thought" suggests an independent non-language component. Luria noted that impairments in establishing narrative intent mirror action planning deficits, and are related to the frontal lobes (Luria & Tsevtkova, 1968). In 1989, Sohlberg and Mateer suggested that attention-related processes could be implicated in complex language production. More specifically, Alexander (2006) highlighted a role for attention mechanisms in the conceptual preparation stage of spoken language production, and said that to produce connected speech one must "develop an overall communicative goal or intention, sustain activity to reach that goal, monitor progress to the goal, inhibit intrusions that are not relevant to the goal, and be attentive to the listener's expectations and reactions" (p. 236). This is in line with a parallel body of work led by Jefferies and Lambon Ralph on controlled semantic processing, which further highlights the link between executive processes and language by demonstrating