

## AGE-RELATED EFFECTS OF SYNTACTIC COMPLEXITY IN SPONTANEOUS SPEECH PRODUCTION

Jeroen Geertzen, Billi Randall, Caroline Williams, Meredith Shafto, and Lorraine Tyler  
(University of Cambridge)  
{jeroen,billi,caroline,meredith,lktyler}@csl.psychol.cam.ac.uk

Recent studies suggest that there may be age-related changes in the syntactic complexity of the sentences which people produce (eg, Kemper et al., 2001). However, the evidence typically relies upon small samples of speech and syntactic complexity is measured in terms of sentence length or the number of constituents used. Studies rarely involve measures that address the processing complexity of full grammatical representations. Natural language parsers have been developed to detect grammatical structure differences, for the purposes, for example, of author validation. As these parsers use generalised phrase structure grammar, they provide an ideal tool to examine age-related syntactic change in sentence production at the level of processing complexity.

We recorded 43 young (20-40yrs) and 30 older (60-90yrs) adults speaking about aspects of their personal lives. Their speech was transcribed, and a representative two minute excerpt taken from each participant for syntactic analysis. Syntactic structure and processing measures were obtained by passing the utterances through RASP, a natural language parser (Briscoe et al., 2006). The parser, using a statistical grammar tuned with large corpora, thereby bases its syntactic analysis on representative language use in English. Such processing measures have been shown to relate to aspects of cognitive processing (Hale, 2001; Roark, 2007).

We investigated three different syntactic aspects of speech. First, we compared the proportion of utterances that could be parsed successfully to give a measure of the well-formedness of the speech. Then we turned to structural measures such as the relative frequency of grammatical dependency types (e.g. modifier, subject, or object) and the longest spanning dependency relation as these are most similar to previous research in age-related changes in language production. Finally, we evaluated syntactic complexity by calculating processing measures, such as the number of parser actions and amount of parser memory needed to construct the grammatical structure of an utterance. The greater the number of parsing actions and the more parser memory, the more complex the utterance. (eg Roark, 2007). These syntactic complexity measures, we assume, tap into the automatic, unconscious aspects of syntactic processing.

There were no age-related differences in the grammaticality of the speech nor in any of the structural measures. There were significant differences, however, on both types of parsing measures: To construct a syntactic representation of older adults' speech using the parser required fewer parsing actions and memory resources than that of young adults.

These results show that while young and older adults produce equally grammatical sentences, the speech of young adults tends to be more complex. This complexity difference emerges at the level of the whole utterance, rather than any simple count measure. This difference may be related to known changes in brain structure across the life span (cf. Tyler et al., 2010).

Briscoe, T., Carroll, J., & Watson, R. (2006). The second release of the RASP system. In Proceedings of the COLING/ACL on Interactive presentation sessions (pp. 77-80).

Burke, D. M., & Shafto, M. A. (2004). Aging and Language Production. *Current directions in psychological science : a journal of the American Psychological Society*, 13(1), 21-24.

Hale, J. (2001). A probabilistic earley parser as a psycholinguistic model. In Second meeting of the North American Chapter of the Association for Computational Linguistics on Language technologies 2001 - NAACL '01 (pp. 1-8).

Kemper, S., Marquis, J., & Thompson, M. (2001). Longitudinal change in language production: effects of aging and dementia on grammatical complexity and propositional content. *Psychology and Aging*, 16(4), 600-614.

Mortensen, L., Meyer, A., & Humphreys, G. Age-related effects on speech production: A review. *Language and Cognitive Processes*, 21, 238-290.

Roark, B., Mitchell, M., & Hollingshead, K. (2007). Syntactic complexity measures for detecting mild cognitive impairment. In Proceedings of the Workshop on BioNLP 2007 (pp. 1-8).

Tyler, L. K., Shafto, M. A., Randall, B., Wright, P., Marslen-Wilson, W. D., & Stamatakis, E. A. (2010). Preserving Syntactic Processing across the Adult Life Span: The Modulation of the Frontotemporal Language System in the Context of Age-Related Atrophy. *Cerebral Cortex*, 20(2), 352-364.