

Testing the “division of labor hypothesis” of aphasic verb production using big-data

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Academy of Aphasia, October 2015, Tucson

INTRODUCTION

Difficulty in retrieving verbs is three times more common than a noun-specific impairment, irrespective of aphasia subtype or lesion location (Matzig et al., 2009). While explanations for verb deficits have included impairments in action representations, manipulability, instrumentality, and abstraction, the most prominent account is a syntactic weakness. Unlike nouns, the mental representation of verbs is known include syntactic constraints such as subcategorization frames. Hence, a syntactic impairment such as agrammatism would specifically impact verb representations (or the two could co-occur). An obvious challenge to the syntactic account is the lack of a one-to-one correspondence between verb deficits and agrammatism (Berndt et al., 1997).

An alternative approach to testing the syntactic account of verb deficits is to consider sentence production ability as a continuous variable rather dichotomous (agrammatic vs non-agrammatic). Likewise, verbs differ in syntactic complexity – semantically “light” verbs (e.g., come, do) are syntactically more complex because they take a larger variety of complements, while semantically “heavy” verbs (e.g., receive, write) occur in a rather narrow range of sentence structures (Maouene et al., 2011).

The association between verb complexity and syntactic impairment was elaborated by Gordon and Dell’s (2003) connectionist model, in which the retrieval of light versus heavy verbs differs from a “division of labor” between syntactic versus semantic representations that are activated during sentence planning. Consistent with this account, small group studies of agrammatic aphasia have been worse at light compared to heavy verb retrieval (e.g. Kim & Thompson, 2004). However, this pattern is not statistically distinct from non-agrammatic aphasic and neurologically healthy persons in other small group studies (Berndt et al., 1997, Breedin et al., 1998). The purpose of this study was to test the “division of labor” hypothesis of verb retrieval in aphasia by 1) comparing with healthy adults, 2) using continuous (rather than dichotomous) measures of syntactic ability, 3) examining predictors of light verb use, and 4) using a larger sample size.

METHODS

A shared database of discourse and test scores (AphasiaBank, MacWhinney et al., 2011) was used as the data source. Re-telling of the Cinderella story was analyzed for 164 individuals with

aphasia (86 male, Mean age 61 years) and 166 demographically matched neurologically healthy individuals (76 male, Mean age 63.3 years). The proportion of light verbs (over total verbs) used was compared to narrative measures of syntactic ability (proportion of grammatical sentences and Developmental Sentence Score, DSS) and semantic ability (Idea Density, ID, and lexical diversity), as well as standard test scores of overall language and word retrieval.

RESULTS & DISCUSSION

Individuals with aphasia and healthy controls produced a similar proportion of light verbs (.38, $U(298) = 13,129, p > 0.05$). Linear regression analysis revealed three significant predictors of high light verb use in aphasia: greater syntactic complexity (high DSS score), lower semantic richness (low idea density) and lower Verb Naming Test scores (picture naming of heavy verbs, Cho-Reyes & Thompson, 2012). These findings support the division of labor in aphasia – persons with stronger syntactic abilities produce more light verbs and have lower semantic ability (Gordon & Dell, 2003).

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