

Effects of Syntactic Complexity in Discourse Comprehension

Comprehension deficits of spoken language have been widely described subsequent to damage to the left hemisphere (Nicholas and Brookshire, 1995). Research to date has primarily focused on comprehension of isolated words or sentences in persons with aphasia (pwa) (Yasuda, Nakamura & Beckman 2000). However, a few studies have suggested that pwa use heuristics (context and general knowledge) to facilitate understanding of discourse (Nicholas & Brookshire, 1995) and that, as a result, complexity factors such as word frequency and syntax do not influence comprehension of discourse as heavily as they do comprehension of sentences.

Some studies have investigated whether the structure of discourse will affect pwa's ability to comprehend information (Brookshire & Nicholas, 1984; Katsuki-Nakamura, Brookshire, & Nicholas, 1988; and Wegner, Brookshire, & Nicholas, 1984). These studies revealed that pwa consistently understood and remembered main ideas better than details and stated information better than implied information (Nicholas and Brookshire; 1995).

Few studies have investigated the effects of syntax in discourse comprehension. Caplan and Evans (1990) studied the influence of syntactic structure on comprehension in patients with parsing impairments. They compared comprehension of pwa on sentence level and story level tasks. Their results suggest that comprehension of more complex passages were on average no more difficult to understand than syntactically simple passages. However, the passages used in this study contained semantically irreversible sentences and syntactic complexity was assigned using only an active or passive voice. As a result, the discourse task did not require syntactic comprehension.

Research to date has not evaluated the influence of syntactically complex sentence forms, such as semantically reversible sentence types on discourse comprehension in aphasia. A primary goal of this study was to evaluate the effect of syntactic complexity on discourse comprehension in pwa when the syntactically complex sentences were reversible and when the texts were constructed so that the meaning of the sentences could not be understood simply on the basis of context, world knowledge, or heuristics. A second goal was to determine how performance on a discourse comprehension test in which a portion of the sentences requires the use of a syntactic analysis would compare to performance on a commonly used test of discourse comprehension (the *Discourse Comprehension Test – Revised (DCT-R)* (Brookshire and Nicholas, 2008) which only uses irreversible sentences.

Methods

Subjects:

Thirty-eight individuals with aphasia and thirty individuals without neurological or developmental impairments participated in the study. Pwa met the following criteria:

1. Single, left-hemispheric stroke
2. Right-handed pre-morbidly
3. Greater than 6 months post-onset
4. Diagnosed with aphasia by a licensed speech-language pathologist.
5. Ability to attempt all tasks presented.

Pwa ranged in age from 25-83 years (mean = 61 years). Education ranged from 10-18 years. Subjects without aphasia had no documented history of brain damage or of an uncorrected hearing impairment and ranged in age from 27-82 years (mean = 62.2 years). Education ranged from 10-18 years.

Stimulus Materials:

The *Test of Syntactic Effects in Discourse Comprehension* (*TSEDC*) (Levy et al, 2010) was administered to all subjects. It consists of nine pairs of passages, which are between 350-400 words in length. The passages are matched for readability and a variety of other dimensions but differ syntactically from each other on a subset of sentences. A sample pair of passages is shown in Table 1 in the appendix. One member of each pair was syntactically simple and the other member of the passage was syntactically complex. Within each passage, approximately 30% of the sentences (**target sentences**) were semantically reversible sentences that expressed thematic roles that could not be inferred from their context. In the **syntactically simple** version of the passage the targets had simple syntactic structures (active, transitive, cleft subject, subject extracted relative clause) and could be understood through the use of heuristics. In the **syntactically complex** version of the passage the targets had complex syntactic structures (passives, unaccusatives, cleft object, object extracted relative clauses) and could not be understood through the use of heuristics. The remaining 70% of each of the passages were identical to each other and contained semantically irreversible simple sentences. These constituted the **control sentences**.

Comprehension of the passages was measured using a 4-alternative forced choice question task in which four question types (factual and inferential questions referring to the target and control sentences) were presented orally and visually after each passage.

The *DCT-R* contains five test stories of comparable length to the *TSEDC* passages. Comprehension of each story was measured by eight yes/no questions evaluating understanding of main ideas and details from information that is both directly stated and implied.

Procedure

Each subject was tested in a single session and was administered the *TSECD*. A subset of pwa ($n=20$) were also administered the *DCT-R*. Order of *TESCD* and *DCT-R* was alternated across subjects. During the *TSECD* administration, each subject was given a practice story and then was presented with alternating versions of the nine passages (complex, simple, complex, simple, etc). Presentation order of passage type (i.e. passage one= complex, passage two= simple) was also alternated across subjects to ensure an equal number of each passage types in the sample.

Results

Mean percent of correctly answered questions was calculated for each subject in each of the four conditions. The data were analyzed in a $2 \times 2 \times 2$ repeated measures ANOVA with the factors of group, passage complexity and type of sentence. Main effects were found of group $F(1,504)=93.2$, $p=0.001$, passage complexity $F(1,504)=4.7$, $p<.05$, and type of sentence $F(1,504)=8.8$, $p=0.01$. There was an interaction between passage complexity and type of

sentence $F(1,504)=4.9$, $p<.05$. Post hoc tests show that this was due to an effect of complexity in the target, but not control sentences (Figure 1). In addition, there was a significant interaction between type of sentence and group $F(1,504)=4.992$, $p=0.05$. Post hoc tests showed that only patients showed an effect of type of sentence.

In order to determine the relationship between the *TSEDC* and *DCT-R*, Pearson product – moment correlations were carried out. A significant effect was found only between the *DCT-R* and *TSEDC* simple passages' control sentences (correlation: $r=.32$). All other correlations were non-significant (*DCT* accuracy and *TSEDC* for target/control sentences in *simple* passages $r=.19$; *DCT-R* accuracy and *TSEDC* for target/control sentences in *complex* passages $r=.24$).

Discussion

The results show that pwa have more difficulty understanding sentences when the meaning of the sentence can not be inferred on the basis of world knowledge, the context, or the use of heuristics. Furthermore, they have difficulty understanding discourses that contain more sentences that have these properties and they have difficulty understanding discourses in which other sentences can only be understood if sentences with these properties are integrated into the meaning. The results taken together suggest that syntactic complexity does influence processing at the discourse level and that heuristic processing alone is not enough to compensate for complex syntactic processing demands in discourse in both patients and controls.

When comparing the *TSEDC* to the *DCT-R*, we found a statistically significant correlation only when comparing the simple passages and control (simple, semantically reversible) sentences of the *TSEDC* with the *DCT-R*. All other correlations were non-significant. This result suggests that the *TSEDC* is sensitive to syntactic complexity in a way that the *DCT-R* is not.

Appendix

Table 1: Test of syntactic effects in discourse comprehension – Example of Story

Syntactically simple passage	Syntactically complex passage
Bob was coming to visit town next week	Bob was coming to visit town next week
Harry and Bill decided to have a dinner party on Saturday and invite a few friends over.	Harry and Bill decided to have a dinner party on Saturday and invite a few friends over.
That day, there was a major snowstorm.	That day, there was a major snowstorm.
The roads were icy.	The roads were icy.
One disaster followed another.	One disaster followed another.
A truck hit Harry's car on the way over.	Harry's car was hit by a truck on the way over.
Sam fell near a woman walking her dog	Sam tripped near a woman walking her dog.
Half the guests finally arrived safely	Half the guests finally arrived safely.
Bob entertained many people who said it was worthwhile coming.	Many people who Bob entertained said it was worthwhile coming.
They planned on getting together in better weather.	They planned on getting together in better weather.

Figure 1

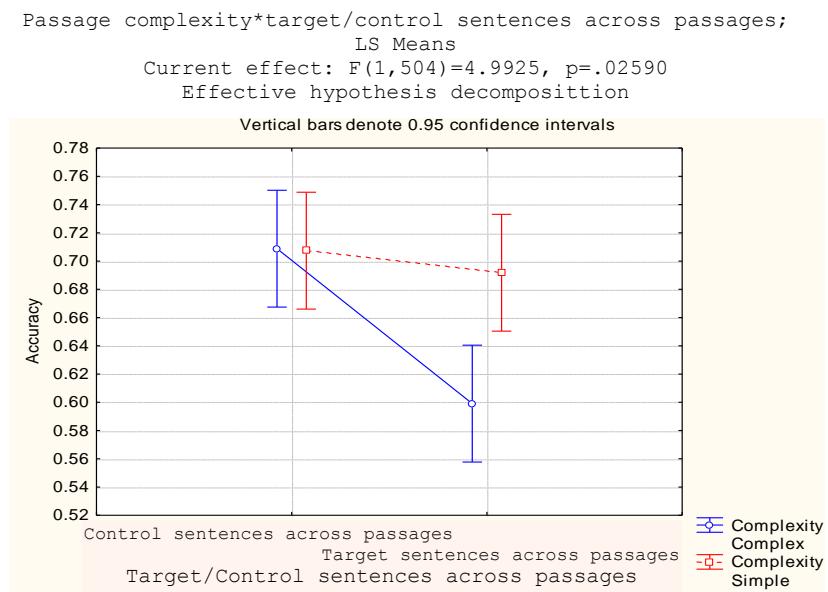
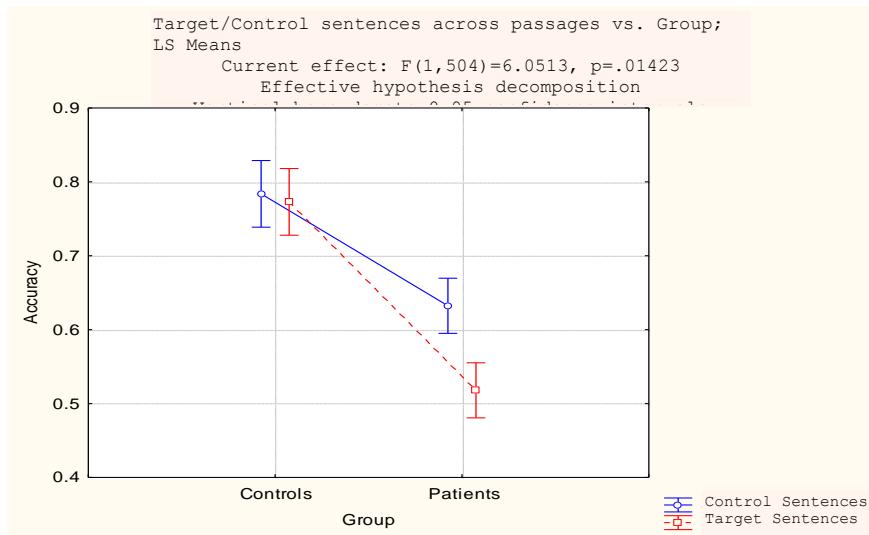


Figure 2



References

- Brookshire, R.H., & Nicholas, L.E., (2008). *Discourse Comprehension Test-Revised*. Sedona, AZ. BRK Publishers.
- Brookshire, R.H., & Nicholas, L.E. (1984). Comprehension of directly and indirectly stated main ideas and details in discourse by brain-damaged and non-brain damaged listeners. *Brain and Language*, 21, 21-36
- Caplan, D., & Evans, K. (1990). The effect of syntactic structure on discourse comprehension in patients with parsing impairments. *Brain and Language*, 39(2), 206-234.
- Caplan, D., & Waters, G., DeDe, G., Michaud, J., & Reddy, A (2007). A study of syntactic processing in aphasia 1: Behavioral (psycholinguistic) aspects. *Brain and Language*, 101(2), 103-150.
- Carpenter, P.A., Miyake, A., & Just, M.A. (1995). Language comprehension: Sentence and discourse processing. *Annual Review of Psychology*, 46, 91-120.
- Graesser, A.C., NcNamara, D.S., Louwerse, M.M., Cai, Z. (2004). Coh-Metrix analysis of text on cohesion and language. *Behavior Research Methods Instruments and Computers*, 36, 193-202.
- Just, M.D., & Carpenter, P.A., (1992). A capacity theory of comprehension: Individual differences in working memory. *Psychological Review*, 99, 122-149.
- Katsuki-Nakamura, J., Brookshire, R.H., & Nicholas, L.E. (1988). Comprehension of monologues and dialogues by aphasic listeners. *Journal of Speech and Hearing Disorders*, 53, 408-415.
- Levy, J., Kiran, S., Caplan, D., Beradino, A., Sandberg, C., & Hoover, E. (2010). *Test of syntactic effects in discourse comprehension*. Presented at the Academy of Aphasia. Athens, Greece. October, 2010.
- Nicholas, L.E. & Brookshire, R.H., (1995). Comprehension of Spoken Narrative Discourse by Adults with Aphasia, right-Hemisphere Brain Damage, or Traumatic Brain Injury. *American Journal of Speech-Language Pathology*, 4(3), 69-81
- Stachowiak, F.J., Huber, W., Poeck, K., & Kerschensteiner, M. (1977). Text comprehension in aphasia. *Brain and Language*, 4, 177-195.
- Wegner, M.L., Brookshire, R.H., & Nicholas, L.E. (1984). Comprehension of main ideas and details in coherent and noncoherent discourse by aphasic and nonaphasic listeners. *Brain and Language*, 21, 37-51.

Yasuda, K. Nakamura, T., Beckman, B. (2000). Comprehension and storage of four serially presented radio news stories by mild aphasic subjects. *Brain and Language* (75) 399-415.