

**Final Report for Period:** 07/2007 - 06/2008

**Submitted on:** 09/27/2008

**Principal Investigator:** Griffin, Zenzi M.

**Award ID:** 0318456

**Organization:** GA Tech Res Corp - GIT

**Submitted By:**

Griffin, Zenzi - Principal Investigator

**Title:**

The time course for structuring spoken utterances

### Project Participants

#### Senior Personnel

**Name:** Griffin, Zenzi

**Worked for more than 160 Hours:** Yes

**Contribution to Project:**

#### Post-doc

#### Graduate Student

**Name:** Lawler, Elisabeth

**Worked for more than 160 Hours:** Yes

**Contribution to Project:**

She set up, ran, analyzed, and reported Experiment 6, as well as helping to run other experiments.

**Name:** Garton, Kristin

**Worked for more than 160 Hours:** Yes

**Contribution to Project:**

She helped design and run experiments; transcribed, coded, and analyzed data.

**Name:** Crew, Christopher

**Worked for more than 160 Hours:** Yes

**Contribution to Project:**

He assembled materials, collected, coded, and analyzed data for a version of Experiment 4 and a follow-up experiment. He has been supported during summers by the grant and during academic year through departmental funds.

#### Undergraduate Student

**Name:** Lumkins, Olvinn

**Worked for more than 160 Hours:** No

**Contribution to Project:**

Transcribed data.

**Name:** Kim, Dae

**Worked for more than 160 Hours:** No

**Contribution to Project:**

Designed stimuli, ran one experiment, and transcribed data.

**Name:** Chang, Enoch

**Worked for more than 160 Hours:** No

**Contribution to Project:**

Transcribed data.

**Name:** Hong, Won

**Worked for more than 160 Hours:** No

**Contribution to Project:**

Transcribed data.

**Name:** Parets, Martin

**Worked for more than 160 Hours:** No

**Contribution to Project:**

Transcribed data.

**Name:** Smith, Russell

**Worked for more than 160 Hours:** No

**Contribution to Project:**

Transcribed data.

**Name:** Tan, Amos

**Worked for more than 160 Hours:** Yes

**Contribution to Project:**

He transcribed recorded utterances from several experiments.

**Name:** Bradley, Danielle

**Worked for more than 160 Hours:** No

**Contribution to Project:**

Transcribed data.

**Name:** Rice, Daniel

**Worked for more than 160 Hours:** No

**Contribution to Project:**

**Name:** Patil, Nikhil

**Worked for more than 160 Hours:** No

**Contribution to Project:**

**Name:** Pirouz, Nikita

**Worked for more than 160 Hours:** Yes

**Contribution to Project:**

**Name:** Rajani, Monal

**Worked for more than 160 Hours:** No

**Contribution to Project:**

**Name:** Lam, Tuan

**Worked for more than 160 Hours:** No

**Contribution to Project:**

**Name:** Kim, Dorothy

**Worked for more than 160 Hours:** No

**Contribution to Project:**

**Name:** Ahn, Jongwha

**Worked for more than 160 Hours:** No

**Contribution to Project:**

Transcribed data for Korean experiment supported by hourly wage.

**Name:** Wangerman, Thomas

**Worked for more than 160 Hours:** No

**Contribution to Project:**

**Name:** Malladi, Saroja

**Worked for more than 160 Hours:** No

**Contribution to Project:**

Coded data

### **Technician, Programmer**

**Name:** Mouzon, Sonia

**Worked for more than 160 Hours:** Yes

**Contribution to Project:**

She helped design and run experiments; transcribed, coded, and analyzed data; helped write up results and present them at a professional conference. Sonia was an undergraduate until she graduated in May 2004. One of the experiments in the proposal formed her senior thesis. She began working as lab manager (Research Technician) in July 2004.

### **Other Participant**

**Name:** Johnson, Imani

**Worked for more than 160 Hours:** No

**Contribution to Project:**

Drawing stimuli for use in additional experiments.

### **Research Experience for Undergraduates**

#### **Organizational Partners**

#### **Other Collaborators or Contacts**

The PI collaborated with Dr. Cynthia Thompson of Northwestern University and her lab on a related project using eye movements to study sentence planning in agrammatic aphasics. She also collaborated with Dr. Daniel Spieler of Georgia Institute of Technology on projects related to age-related changes in language planning. She collaborated on a series of experiments on choice of referring expression with Dr. Jennifer Arnold of the University of North Carolina at Chapel Hill. With Dr. Victor Ferreira of the University of California in San Diego, she authored on a handbook chapter.

#### **Activities and Findings**

#### **Research and Education Activities: (See PDF version submitted by PI at the end of the report)**

A series of experiments were proposed to test the extent to which syntactic structures are created over time by speakers as opposed to being retrieved as whole frames. Theories answer this question differently depending on their assumptions about the source of efficiency in language production and how syntactic information is represented and accessed. We have collected data for proposed the experiments and a follow up. The utterances from these experiments have been transcribed and the eye movement data have been processed. We are behind schedule in analyzing and writing up these

experiments due to the turn over in graduate students and the cuts to the initial budget. The PI has been begun to collaborate on studies conducted by Dr. Cynthia Thompson of Northwestern University that use eyetracking to address the time course of planning in agrammatic aphasics. The lab has also collected data for several experiments on choice of referring expression and the coordination of word production and articulation. The PI was also able to collect some pilot data from three-year-olds to examine their coordination of word preparation and articulation.

**Findings: (See PDF version submitted by PI at the end of the report)**

The primary question asked in the series of proposed experiments was whether speakers can structure their sentences as they speak while remaining fluent. Evidence for such incremental structure-building was sought in testing whether speakers looked back in forth between potential referents that they could mention next part way through articulating a sentence more often when they had flexibility to continue the sentence in multiple ways than when they had little flexibility. Across studies that used several different methods to manipulate how much flexibility speakers had in continuing their sentences, we found good evidence for incremental structure building. In addition, the point in time when speakers committed to different structures was modulated by the time available to plan preceding words. For example, if the subject noun phrase was short (e.g., 'A girl'), speakers decided which object to mention after the verb before beginning to utter a sentence. However, when the subject noun phrase was long (e.g., 'A very tall woman'), speakers decided which object to mention after the verb while articulating the subject noun phrase. In other words, to the extent that the timing of word retrieval allowed a decision about word order to be deferred, it was deferred.

In addition, the grant has provided partial support for several other projects. Collaborative work with Dr. Jennifer Arnold has shown non-linguistic influences on choice of reference form (Arnold & Griffin, 2007). Collaborative work with the lab of Dr. Cynthia Thompson has found a surprising degree of similarity between the eye movements of agrammatic aphasics during speech planning and those of normal controls (Thompson et al., 2007). A collaborative project with an undergraduate student has provided has begun to explore the factors that make parents more or less likely to mistakenly call their children by the wrong name. In particular, having a sibling of the same gender, similar age, or who has a similar sounding name increases the likelihood that a person will recall being called by the sibling's name more than rarely (Griffin & Wangerman, 2008).

**Training and Development:**

The research skills of graduate students, Christopher Crew, Elisabeth Lawler, and Kristin Garton, were extended through their work on the proposed experiments. Experiment 4 and its follow-up form Christopher Crew's first year project and master's thesis (successfully defended in the summer of 2008). A former undergraduate, Sonia Mouzon, was trained in every aspect of research (designing materials, deciding on procedure, writing instructions, running subjects, transcribing utterances, coding data, analysis, writing, and presenting results). Experiment 3 was her senior thesis and she presented the results at a professional psychology conference. She continued to gain research experience by overseeing the analysis and running of other proposed experiments in the position of lab manager until Jan 2005. One undergraduate (Tuan Lam) has begun graduate studies in psycholinguistics at the University of Illinois at Urbana-Champaign. Daniel Rice, an undergraduate research assistant, is applying to graduate programs in Industrial/Organizational Psychology and Thomas Wangerman, another undergraduate assistant, is applying to graduate programs in communication disorders. Several other undergraduates have gained research experience over the course of the project. The PI was also able to gain first hand experience in collecting data from children as a visiting professor at Hunter College's Language Acquisition Research Center.

**Outreach Activities:**

A press release for a publication on speech errors was disseminated in December 2005 and was picked up by several brief science reports and the science page of the Iran Daily. The lab continually attempts to present accessible and interesting aspects of our research on the lab web page, including example eye-movement-and-speech movies that vividly illustrate their relationship. Dr. Griffin has spoken about the results of the completed experiments at over 20 invited talks as well as at professional conferences.

### Journal Publications

Thompson, CK; Dickey, MW; Cho, S; Lee, J; Griffin, Z, "Verb argument structure encoding during sentence production in agrammatic aphasic speakers: An eye-tracking study", BRAIN AND LANGUAGE, p. 24, vol. 103, (2007). Published, 10.1016/j.bandl.2007.07.01

Arnold, JE; Griffin, ZM, "The effect of additional characters on choice of referring expression: Everyone counts", JOURNAL OF MEMORY AND LANGUAGE, p. 521, vol. 56, (2007). Published, 10.1016/j.jml.2006.09.00

Griffin, ZM; Spieler, DH, "Observing the what and when of language production for different age groups by monitoring speakers' eye movements", BRAIN AND LANGUAGE, p. 272, vol. 99, (2006). Published, 10.1016/j.bandl.2005.08.00

### Books or Other One-time Publications

Griffin, Z. M., & Crew, C., "Normal Adult Cognitive Research in Language Production", ( ). chapter, Accepted  
 Editor(s): M. Spivey, M. Joannis, and K. McRae  
 Collection: Cambridge Handbook of Psycholinguistics  
 Bibliography: Cambridge: Cambridge University Press

Griffin, Z. M., & Ferreira, V. S., "Properties of Spoken Language Production", (2006). Book, Published  
 Editor(s): M. J. Traxler & M. A. Gernsbacher  
 Collection: Handbook of Psycholinguistics  
 Bibliography: 2nd ed., pp. 21-59). London, England: Elsevier.

### Web/Internet Site

**URL(s):**

<http://homepage.psy.utexas.edu/homepage/faculty/Griffin/Publications.html>

**Description:**

This is a web page that contains links to PDF and GIF formatted images of posters presented at professional conferences as well as several articles. The posters related to the project include:

Griffin, Z. M., & Wangerman, T. (2008, July). "Lisa, Patty, Selma, Snowball ... Maggie!" Names that parents call their children by mistake. Poster presented at the Fifth International Workshop on Language Production, Annapolis, MD.

Lawler, E. N., Griffin, Z. M., & Kim, D. (2004, March). The role of verbs in Korean-English translation. Poster presented at the 17th Annual CUNY Conference on Human Sentence Processing, College Park MD.

Griffin, Z. M., & Mouzon, S. S. (2004, March). Can speakers order a sentence's arguments while saying it? Poster presented at the 17th Annual CUNY Conference on Human Sentence Processing, College Park MD.

Lawler, E. N., & Griffin, Z. M. (2003, May). Gaze anticipates speech in sentence-construction task. Poster presented at the 15th Annual Convention of the American Psychological Society, Atlanta GA.

## Other Specific Products

### Contributions

#### **Contributions within Discipline:**

The sponsored experiments provide the first clear evidence that speakers may speak fluently even when they decide the order in which they mention arguments in their sentences on the fly and therefore have not decided the structure of the sentences in advance of articulating them. In other words, someone describing a scene of a woman throwing a bone to a dog can speak as smoothly as a newscaster reading off of a teleprompter even though the person has not decided whether to say "The woman is throwing a bone to a dog" or "A woman is throwing a dog a bone" when the person starts articulating the word "woman." So, speakers do not select static syntactic frames for each clause of their sentences and then fill in the content words (see Garrett, 1975). The results also challenge the assumptions of more recent major theories of sentence production that rely on lexical syntactic representations (e.g., Ferreira, 2000). In contrast, the results support a radically different theory of how people form grammatical sentences (Chang, 2002). These findings are in tune with the shift in cognitive science away from the use of abstract, amodal, symbolic, production rules to conceptualize processing to more dynamic, context-sensitive, adaptive frameworks.

Likewise, the collaborative work on reference form with Jennifer Arnold (who was trained as linguist) emphasizes the cognitive and situational factors that influence whether a speaker refers to someone by name or with a pronoun. The preliminary data on parents' speech errors in addressing their children takes the field forward in addressing normal language use. Finally, the PI's incisive review of research on language production in older and younger adults highlights the interpretive and methodological weaknesses of past work while indicating what conclusions can be safely taken from them.

#### **Contributions to Other Disciplines:**

The results of the sponsored work have consequences for understanding and treating agrammatic aphasia, developing methods of natural language generation in computer science, linguistic theories of reference, and the understanding of social relationships.

The primary results suggest that speakers structure their sentences by deciding what to talk about next at multiple points in time rather than selecting a fixed syntactic frame like "X gave Y to Z." The PI has become a consultant on a collaborative project with Dr. Cynthia Thompson to extend the research to studying the treatment of agrammatic patients. Thus far, this work has led to one publication and three presentations. If unimpaired speakers do not use static syntactic frames there is no reason to think that people who have trouble forming sentences after brain injuries have lost access to such frames and need to relearn them. Furthermore, the different view of how grammatical sentences are constructed may do a better job than syntactic theories in explaining why training with some sentence structures generalizes to other particular sentence structures. Similarly, if people do not use fixed sentence frames to generate utterances, a successful language generation system is unlikely to use them.

Theories of reference have often looked no further than the words used earlier in a discourse to determine whether use of a pronoun would be felicitous or not. In addition, such theories typically assume that speakers rely on models of what they think listeners know in order to decide what would be an appropriate reference form. In contrast, work conducted in the PIÆs lab indicates that speakers are sensitive to factors outside of the actual discourse and to resource limitations in the speaker. By collaborating with a trained linguist on this work (Dr. Jennifer Arnold), the results are distributed to both the psycholinguistic and linguistic communities.

Preliminary work on the factors that are associated with parents calling their children by the wrong name indicates that there are semantic categories for people as there are for other categories like animals and artifacts, and that names are not pure referring expressions. For example, all other things being equal, a mother is more likely to mistakenly call her son by the name of another male in the family than a female family member. At some level, the name is tied to features of maleness and family member, in addition to the individual that bears the name. The closer in age two siblings are, the more likely they are to be mislabeled with the otherÆs name. The similarity of their names is also important. Siblings with names that start with the same sound are more likely to be misnamed than siblings with different sounding names. Other responses in the preliminary survey suggest very strong constraints on the social categories of people whose names substitute for one another as well as strong situational constraints. The PI plans to follow up this study with experimental, corpus, and survey research examining the factors that lead to name substitutions. The results are likely to reveal implicit categories people assign other people to.

#### **Contributions to Human Resource Development:**

The project has involved extensive research training for a young woman from an underrepresented minority group as well as support for the training of a minority graduate student. Thus far, three graduate students have gained research experience while working on the project as well as many undergraduates who have gone on to graduate studies.

#### **Contributions to Resources for Research and Education:**

The software that was needed for the funded project has also proved useful for other experiments.

#### **Contributions Beyond Science and Engineering:**

#### **Categories for which nothing is reported:**

Organizational Partners

Any Product

Contributions: To Any Beyond Science and Engineering

Experiment 3 successfully replicated the basic finding of Bock (1986). In describing pictured scenes, speakers mentioned objects that were primed by associated words earlier in the sentences than when pictures were preceded by unrelated words and this priming effect resulted in different sentence structures. For example, reading the words 'meat' and 'skeleton' (related to bones) made speakers more likely to describe a picture as 'A woman is throwing a bone to a dog' rather than 'A woman is throwing a dog a bone.' Furthermore, our use of two prime words instead of one seemed to result in priming effects that were twice the size of the effect Bock obtained with single words. Thus, our manipulation of how biased speakers were to produce one order of mention versus another was successful. In addition, we saw clear differences in the number of times speakers gazed back and forth between patients (e.g., the bone) and recipients (e.g., the dog) based on the priming manipulation. As expected, gaze shifts were less common when speakers were primed to mention the patient (the bone) earlier in their sentences. This result demonstrates that the results from our preliminary experiment (Experiment 1) are not solely due to our heavy-handed manipulation of order-of-mention via repetition. Instead, other factors that influence how biased speakers are to mention objects in one order as opposed to another affect the way speakers look at the scenes they describe.

The critical theoretical question concerned when differences in gaze shifts occur relative to articulating a sentence. This relationship indicates whether speakers structure their sentences in advance or as they speak. The results of Experiment 3 suggest that the length of a subject noun phrase is important in determining when speakers make decisions about order of mention. If the subject noun phrase is short (e.g., 'A girl'), speakers decided which object to mention after the verb before beginning to utter a sentence. However, when the subject noun phrase is long (e.g., 'A very tall woman'), speakers decide which object to mention after the verb while articulating the subject noun phrase. In other words, to the extent that the timing of word retrieval allowed a decision about word order to be deferred, it was deferred. A follow-up experiment was run in which participants were given long names for grammatical subjects to allow for later planning of direct objects. The data are currently being analyzed. So far the results are consistent with the idea that speakers do as little advance planning of what they will say as they can typically get away with.

Experiment 6 involved monitoring eye movements while speakers viewed a scrambled set of words that they used to construct a sentence. It demonstrated that eye movements to words in a sentence construction task might also be informative in the study of sentence planning. Speakers tended to look at words shortly before articulating them in a sentence, just as they would typically look at objects before mentioning them. The main difference between gazes to words and gazes to objects during sentence production was that timing was more variable with respect to word onset for written words and speakers gazed at the words less consistently (probably due to their large size). Analysis of Experiment 6 found that fluent direct objects were associated with fewer gaze transitions between candidate words during speech than disfluent direct objects were, but there was no difference in gaze transitions before speech began. This suggests that some disfluencies are due to delays in deciding word order.



We have collected data for proposed Experiments 2, 3, 6, 7, and a follow up experiment to Experiment 3. The utterances from these experiments have been transcribed and the eye movement data have been processed. Materials are being created for Experiments 4b and 5b.

Results from Experiment 3 were presented at the CUNY Human Sentence Processing conference in March 2004 and in a senior thesis in April 2004. Writing for a manuscript reporting the results of Experiment 1 and 3 is in progress as well as another manuscript reporting the results of Experiment 6. The PI presented and discussed the theoretical background for the whole project in a talk at the International Language Production Workshop held in Marseille, France, in September 2004.