Telegraphic speech patterns in "open strategy" prompted speech

Walter Rolandi, Silke Witt

The Voice User Interface Company, Columbia, SC 29209 USA

`wrolandi@wrolandi.com`, `switt@amazon.com`

Abstract

This paper examines the verbal behavior of users in response to an "open strategy" prompt supported by a very large statistical language model (SLM) grammar. Open strategy prompts are also known as "natural language" or "How may I help you?" (HMIHY) prompts. Circumstantial data had previously suggested two hypotheses: 1) that users will initially respond to open strategy prompts with longer, multi-word, syntactically correct utterances and 2) that users will tend to respond with significantly shorter, less grammatical utterances as a function of time. Data collected from a particular SLM application over a four year period was examined to test these hypotheses. The data suggest that the phenomenon of "telegraphic speech" in response to open strategy prompts over time may be real.

Index Terms: telegraphic speech, speech recognition, SLM, statistical language models, natural language grammars, open strategy prompts, natural language prompts, HMIHY prompts, voice user interface, VUI.

1. Introduction

The term "telegraphic speech" first appeared in print in 1963 [1]. Telegraphic speech got its name because it resembles the style of writing seen in telegrams. Sending a telegram used to be considered very expensive and the cost of a telegram was determined by the number of words the telegram contained. In order to reduce the cost, people would eliminate any written components that were not semantically critical [2]. It is defined as a "simplified manner of speech in which only the most important content words are used to express ideas, while grammatical function words (such as determiners, conjunctions, and prepositions) as well as inflectional endings are often omitted [3]. Speakers exhibiting telegraphic speech tend to speak in simple noun-verb or even noun-noun two word combinations. Telegraphic speech is commonly observed in early language acquisition--typically in a child's second year [3]. Additionally, it is a feature of agrammatism, an aphasic neurological disorder. Patients with agrammatism exhibit impaired grammatical processing and general vocabulary reduction [4].

It has been suggested that telegraphic speech can be induced in users of speech recognition applications [2], particularly applications that employ very large grammars [5]. If this is the case, telegraphic speech should emerge over time in open strategy or natural language [6] prompted speech applications which employ very large statistical language model (SLM) grammars. Casual observation of user behavior across a number of speech recognition applications seems to support this hypothesis but the phenomenon has apparently never been formally investigated. Specifically, two hypotheses were investigated in this study: 1) that users will initially respond to open strategy prompts with longer, multi-word, syntactically correct utterances and 2) that users will tend to respond with significantly shorter, less grammatical utterances as a function of time.

2. The data sets

Data was obtained from a commercially successful, English language call routing system that can accurately send its callers to over 120 different destinations based on the caller's response to an open strategy prompt. The system is a telecommunications company customer service application and its users are telephone company customers.

Six large data sets were recorded and transcribed for analysis over a four year period. All user utterances were made in response to the same open strategy prompt. The first data set (2005) is included in the analysis as a baseline point of reference. It was collected in order to determine what users would actually say in response to the open strategy prompt alone. Users heard the open strategy prompt unaccompanied by any model or example utterances. All subsequent sets (2006a, 2006b, 2007, 2008 and 2009) were collected from the live production system. In the production system, samples of permissible utterances were randomly modeled to the user following the open strategy prompt. The transcriptions were subsequently processed using a number of scripting tools to quantify their characteristics.

3. Mean number of words per utterance

User utterances in the initial 2005 data set contained 7.1 words on average. Large utterances ranging from 10 and 59 words were not at all uncommon. As seen in Table 1, the number of words per user utterance however steadily declined in all subsequent data sets. In the last 2009 data set, the average words per user utterance had dropped to slightly less than half (3.5) of the initial 2005 value (7.1). Graph 1 depicts the individual values and their trendline.

| Data Set	Words
2005	7.1
2006a	6.0
2006b	5.6
2007	4.2
2008	4.0
2009	3.5

Table 1
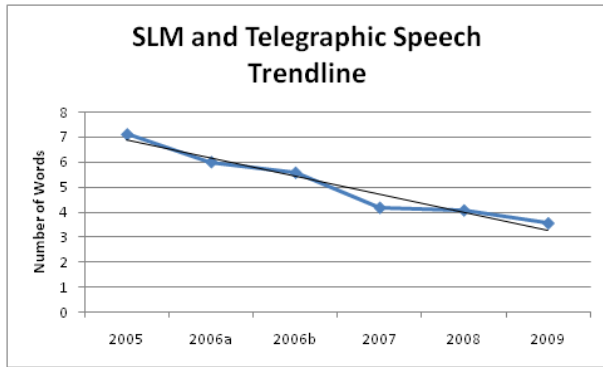
Graph 1

4. Word number trends

Graph 2 depicts the relative trends of words per utterance across the data sets. The incidence of three word utterances seems to hold relatively constant while the incidence of one and two word utterances increases as a function of time. Note that the incidence of all utterances containing more than three words tends to decline over time.
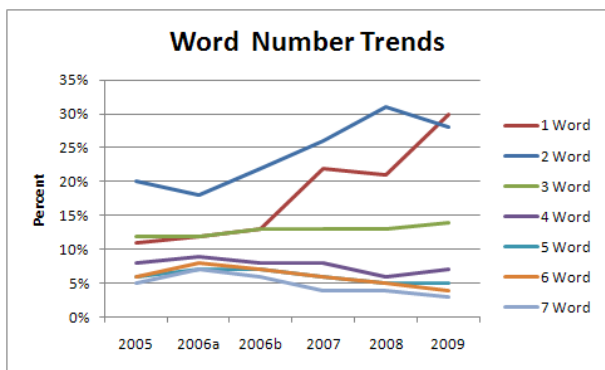
Graph 2

Graph 3 depicts a sample of multi-word "upper count" utterances over time. The incidence of 8, 13 and 18 word utterances is plotted. The data suggest an inverse relationship between the word count and its incidence over time.
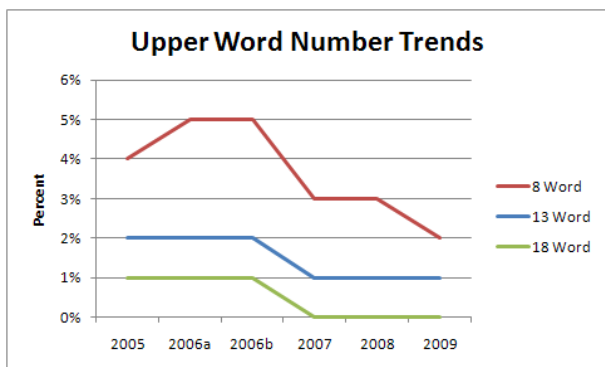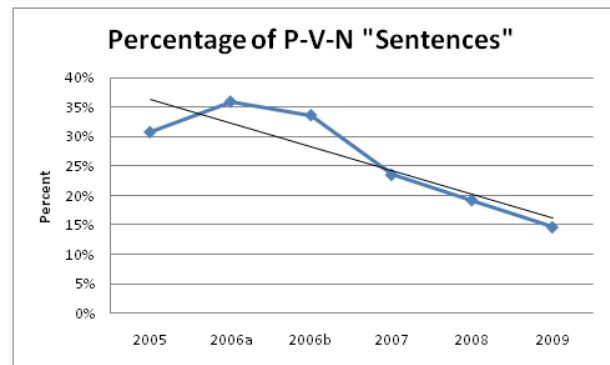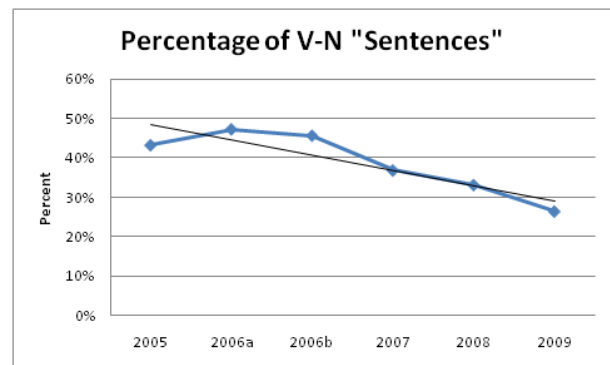

Graph 3

5. Grammatical trends

An effort was made to analyze the grammaticality of utterances across the data sets. Using the Natural Language Toolkit, Python Part-of-Speech scripts [7] were run on the data set transcriptions. The scripts assigned the most likely part of speech to each of the words in each of the utterances in each set. Two types of "sentences" were then operationalized: sentences containing a pronoun, verb and a noun (P-V-N, example: "I need service.") and simple sentences containing a verb and noun (V-N, example: "Get Internet.") only.

Graph 4 depicts the decline in the incidence of the more grammatically complete P-V-N sentences over time. Similarly, Graph 5 depicts the decline in the incidence of simple V-N sentences over time. Note that there is an initial increase of both P-V-N and V-N sentences between the initial 2005 dataset and the following 2006a data set. The increases are most likely due to the fact that users heard examples of acceptable, in-grammar utterances in the production system. No model utterances were provided when the 2005 data set was collected.
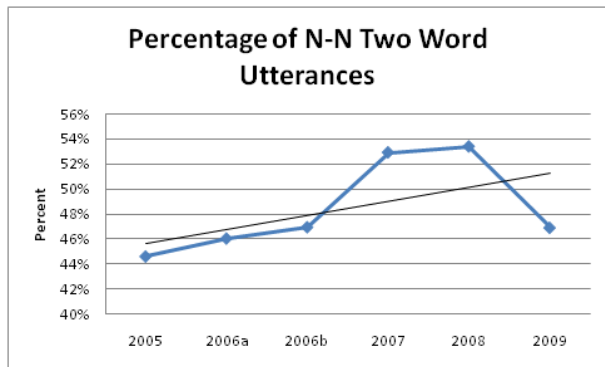

Graph 4

Graph 5

Finally, a third indication of grammatical deconstruction was explored. The incidence of two word utterances containing no verbs but only nouns (N-N, example: "Phone bill.") was determined. Graph 6 depicts a trendline indicating that the incidence of agrammatical N-N utterances increases over time.

Percentage of N-N Two Word Utterances

Graph 6

6. Discussion

While this study investigates only a single application, the data do seem to suggest that there is a relationship between the open strategy prompt, the SLM and telegraphic speech. Why this may be the case is unclear. It has been proposed that users, over time, experience speech recognition failures which have a punitive effect on non-telegraphic speech [2, 5]. The idea is that users eventually discover less complicated, less time consuming, and more behaviorally efficient ways to communicate their needs to speech recognition applications. However this implies that users of the system analyzed in this study are "repeat" callers who have had multiple encounters with the open strategy prompt and the SLM. Based on overall call volume and the known caller population, it is reasonable to assume that individual callers called the application 2-3 times per year. While this is an acceptable assumption, there is unfortunately no way to determine the incidence of repeat callers in the data sets.

The application was the first major speech recognition application in the country where it was deployed. As such, it had been widely publicized and was generally known to the public. It is possible therefore that the strengths and weaknesses of the application, what to say and what not to say, could have been communicated by word of mouth.

It is also possible that callers experienced speech recognition problems with other applications during the four year period in which the data were collected. Their experiences with other applications, perhaps potentiated by some cumulative effect of recognition failure experiences [8], could have potentially discouraged longer, more grammatical utterances but this is completely speculative. More research is clearly needed.

Open strategy, natural language prompting practices and large SLM grammars have been deployed in an effort to allow users to speak more naturally when interacting with speech recognition applications. It would be an unfortunate irony if their use were to be definitively shown to induce less "natural", telegraphic speech. In any event, voice user interface (VUI) design professionals might benefit from anticipating the emergence of telegraphic utterances and factor these types of utterances into their open strategy prompt grammars.

7. Conclusions

The data under investigation seem to support both hypotheses: users appeared initially to respond to an open strategy prompt

with longer, multi-word, syntactically correct utterances and 2) users appeared to respond with significantly shorter, less grammatical utterances as a function of time. The data is for only one application however and any generalizations would not be warranted. The phenomenon of telegraphic speech in response to open strategy prompts will require further investigation.

8. References

[1] R. Brown & C. Fraser. "The acquisition of syntax". *Verbal behavior and learning: problems and processes*. (Cofer C N & Musgrave B S, eds.) New York: McGraw-Hill, 1963.

[2] W. Rolandi, "Speech Recognition and Telegraphic Speech", *Speech Technology Magazine*. November-December, 2005.

[3] Nordquist, Richard. "Telegraphic Speech - Definition and Examples of Telegraphic Speech." Grammar and Composition - Homepage of About Grammar and Composition. N.p., n.d. Web. 2 Oct. 2016.

[4] Dennis C. Tanner. *Exploring the Psychology, Diagnosis, and Treatment of Neurogenic Communication Disorders*. IUniverse, Inc., New York, 2010.

[5] W. Rolandi, "Is it Stupid to be Clever?", *Speech Technology Magazine*. September-October, 2002.

[6] J. D. Williams, S. M. Witt, "A Comparison of Dialog Strategies for Call Routing". *Int. J. of Speech Technology*. Volume 7, Number 1, pp. 9-24. Jan. 2004.

[7] Natural Language Toolkit,NLTK Home, http://www.nltk.org/Home, accessed 20 March 2011

[8] W. Rolandi, "The Cumulative Effect of Recognition Failures", *Speech Technology Magazine*. July-August, 2005.