Cognitive Science 30 (2006) 43–63

Idiomatic Syntactic Constructions and Language Learning

Michael P. Kaschak[a], Jenny R. Saffran[b]

[a]*Department of Psychology, Florida State University*
[b]*Department of Psychology, University of Wisconsin—Madison*

Received 16 November 2004; received in revised form 10 March 2005; accepted 7 June 2005

Abstract

This article explores the influence of idiomatic syntactic constructions (i.e., constructions whose phrase structure rules violate the rules that underlie the construction of other kinds of sentences in the language) on the acquisition of phrase structure. In Experiment 1, participants were trained on an artificial language generated from hierarchical phrase structure rules. Some participants were given exposure to an idiomatic construction (IC) during training, whereas others were not. Under some circumstances, the presence of an idiomatic construction in the input aided learners in acquiring the phrase structure of the language. Experiment 2 provides a replication of the first experiment and extends the findings by showing that idiomatic constructions that strongly violate the predictive dependencies that define the phrase structure of the language do not aid learners in acquiring the structure of the language. Together, our data suggest that (a) idiomatic constructions aid learners in acquiring the phrase structure of a language by highlighting relevant structural elements in the language, and (b) such constructions are useful cues to learning to the extent that learners can keep their knowledge of the idiomatic construction separate from their knowledge of the rest of the language.

Keywords: Language acquisition; Statistical learning; Cross-sentential learning cues; Syntax; Idiomatic constructions; Construction grammar

1. Introduction

The question of how children acquire the phrase structure of their native language is central to understanding language acquisition. On the face of it, this is a daunting task. Children must learn the abstract, hierarchical structure of their language, yet there are few obvious cues to this structure in the language that they hear (see chapters in Morgan & Demuth, 1996, for examples of such cues). Recently, it has been proposed that learners use the predictive dependences present in their linguistic input as a means to discovering the relevant structures in their language (e.g., Saffran, 2001, 2002; Saffran, Aslin, & Newport, 1996; Seidenberg & MacDonald, 1999).

Correspondence should be addressed to Michael P. Kaschak, Department of Psychology, Florida State University, Tallahassee, FL 32306. E-mail: kaschak@psy.fsu.edu.

Children and adults can use predictive dependencies between syllables (i.e., the probability that one syllable follows another) to find word boundaries in a speech stream (e.g., Saffran, Aslin, et al., 1996; Saffran, Newport, & Aslin, 1996). They can also use predictive dependencies between word types (e.g., the probability that an article such as *a* or *the* is followed by a noun) to learn the rudiments of phrase structure (e.g., Saffran, 2001, 2002; Saffran & Wilson, 2003; Seidenberg, 1997; Seidenberg & MacDonald, 1999).

This article provides further support for the claim that statistical regularities in linguistic input play a role in the acquisition of syntax by focusing on a type of input-related learning cue first discussed by Morgan, Meier, and Newport (1989): cross-sentential cues to phrase structure. Cross-sentential cues are not fully realized in any one particular sentence token, but rather emerge through a comparison computed across semantically and/or syntactically related sentence tokens. Morgan et al. (1989) focused on two kinds of cross-sentential cues, illustrated in the following:

1. The fish swam around the tank.
2. He enjoyed chasing the goldfish flakes that had been dropped into the water.
3. The fish caught the food in his mouth.
4. The food was caught by the fish.

Sentences 1 and 2 provide a cue to phrase structure through pronominalization. Replacing the noun phrase "the fish" by the word *he* suggests that "the fish" represents a single linguistic unit. Sentences 3 and 4 use the movement of phrases to highlight the structural elements. The fact that "the fish" and "the food" remain as intact units in superficially different (but semantically related) sentences suggests that these groupings represent important syntactic units. This kind of distributional information has a distinguished place in the study of linguistic structure, most notably in the work of the American structuralist linguistics of the first half of the 20th century (e.g., Bloomfield, 1933).

Morgan et al.'s (1989) work follows from a tradition of using artificial grammar paradigms in the service of understanding the acquisition of natural languages (e.g., Braine, 1966; Saporta, Blumenthal, & Reiff, 1963; Morgan & Newport, 1981; Morgan, 1986; Morgan, Meier, & Newport, 1987). Whereas adults generally do a reasonable job of acquiring artificial grammars that have the properties of natural language (e.g., hierarchical phrase structure), they learn the grammar more successfully when the training input contains additional correlated cues. In most grammar-learning studies, these cues are local (i.e., encapsulated within one particular sentence). For example, Morgan et al. (1987) used prosodic boundaries, function words, and morphological markers as cues to phrase units in their artificial language training studies. They found that all three cues aided learners in acquiring the phrase structure of the language. In a subsequent article, Morgan et al. (1989) showed that nonlocal, cross-sentential cues to phrase structure (pronominalization and movement) also improve the learning of an artificial language.

The following experiments build on Morgan et al.'s (1989) results by exploring the role of another kind of cross-sentential cue in language learning: the presence of idiomatic syntactic constructions in a language. Our interest in idiomatic syntactic constructions is inspired by recent work in linguistics, particularly the development of usage-based theories of linguistic structure such as construction grammar (e.g., Fillmore, Kay, & O'Connor, 1988; Kay & Fill-

more, 1999). In one of the earliest discussions of construction grammar, Fillmore et al. (1988) discussed the long-standing distinction drawn in theoretical linguistics between "core" and "peripheral" elements of syntax. The core of a grammar consists of the general, productive rules that govern the phrase structure of the language, whereas the periphery is a collection of syntactic oddities whose structure and interpretation cannot be easily explained via the principles of the core grammar. Fillmore et al. (1988) cogently argued that peripheral aspects of syntax were often as systematic and productive as elements of the core grammar (i.e., noncore constructions display syntactic regularities in their own right, and these patterns can be used to generate a near-infinite number of examples of the constructions). In the years that followed, Fillmore, Kay, and colleagues (e.g., Goldberg, 1995; Lambrecht, 1990) have sought to build a linguistic theory that integrated representations of core and peripheral constructions into a single, unified formalism. Examples of the kinds of peripheral constructions in which we are interested are presented in Sentences 5 to 9 (see Fillmore et al., 1988; Kay, 1997; Kay & Fillmore, 1999; for discussions of these and other idiomatic constructions [ICs]):

5. No writing on the walls!
6. The harder you work, the sooner you'll finish.
7. Him be a doctor?
8. I wouldn't go to New York in the summer, let alone the winter.
9. What are you doing in that chair?

Note that even in cases where the idiomatic construction is based around a particular lexical item (e.g., the *let alone* construction illustrated in Sentence 8), it may still be fully productive.

There are several reasons to explore idiomatic syntactic constructions as providing cross-sentential cue to phrase structure. First, Morgan et al. (1989) discussed how cross-sentential cues can aid learners in discovering the structure of the language to which they are being exposed. Hearing the same set of words (e.g., "the fish" from Sentences 3 and 4) in different locations in different sentences provides a cue that those words "go together" in the language, as does hearing multiple words ("the fish") replaced by a single word ("it") in a subsequent sentence. Idiomatic syntactic constructions should serve a similar function as cross-sentential cues. By presenting familiar phrase types in a novel or unique sentential context (e.g., presenting a noun phrase in the unusual construction illustrated by Sentence 7), the idiomatic construction highlights that phrase type is an important structural element in the language, by preserving the predictive dependencies of the phrase type across contexts. That is, even though the overall structure of the sentence may be unusual, the structure of elements of the languages' phrase structure (e.g., the structure of a noun phrase) remains intact, and this provides learners with a cue that this type of phrase is an important element of the language.

A second reason to explore the role of idiomatic constructions in language acquisition is to extend the statistical learning approach of Saffran and colleagues (e.g., Saffran, 2001, 2002; Saffran, Aslin, & Newport, et al., 1996; Saffran & Wilson, 2003) to encompass the acquisition of more complex languages. Previous studies have presented participants with linguistic input derived from a phrase structure that is highly regular, which might be termed a *core-only* language. It is unknown if learners can use predictive dependencies to acquire a language that has both core and peripheral elements. If learners can acquire such a grammar, it would extend the statistical approach to language learning to encompass languages that embody other features of natural lan-

guages. If learners fail to learn the more complex grammar, it suggests that statistical information is not a good cue for learning at least some kinds of peripheral grammatical constructions.

A final reason to study the relation between idiomatic structures and language acquisition is derived from both Fillmore et al. (1988) and Saffran (2002). In explicating the types of syntactic idioms that occur in languages, Fillmore et al. (1988) noted that idiomatic constructions are limited in the ways that they differ from the core grammar. Why is it that languages have certain kinds of idiomatic constructions, but not others? Saffran (2002) proposed that languages are structured as they are because they have evolved to fit the constraints of the human learning mechanism (see Kroch, 1989, for a similar proposal). Some deviations from the core grammar may be easier to learn, and it is these idiomatic structures that maintain a place in the language. Deviations that are harder to learn may become disfavored and lose their place in the language. Although the primary purpose of this work is to highlight the possible role of idiomatic constructions as a cue to phrase structure, a secondary purpose is to determine if learnability factors place constraints on the kinds of idiomatic constructions that appear in languages. If so, it would support the view that the structures present in human languages are shaped by human learning mechanisms (Hauser, Chomsky, & Fitch, 2002; Newport & Aslin, 2004; Saffran, 2002).

In these studies, we presented adult participants with a modified version of the artificial grammar used by Saffran (2001), which itself is a modification of the grammar introduced by Morgan and Newport (1981; see the following Method section for details). As in Saffran (2001), participants receive no cues to the phrase structure of the language other than the predictive dependencies that exist between classes of words. There are two reasons why we chose to use this particular language. First, the directionality of the statistical patterns is opposite that found in English. In English, perfect predictors come before the items that they predict (e.g., determiners come before nouns, prepositions come before noun phrases, and so on), but in the artificial grammar perfect predictors appear after the items that they predict (see the description of the language that follows). Thus, any attempts by participants to simply map the input onto their knowledge of English would be misleading at best. Second, whereas this language is moderately complex, previous studies have shown that adults can succeed in acquiring the rudiments of the phrase structure without extensive training.

We inserted an idiomatic syntactic construction into this grammar. The idiomatic construction used phrase types from the original grammar, but arranged them in a way that violated the principles of that grammar. If the idiomatic construction provides learners with an additional cue to the phrase structure of the artificial language, participants who hear the test language with the idiomatic construction should outperform participants who hear the test language without the idiomatic construction on a test of the rules of the language.

2. Experiment 1

The purpose of Experiment 1 was to examine the influence of an idiomatic syntactic construction on adults' ability to learn a language based on predictive dependencies between classes of words. Participants were trained in one of three conditions. In the control condition, participants were trained on the language without hearing the idiomatic construction (i.e., they were trained on the "core" of the language alone). This condition provides a baseline from which to observe

the influence of the idiomatic construction on the learning of the language. In the IC condition, participants heard the same sentences as those in the control condition and also heard an additional set of the idiomatic sentences. In the IC + prosody (P) condition, participants heard the same training set as those in the IC condition, except that the idiomatic sentences were presented with a different prosody than the standard (core) sentences. Two different IC training conditions were employed to determine if the salience of the idiomatic construction (here, manipulated via prosodic marking) affects its influence on the learning process.

2.1. Method

2.1.1. Participants

The participants were 60 introductory psychology students from the University of Wisconsin (20 in each training condition). All were native speakers of English. They received extra credit in exchange for their participation.

2.1.2. Materials

The training phase of this experiment used sentences generated from the following sets of rules. The structure of the main language (which is called the *core* of the grammar) is essentially the same as that used by Saffran (2001):

(A) S = A-phrase (AP) + C-phrase (CP) + E-word
(B) AP = A-word + optional D-word
(C) CP = C-word + optional G-word

Each word consisted of a nonsense syllable; sentences were generated by inserting nonsense syllables into the appropriate slots in the sentence. There were four A-words (bif, hep, mib, rud), four C-words (cav, lum, neb, sig), two D-words (klor, pell), two G-words (tiz, pilk), and four E-words (jux, vot, loke, dupp). The following sequences of word categories were the acceptable core sentence patterns:

A-C-E
A-D-C-E
A-C-G-E
A-D-C-G-E

The structure of the idiomatic construction was as follows:

(D) S = E-word + CP + "wug" + C-word
(E) "wug" is a lexical item that is fixed in the construction
(F) The C-word at the end of the sentence never appears with a G-word

These rules generated the following types of sentences:

E–C-wug–C
E–C–G–wug–C

The idiomatic construction (called the *wug* construction) violates several aspects of the core grammar. First, the wug construction does not have an A-phrase. Second, the E-word appears

before the C-phrase. Third, the C-word at the end of the wug construction is prohibited from appearing with a G-word. Because idiomatic syntactic constructions in natural languages are of low relative frequency as compared to sentences generated from core rules, one additional constraint was put on the appearance of wug construction in the language: wug sentences made up only 14% of the training set.

Appendix A presents all of the training and test materials used in this experiment. The training set was generated in the following manner. First, all possible sentences were generated from the core rules and the wug rules. Then, 50 core sentences and 8 wug sentences were selected at random. We chose to have wug sentences appear relatively infrequently in the training set (14% of items were wug sentences) because in natural languages, idiomatic constructions are typically used with low frequency relative to the sentences generated from core rules. The training set was checked to ensure that different possible compositions of A-phrases and C-phrases occurred with roughly equal frequency and to ensure that no particular combination of words appeared more frequently than any other. The 58 sentences were then placed into a random order, with the constraint that the same word or phrase could not appear in more than two consecutive sentences. A trained female speaker recorded the input for the three training conditions.

For the control condition (which served as a baseline to observe how participants would learn the core of the grammar without exposure to the idiomatic construction), the training string consisted of the 50 core sentences, spoken at a rate of approximately one word per second. The sentences were spoken with a descending sentential prosody (i.e., each word was produced with a pitch lower than the previous word). We used a uniform rate of presentation and prosodic structure to ensure that the predictive dependencies between word classes (i.e., the regularity with which particular classes of words appear together in the training input) were the only cues to the phrase structure of the language. For the IC condition (in which participants heard the core sentences, plus the wug construction), the full set of 58 sentences was recorded in the same manner. The core sentences were presented in the same order as in the control condition, with the wug sentences randomly interspersed. All of the core and wug sentences were spoken with the same descending prosodic structure. The training string for the IC + P condition was identical to that for the IC condition, except that the wug sentences were spoken with an ascending prosody, whereas the core sentences were spoken with a descending prosody. The length of the training set was between 7 and 7.5 min for all training conditions. The training set was repeated four times to produce just under 30 min of training.

Participants in all training conditions received an identical test following training, which was designed to assess the participants' knowledge of five core rules, as well as two rules for the wug sentences.

Core Rules
Rule 1: All sentences must have an A-phrase
Rule 2: In an A-phrase, A-words precede D-words; in a C-phrase, C-words precede G-words
Rule 3: Sentences must have an E-word
Rule 4: C-phrases must precede E-words
Rule 5: If there is a G-word, there must be a C-word

Idiomatic Construction Rules
Rule 6: An E-word and a C-phrase (in that order) precede "wug"
Rule 7: The final C-phrase must be a C-word only (no G-words in sentence final position)

Six test items were used to assess the acquisition of each rule. Each test item consisted of a pair of sentences. One sentence was grammatically correct, whereas the other violated the rule being tested. All test items were presented with descending prosody, except that half of the items testing idiomatic construction rules were presented with ascending prosody (as were the training items in the IC + P condition). This was done to test whether knowledge of the idiomatic construction rules in the IC + P condition would be better tapped by presenting the wug construction with the same prosody with which it was initially encountered.

There were a total of 54 test items: 6 items for each of the five core rules (30 test items), 6 items for each of the two wug rules spoken with descending prosody (12 items), and 6 items for each of the two wug rules spoken with ascending prosody (12 items). The test items were recorded in the same manner as the training exposure and were presented to all participants in the same random order. Note that participants in the control training condition were presented with items assessing their knowledge of the idiomatic construction rules. Although we did not expect control participants to have any knowledge of the construction, we included idiomatic construction items on their test to obtain a baseline of how participants would respond to the test items absent any exposure to the construction. If the control participants perform at chance on these test items (i.e., if they average about 3 out of 6 for each of the idiomatic construction rules), it will show that participants cannot use their knowledge of the core of the grammar to distinguish good wug sentences from bad ones. Thus, if participants in the other training conditions show above-chance performance on the idiomatic construction items, it suggests that they have learned something about the wug sentences themselves.

2.1.3. Procedure

The participants were told that the experiment concerned the way people learn languages, and they were informed that they were going to listen to approximately 30 min of a nonsense language. They were instructed to pay attention to the language, but were told not to spend too much time trying to figure the language out. To keep the participants from focusing too much on the language, they were given a set of Lego toys to play with while listening to the training set (see Saffran, 2001, for a discussion of this methodology). After the first 15 min of listening, the participants were given a break before continuing with the second 15 min of training.

At the end of the training phase, the participants were told that they were going to be given a test to assess what they learned about the language. They were informed that they were going to hear a pair of sentences on each trial. They were asked to decide which of the two sentences sounded more like the language they just heard, and to indicate their choice by circling a "1" or a "2" on an answer sheet. All participants received the same 54-item test.

2.2. Results

Several analyses were conducted to assess the participants' performance on the grammaticality test. The first analysis examined the participants' overall performance on the test.

We submitted the test responses to a 2 (rule type: core vs. idiomatic) × 3 (training: control, IC, IC + P) mixed factor analysis of variance (ANOVA), with training as a between-subject factor. We collapsed all items from the idiomatic rule tests into one category, as preliminary analyses indicated that prosody (ascending vs. descending) did not affect performance on these rules. For the core rules and the idiomatic construction rules, we averaged each participant's scores on the individual rule items to generate a core average and an idiomatic construction average ranging from 0 to 6. The relevant means are presented at the top of Table 1. This analysis revealed a main effect of rule type, $F(1, 57) = 58.04, p < .001$, with participants responding more accurately to the core rule items than to the idiomatic rule items. There was also a main effect of training, $F(2, 57) = 3.95, p = .025$, such that performance in the control and IC conditions was equivalent, and performance in the IC + P condition being superior to that in both the control and IC conditions. There was no interaction of rule type and training ($F < 1$). These results lead to two conclusions. First, the main effect of training suggests that the presence of a prosodically marked idiomatic construction aided learners as they acquired the phrase structure of the language. Second, the lack of a Rule type × Training interaction suggests that the increased performance in the IC + P condition was due to a general increase in performance across rule types (i.e., that participants were doing better on tests of core rules and idiomatic rules).

To further understand the differences in test performance that were seen across training conditions, we conducted another set of analyses that focused on changes for individual test rules across training conditions. Individual rule means (out of six) in each training condition are presented at the bottom of Table 1. A single-factor ANOVA was conducted for each rule to determine whether performance on the rule changed across training conditions. Although partici-

Table 1
Mean number of correct responses (out of six) on test items for Experiment 1 (standard errors in parentheses)

	Training Condition			
Rule type	Control	IC	IC + P	Total
Core	4.08 (.14)*	4.01 (.21)*	4.41 (.11)*	4.17
IC	3.09 (.17)	3.19 (.12)	3.58 (.15)*	3.28
Total	3.58	3.60	3.99	
Individual Rules				
Rule 1	4.85 (.25)*	4.40 (.28)*	4.95 (.25)*	
Rule 2	4.00 (.23)*	4.15 (.36)*	3.80 (.35)*	
Rule 3	4.05 (.37)*	4.15 (.37)*	5.10 (.19)*	
Rule 4	3.80 (.21)*	3.45 (.29)*	3.90 (.31)*	
Rule 5	3.70 (.30)*	3.90 (.25)*	4.30 (.25)*	
Rule 6				
Descending prosody	2.90 (.29)	2.35 (.25)*	3.25 (.27)	
Ascending prosody	2.70 (.33)	3.25 (.28)	3.50 (.19)*	
Rule 7				
Descending prosody	3.70 (.33)*	3.70 (.22)*	3.90 (.27)*	
Ascending prosody	3.05 (.25)	3.45 (.21)*	3.65 (.27)*	

Note. Means marked with an asterisk (*) are statistically different from chance performance on the test (chance = 3 out of 6 correct). Conditions and rule types are labeled as follows: IC = idiomatic construction, and IC + P = idiomatic construction + prosody.

pants in the IC + P condition outperformed participants in the other conditions on all individual rules (except Rule 2), the only significant result was on Rule 3, "Sentences must have an E-word," $F(2, 57) = 3.26$, $p = .045$. It appears that the extra exposure to the E-words that participants got due to their presence at the beginning of the wug sentences highlighted the function of these words in the core language.

Although we have interpreted the preceding results as indicative of participants' knowledge of the phrase structure of the language, it is possible that surface variables in the exposure sentences affected performance during testing. Following previous work using a very similar artificial grammar (Saffran, 2001, 2002), we conducted an analysis of covariance (ANCOVA) to rule out several surface variables that might have influenced the mapping between training and test sentences: (a) length of the test item, (b) the legality of the first word of the item, (c) chunk strength (the average of the input frequencies for all word pairs for each item), (d) anchor strength (the composite of the input frequencies for the initial and final word pairs in each item), (e) uniqueness (the number of word pairs in each item that never appeared in the training input), and (f) similarity (the number of words by which each item differed from the most similar sentence in the input). With the exception of the legality of the first word of the item, all variables were continuous.

The test consisted of 54 forced-choice pairs contrasting grammatical and ungrammatical items, yielding 108 items for the analysis for each training condition. This resulted in a total of 324 items to be entered into the analysis. The dependent variable was the proportion of times each item was selected as being grammatical. In addition to the six surface variables described previously, the ANCOVA included the grammaticality of each item (coded as a two-level factor: grammatical or not) as well as the training condition in which the item appeared and the interaction of grammaticality and training. The question of interest is whether the grammaticality of the item accounts for participants' endorsement of items as grammatical after accounting for the surface variables.

The results of the ANCOVA are presented in Table 2. The only surface variable that accounted for a significant amount of the variance in participants' responses was length, $F(1,$

Table 2
Results of ANCOVA analyses for Experiments 1 and 2 (F values)

Factor	Experiment 1	Experiment 2
Grammaticality	70.32*	89.56*
Training	<1	<1
Grammaticality × Training	4.79*	2.91
Legality of first word	<1	1.65
Length	15.54*	5.94*
Chunk strength	<1	<1
Anchor strength	<1	<1
Uniqueness	2.06	1.07
Similarity	1.19	<1

Note. For all factors except training and Grammaticality × Training, $df = 1, 312$. For Training and Grammaticality × Training, $df = 2, 312$.

*$p < .05$.

312) = 15.53, $p < .001$. More important, the grammaticality of the test items remained a significant predictor of participants' responses even after taking the surface variables into account, $F(1, 312) = 70.32$, $p < .001$. The Grammaticality × Training interaction was also significant, $F(2, 312) = 4.79$, $p = .009$.

2.3. Discussion

The results of this experiment suggest that, under certain circumstances, the presence of an idiomatic syntactic construction in the training set can enhance learners' ability to acquire a grammar. When they were marked to stand out from the rest of the language, the wug sentences enhanced performance on a test of the rules of the entire language; when they were not marked, the wug sentences had no effect on the acquisition of the language. One explanation for this finding is that the combination of two cues (prosody plus the lexical item "wug") provided a better basis for keeping the rules of the idiomatic construction separate from those of the core language than could be had based on one cue alone (the lexical item "wug").[1] This separation allowed participants in the IC + P condition to benefit from the presence of the idiomatic construction more than participants in the IC condition could. More generally, an examination of performance on the individual rule tests suggests that the mechanism through which the wug sentences improved learning of the language was by highlighting relevant aspects of the structure of the core language (particularly, highlighting the function of E-words in the language).

Although the results of the ANCOVA demonstrate that surface features of the test items alone cannot account for performance on the grammaticality test, there are two alternative accounts of our results that need to be ruled out. First, the enhanced test performance in the IC + P condition may have had nothing to do with the idiomatic construction, but is instead a function of having heard more training sentences. This explanation is ruled out by noting that participants in the IC condition heard the same training set as participants in the IC + P condition, yet they did no better on the test than the participants in the control condition.

A second alternative hypothesis is that the improved performance in the IC + P condition is due to the prosodic variety of that training condition (i.e., the changing prosodic contours led participants to pay more attention to the language, resulting in better learning).[2] On this account, one would expect that learning of the core language could be increased by varying the prosody of the training sentences (without inserting any idiomatic constructions into the language). To test this hypothesis, we ran a control experiment with 60 introductory psychology students from Florida State University. In this experiment, participants were presented with the same training items as in the control condition of Experiment 1, and with the same test items (except that we removed the items testing the idiomatic rules). To vary the prosodic structure of the language, we trained participants in one of three conditions: (a) the single-speaker condition (in which all training sentences were spoken by a single person, in the same descending P as in Experiment 1); (b) the two-speaker condition (in which training sentences were spoken by two speakers, each of whom used a different rate of speaking and intonation contour); and the five-speaker condition (in which training sentences were spoken by five speakers, each of whom used a unique P). We then presented participants with the core rule test items from Experiment 1. Expressed as the mean number of items correct per rule (as in the initial analysis

from Experiment 1), participants in the single-speaker condition averaged 4.17 items correct, participants in the two-speaker condition averaged 3.92 items correct, and participants in the five-speaker condition averaged 4.22 items correct. There was no significant difference across these conditions ($F < 1$). Thus, variety in the prosodic features of the training input alone is not sufficient to improve learning of the language.

3. Experiment 2

The results of Experiment 1 suggest that idiomatic constructions may aid the learning of the core grammar of a language. The goal of Experiment 2 is to further explore the relation between the core grammar and idiomatic syntactic constructions, particularly with regard to issues of learnability. Earlier, it was noted that there are limits on the ways that idiomatic constructions deviate from core grammars in natural languages. It was suggested that one factor in setting these limits might be learnability. Certain kinds of deviations from the core grammar may be more difficult to learn, and consequently less likely to maintain a place in a language across historical time (Kroch, 1989; Saffran, 2002).

We explore this learnability hypothesis in an experiment that replicates and extends Experiment 1. Participants were trained in the control and IC + P conditions used in the first experiment (the IC condition was dropped because no effect of the wug sentences was observed). A third group of participants was trained in the violating IC + P condition. This condition was identical to the IC + P condition, save that the wug sentences were altered in such a way that they violated all of the predictive dependencies found in the core grammar. Violating wug sentences were generated according to the following rules:

(G) S = E-word + a G-word + wug + a C-word
(H) The G-word is never accompanied by a C-word
(I) The C-word is never accompanied by a G-word

The violating wug construction was thus identical to the original wug construction with the exception that the C-word was omitted from the C-phrase that preceded "wug." Note that none of the transitions between word categories in the violating wug construction are found in the core grammar. We are aware of no naturally occurring constructions with this property.

Experiment 2 is designed to address two questions. First, is the violating wug construction as easy to learn as the original wug construction when the constructions are presented in identical training contexts? Second, does the violating wug construction aid learning of the core rules the way that the original wug construction did? The statistical approach to language learning predicts that the answer to both questions should be, "no." Saffran (2002) demonstrates that phrase structures become harder to learn as the predictive dependencies between word classes become weaker. The unconventional use of the C- and G-words in the violating wug construction serves to weaken the predictive dependencies that define the phrase types in the core grammar. The result of this weakening should be that the idiomatic construction does not aid learning overall and is harder to learn in and of itself.

3.1. Method

3.1.1. Participants

The participants were 60 introductory psychology students from the University of Wisconsin–Madison (20 in each training condition). All were native speakers of English. They received extra credit in exchange for their participation.

3.1.2. Materials

The training materials for the control and IC + P conditions were the same as those used in Experiment 1. The violating IC + P training materials used the same sentences as the IC + P condition, except that the C-word was omitted from the C-phrase that preceded the word "wug." In cases where the original training condition had only a C-word before "wug," the word was replaced by a G-word. The new training set was recorded in the same manner as the IC + P condition in Experiment 1 (descending prosody on the core sentences, ascending prosody on the violating wug sentences).

The test items used in Experiment 2 were essentially the same as those used for Experiment 1. The only change occurred with the idiomatic construction items. Half of the idiomatic construction items were assigned to be violating idiomatic construction items, and half of the items remained in the same form as in Experiment 1 (i.e., they tested the original wug sentences). idiomatic construction items were turned into violating idiomatic construction items by either (a) removing the C-word from the pre-wug C-phrase (if there was a full C-phrase) or (b) swapping the C-word for a G-word (if there was not a full C-phrase). Because the original idiomatic construction items did not test for knowledge concerning the structure of the pre-wug C-phrase (i.e., they tested the ordering of the C-phrase and the E-word and the fact that the final C-word could not be accompanied by a G-word), we did not need to change the rules that were assessed by the test. The new test was recorded in the same fashion as in Experiment 1, except that all of the idiomatic construction and violating idiomatic construction items were produced with ascending prosody (because there was no condition in which the wug sentences were produced with descending prosody).

3.1.3. Procedure

The procedure was identical to that of Experiment 1.

3.2. Results

The results of this experiment were analyzed in the same manner as the data from Experiment 1. To examine overall performance on the test, we conducted a 3 (rule type: core, idiomatic, violating idiomatic) × 3 (training: control, IC+P, violating IC+P) mixed-factor ANOVA with training as a between-subject factor. The relevant means are presented at the top of Table 3. This analysis revealed a main effect of rule type, $F(2, 114) = 6.63$, $p = .002$, with participants generally performing better on tests of the core rules than on tests of either kind of idiomatic construction rules. There was also a main effect of training, $F(2, 57) = 7.00$, $p = .002$, with participants in the IC + P condition outperforming participants in the other two conditions. There was no interaction of rule type and training ($F < 1$). These results provide a replication of Ex-

Table 3
Mean number of correct responses (out of six) on test items for Experiment 2 (standard errors in parentheses)

	Training Condition			
Rule type	Control	IC + P	Violating IC + P	Total
Core	4.03 (.17)*	4.59 (.12)*	4.17 (.14)*	4.26
IC	3.60 (.18)	4.18 (.22)	3.60 (.18)*	3.79
Violating IC	3.68 (.22)*	4.10 (.11)*	3.83 (.18)*	3.87
Total	3.77	4.29	3.87	
Individual Rules				
Rule 1	4.45 (.35)*	5.10 (.19)*	4.70 (.22)*	
Rule 2	3.65 (.32)	4.00 (.25)*	3.85 (.25)*	
Rule 3	4.50 (.28)*	5.15 (.23)*	4.35 (.30)*	
Rule 4	4.00 (.28)*	3.50 (.32)	3.70 (.27)*	
Rule 5	3.55 (.28)	5.20 (.25)*	4.24 (.31)*	
Rule 6 (IC)	3.80 (.24)*	4.30 (.30)*	3.80 (.30)*	
Rule 7 (IC)	3.40 (.26)	4.05 (.22)*	3.85 (.24)*	
Rule 8 (Violating IC)	3.75 (.26)*	4.05 (.25)*	3.40 (.29)	
Rule 9 (Violating IC)	3.60 (.34)	4.15 (.25)*	3.80 (.27)*	

Note. Means marked with an asterisk (*) are statistically different from chance performance on the test (chance = 3 out of 6 correct). Conditions and rule types are labeled as follows: IC = idiomatic construction, violating IC = violating idiomatic construction, IC + P = idiomatic construction + prosody, and violating IC + P = violating idiomatic construction + prosody.

periment 1, as the presence of a prosodically marked idiomatic construction facilitated learning of the phrase structure of the language. At the same time, these data indicate that there are limits to the benefit provided by an idiomatic construction. In particular, when the idiomatic construction violates all of the predictive dependencies of the core language, it has no detectable effect on the learning of the language.

To follow up this initial analysis, we analyzed performance on the individual rule tests (see bottom of Table 3). Although participants in the IC + P condition outperformed participants in the other training conditions on all rules except Rule 4 ("C words must precede E words"), the only rule that showed a statistically significant difference across training conditions was Rule 5 ("C words must precede G words"). The added exposure to C-phrases provided by the wug sentences in the IC + P condition seems to have benefited learners in adducing the structure of this phrase type from the core language.

As in Experiment 1, we conducted an ANCOVA to test whether the grammaticality of the test items was a significant predictor of task performance even when the surface characteristics of the test items are taken into account (see Table 2). As in Experiment 1, length was a significant predictor of the participants' responses, $F(1, 312) = 5.94$, $p = .015$. After accounting for the surface variables, the grammaticality of the test items was a significant predictor of the participants' responses, $F(1, 312) = 89.56$, $p < .001$. The Grammaticality × Training interaction was marginally significant, $F(2, 312) = 2.91$, $p = .056$.

3.3. Discussion

Experiment 2 confirms that the presence of an idiomatic syntactic construction (the wug construction) can aid learners in the acquisition of phrase structure. The data also show that there are limits on this phenomenon. An idiomatic construction that deviates from the main part of the language such that it violates all of the predictive dependencies of the core grammar has no effect on learners' ability to learn the structure of the language. The lack of an interaction between rule type and training (and an examination of the means for the idiomatic construction and violating idiomatic construction rules) suggests, however, that there was no detectable difference in the learnability of the two kinds of idiomatic constructions. Thus, whereas the kind of idiomatic structure presented at training affected overall performance in learning the phrase structure of the language, it is not clear that one idiomatic construction was more learnable than the other (contrary to our predictions). It is possible that this null result is a function of the relatively low frequency with which these constructions were presented during training and that more extensive training might draw out differences in the learning of each construction type. This possibility awaits further testing.

A potentially troubling aspect of the results of this experiment is that participants in all training conditions performed above chance on virtually all rule types (even when they had no exposure to the kinds of sentences that were tested by that rule). The data at hand do not provide us with a clear explanation for this finding. One possibility is that participants in this experiment were making greater use of the surface features of the test items to make their responses (as compared to the participants in Experiment 1). Even if participants in this experiment made more use of surface cues in making decisions about which items were grammatical, it is important to note that (a) this tendency appears to be present in all training conditions (meaning that it does not contaminate interpretation of the main effects reported earlier), and (b) the ANCOVA showed that the grammaticality of the test items played a significant role in shaping test performance even when surface variables are taken into account.

4. General discussion

These experiments were motivated by three questions. First, does the presence of an idiomatic syntactic construction in one's linguistic environment aid learners in acquiring the phrase structure of the language? Second, can learners acquire a grammar that contains both core and peripheral syntactic patterns based solely on predictive dependencies between classes of words? Finally, are some deviations from the core grammar—namely those that more strongly violate the constraints of the core grammar—less learnable than other deviations? The data reported here indicate an affirmative answer to the first two questions, but not the third.

Morgan et al. (1989) demonstrated that cross-sentential cues, namely pronominalization and movement, aid learners in acquiring the phrase structure of an artificial grammar. The results of Experiments 1 and 2 broaden this claim by showing that another type of cross-sentential cue to phrase structure, idiomatic syntactic constructions, can also aid learners in acquiring the structure of a language. Morgan et al. (1989) argued that the cross-sentential cues in their study provided benefit to the learners by highlighting relevant structural aspects of

the language. The analysis of individual rule types from our experiments suggests that a similar mechanism was at work in our experiments: The elements of the core grammar that benefited most from the presence of the wug sentences were those whose predictive dependencies were highlighted by the IC (in particular, E-words in Experiment 1 and C-phrases in Experiment 2). These data are of note for several reasons. First, the data show that cross-sentential cues to phrase structure can be used by learners in a task where there is no semantic or referential context. In Morgan et al.'s (1989) experiments, learners were trained on the language in a setting in which it was possible to connect the words in the language to visual referents (in this case, shapes). Thus, these learners had another source of information that fostered their ability to use the cross-sentential cues to phrase structure in learning the structure of the training language. Learners in these experiments were able to use the cross-sentential cue even though the only cue to phrase structure (and to the relation between the core and periphery of the training language) was the predictive dependencies that exist between classes of words. These results support the claim that distributional information can play a central role in language learning.

Second, the data show that the idiomatic construction was a useful cue for learners only when it was marked to stand out from the rest of the language via a unique prosodic structure. Although we did not directly address this issue in our experiments, one explanation for this finding may be that the presence of two cues (the lexical item "wug" and the unique prosodic structure) helped learners keep their knowledge of the wug sentences separate from their knowledge of the rest of the language. Keeping the sentence types separate could facilitate the learners' ability to detect the common structural elements across the core and idiomatic constructions, which in turn could strengthen their knowledge of the overall structure of the language. Interestingly, this explanation may explain why Morgan et al. (1989) found that cross-sentential cues only aided learners when pairs of sentences illustrating the cues were presented simultaneously and with a referential domain. The simultaneous presentation of sentences, accompanied by a referential domain, may have helped learners keep the two kinds of sentences in the language (i.e., those with the "normal" word order and those with "movement") separate, again helping to highlight the structural similarities across sentence types.

Saffran (2001, 2002; see also Kroch, 1989) argued that the learnability of particular kinds of linguistic structures may shape the form that languages can take (with less learnable structures being less likely to be found in natural languages). We attempted to provide support for this claim by comparing the learning of two kinds of idiomatic constructions: one that retains some of the predictive dependencies of the core grammar, and one that does not (the latter being a state of affairs that is, as far as we can tell, quite rare in natural languages). It was expected that the idiomatic construction that retained the predictive dependencies of the core grammar would be more learnable than one that does not. The results of Experiment 2 did not support this prediction. Presently, it is unclear whether this outcome should be construed as evidence against the learnability hypothesis or as a function of the relatively low frequency of the idiomatic constructions in the training phase of the experiment.

It is worth noting that the results of both experiments show that learners are generally less successful in acquiring the structure of the idiomatic constructions than they are in acquiring the core grammar of the language. The most obvious explanation for this finding is that the idiomatic constructions were presented far less often than core sentences during training. Another possibility is that input in which the only cues to phrase structure are the transi-

tional probabilities between word classes is insufficient to support the acquisition of idiomatic constructions. Rather, additional cues (such as meaning or pragmatic context) are needed for the acquisition of these constructions. Given that many idiomatic constructions have a marked interpretation and specific pragmatic context of use (see Kay, 1997, for many examples), it will be important to develop studies that can distinguish between these accounts.

One further question remains about the role of idiomatic constructions in the acquisition of phrase structure. Although such constructions have been shown to be a useful cue for language learners, is this a cue that is available for children to use? As it turns out, many of the idiomatic syntactic constructions that have received attention in the linguistics literature are present in the world of young children.

10. No writing on the walls!
11. The sooner you eat your dinner, the sooner you can have ice cream.
12. What are you doing with those scissors?
13. … all of a sudden …

These syntactic constructions, and others like them, form part of the input that children receive as they acquire their language. As noted previously, these constructions are often marked as distinct from the rest of the language via a characteristic prosodic structure (e.g., Lambrecht, 1990; Taylor, 1998), a limited context of use (e.g., Fillmore et al., 1988; Kay & Fillmore, 1999), or both, just as the wug sentences were marked as distinct from the rest of the language via prosody.

The data reported here extend the statistical learning approach that has received considerable support over the past several years (e.g., Aslin, Saffran, & Newport, 1999; Saffran, 2001; Saffran, et al., 1996). The statistical learning approach rests on the claim that learners are able to use the statistical regularities present in their linguistic environment to acquire many levels of structure in their language, including words (Saffran, Aslin, et al., 1996; Thiessen & Saffran, 2003) and syntax (Saffran, 2001; Saffran & Wilson, 2003). Typically, studies of statistical language learning have focused on learning languages that might be considered "core only." These data show that predictive dependencies can be used to acquire the phrase structure of a language that contains both core and peripheral elements. Paradoxically, it turns out that acquisition of the language was best in those conditions that were most complex (i.e., containing core and peripheral constructions and two different prosodic structures). This is consonant with the principles of learning mechanisms described in the context of memory experiments (e.g., Hintzman, 1986) and serial response tasks (e.g., Cleermans & McClelland, 1991), where it has been shown that adding variability to the stimuli in training sets can have beneficial effects on learning. Related findings are emerging from artificial grammar-learning tasks with different kinds of structures (e.g., Gomez, 2002).

The acquisition of phrase structure is one of the biggest challenges a child faces in learning their native language. Cues to the phrase structure of the language are not obvious in the speech that children hear, and the cues that are present (such as predictive dependencies between types of words) are complicated by the presence of idiomatic constructions that weaken the extent to which relations between word classes are indicative of the phrase structure of the language. Nonetheless, the results of these experiments suggest that there are potential benefits to this added complexity. By highlighting important elements of phrase structure (such as particular

phrase types in a language), idiomatic syntactic constructions may aid learners to discover the structure of the language that they hear.

Notes

1. Thanks to an anonymous reviewer for suggesting this hypothesis.
2. Thanks to an anonymous reviewer for this suggestion.

Acknowledgments

Portions of this work were supported by an NSF graduate fellowship to the first author, and by grants from NIH (R01HD37466) and NSF (BCS–9983630) to the second author.

Thanks to Bert Williams, Denae van Etten, Lana Nenide, Ashley Karlin, Timothy Baskin, and Laura Schweitzer for their assistance in running these experiments, and to three anonymous reviewers for their helpful comments on an earlier draft of this article.

References

Aslin, R. N., Saffran, J. R., & Newport, E. L. (1999). Statistical learning in linguistic and non-linguistic domains. In B. MacWhinney (Ed.), *The emergence of language* (pp. 359–380). Mahwah, NJ: Lawrence Erlbaum Associates, Inc.

Bloomfield, L. (1933). *Language.* Chicago: University of Chicago Press.

Braine, M. D. S. (1966). Learning the positions of words relative to a marker element. *Journal of Experimental Psychology, 72,* 532–540.

Cleermans, A., & McClelland, J. L. (1991). Learning the structure of event sequences. *Journal of Experimental Psychology: General, 120,* 235–253.

Fillmore, C. J., Kay, P., & O'Connor, C. (1988). Regularity and idiomaticity in grammatical constructions: The case of let alone. *Language, 64,* 501–538.

Goldberg, A. E. (1995). *Constructions: A construction grammar approach to argument structure.* Chicago: University of Chicago Press.

Gomez, R. L. (2002). Variability and detection of invariant structure. *Psychological Science, 13,* 431–436.

Hauser, M. D., Chomsky, N., & Fitch, W. T. (2002). The faculty of language: What is it, who has it, and how did it evolve? *Science, 298,* 1569–1579.

Hintzman, D. L. (1986). "Schema-abstraction" in a multiple trace model. *Psychological Review, 93,* 411–428.

Kay, P. (1997). *Words and the grammar of context.* Stanford, CA: CSLI.

Kay, P., & Fillmore, C. J. (1999). Grammatical constructions and linguistic generalizations: The *What's X doing Y?* construction. *Language, 75,* 1–33.

Kroch, A. (1989). Reflexes of grammar in patterns of language change. *Language Variation and Change, 1,* 199–244.

Lambrecht, K. (1990). "What, me worry?"—*Mad Magazine* sentences revisited. *Proceedings of the Berkeley Linguistics Society, 16,* 215–228.

Morgan, J. L. (1986). *From simple input to complex grammar.* Cambridge, MA: MIT Press.

Morgan, J. L., & Demuth, K. (Eds.). (1996). *Signal to syntax: Bootstrapping from speech to grammar in early acquisition.* Mahwah, NJ: Lawrence Erlbaum Associates, Inc.

Morgan, J. L., Meier, R. P., & Newport, E. L. (1987). Structural packaging in the input to language learning: Contributions of prosodic and morphological marking of phrases to the acquisition of language. *Cognitive Psychology, 19,* 498–550.

Morgan, J. L., Meier, R. P., & Newport, E. L. (1989). Facilitating the acquisition of syntax with cross-sentential cues to phrase structure. *Journal of Memory and Language, 28,* 360–374.

Morgan, J. L., & Newport, E. L. (1981). The role of constituent structure in the induction of an artificial language. *Journal of Verbal Learning and Verbal Behavior, 20,* 67–85.

Newport, E. L., & Aslin, R. N. (2004). Learning at a distance: I. Statistical learning of non-adjacent dependencies. *Cognitive Psychology, 48,* 127–162.

Pinker, S. (1984). *Language learnability and language development.* Cambridge, MA: MIT Press.

Saffran, J. R. (2001). The use of predictive dependencies in language learning. *Journal of Memory and Language, 44,* 493–515.

Saffran, J. R. (2002). Constraints on statistical language learning. *Journal of Memory and Language, 47,* 172–196.

Saffran, J. R., Aslin, R. N., & Newport, E. L. (1996) Statistical learning by 8-month old infants. *Science, 274,* 1926–1928.

Saffran, J. R., Newport, E. L., & Aslin, R. N. (1996). Word segmentation: The role of distributional cues. *Journal of Memory and Language, 35,* 606–621.

Saffran, J. R., & Wilson, D. P. (2003). From syllables to syntax: Multi-level statistical learning by 12-month old infants. *Infancy, 4,* 273–284.

Saporta, S., Blumenthal, A. L., & Reiff, D. G. (1963). Grammatical models and language learning. In R. J. DePietro (Ed.), *Monograph series on languages and linguistics* (16; pp. 133–142). Washington, DC: Georgetown University Institute of Languages and Linguistics.

Seidenberg, M. (1997). Language acquisition and use: Learning and applying probabilistic constraints. *Science, 275,* 1599–1603.

Seidenberg, M. S., & MacDonald, M. C. (1999). A probabilistic constraints approach to language acquisition and processing. *Cognitive Science, 23,* 569–588.

Taylor, J. R. (1998). Syntactic constructions as prototype categories. In M. Tomasello (Ed.), *The new psychology of language* (pp. 177–202). Mahwah, NJ: Lawrence Erlbaum Associates, Inc.

Thiessen, E. D., & Saffran, J. R. (2003). When cues collide: Use of stress and statistical cues to word boundaries by 7- to 9-month old infants. *Developmental Psychology, 39,* 706–716.

Appendix A. Training Set and Test Items from Experiments 1 and 2

Training Set: Violating wug items are in brackets beneath the wug sentences that they replaced. Word categories are listed in parentheses next to each item.

mib pell lum dupp (ADCE)
hep lum vot (ACE)
rud pell sig pilk dupp (ADCGE)
biff klor neb jux (ADCE)
mib sig tiz vot (ACGE)
hep pell cav pilk vot (ADCGE)
mib lum dupp (ACE)
rud klor lum loke (ADCE)
jux neb wug cav (EC WUG C)
[jux pilk wug cav] (EG WUG C)
hep neb vot (ACE)
dupp lum wug cav (EC WUG C)
[dupp pilk wug cav] (EG WUG C)
hep neb tiz dupp (ACGE)
mib sig pilk jux (ACGE)
rud lum jux (ACE)
mib sig dupp (ACE)
loke sig pilk wug lum (ECG WUG C)
[loke tiz wug lum] (EG WUG C)
rud cav vot (ACE)
mib pell neb tiz jux (ADCGE)
hep klor lum vot (ADCE)

mib cav dupp (ACE)
rud pell sig vot (ADCE)
biff neb pilk jux (ACGE)
rud klor cav vot (ADCE)
jux lum tiz wug sig (ECG WUG C)
[jux tiz wug sig] (EG WUG C)
biff klor cav tiz dupp (ADCGE)
mib neb loke (ACE)
rud lum pilk neb dupp (ADCGE)
biff pell sig vot (ADCE)
vot neb pilk wug lum (ECG WUG C)
[vot pilk wug lum] (EG WUG C)
biff sig vot (ACE)
hep cav jux (ACE)
mib klor cav dupp (ADCE)
hep pell sig jux (ADCE)
hep klor neb pilk loke (ADCGE)
loke sig wug neb (EC WUG C)
[loke pilk wug neb] (EG WUG C)
biff lum tiz dupp (ACGE)
hep klor neb pilk loke (ADCGE)
hep klor neb jux (ADCE)
biff sig loke (ACE)
mib pell neb loke (ADCE)
hep cav pilk jux (ACGE)
mib lum tiz loke (ACGE)
rud sig tiz loke (ACGE)
biff sig tiz dupp (ACGE)
hep sig loke (ACE)
mib cav tiz vot (ACGE)
biff pell sig tiz loke (ADCGE)
mib klor lum pilk jux (ADCGE)
dupp cav pilk wug sig (ECG WUG C)
[dupp tiz wug sig] (EG WUG C)
rud lum loke (ACE)
rud neb jux (ACE)
biff lum jux (ACE)
hep sig dupp (ACE)
biff pell lum vot (ADCE)
rud neb tiz vot (ACGE)
vot cav wug neb (EC WUG C)
[vot tiz wug neb] (EG WUG C)
hep lum pilk loke (ACGE)
biff neb tiz loke (ACGE)
rud klor sig jux (ADCE)

Test Items: Items are listed by rule. Correct answers in each pair are listed first. Violating idiomatic construction items from Experiment 2 are in brackets beneath the idiomatic construction items they replaced. Word categories are in parentheses after each item.

Core Rules
Rule 1: All sentences must have an A-phrase
rud klor neb tiz vot (ADCGE) / neb tiz vot (CGE)
biff cav dupp (ACE) / cav dupp (CE)
hep sig tiz dupp (ACGE) / sig tiz dupp (CGE)
mib pell lum pilk jux (ADCGE) / lum pilk jux (CGE)
rud cav pilk loke (ACGE)/ cav pilk loke(CGE)
hep klor neb vot (ADCE) / klor neb vot (DCE)

Rule 2: In an A-phrase, A-words precede D-words; In a C-phrase, C-words precede G-words
biff klor lum tiz loke (ADCGE)/ biff tiz lum klor loke (AGCDE)

biff pell lum pilk vot (ADCGE(/ biff pilk lum pell vot (AGCDE)
mib klor sig tiz vot (ADCGE)/ mib tiz sig klor vot (AGCDE)
hep pell neb pilk dupp (ADCGE) / hep pilk neb pell dupp(AGCDE)
rud klor neb tiz jux (ADCGE) / rud tiz neb klor jux (AGCDE)
rud pell cav tiz jux (ADCGE) / rud tiz cav pell jux (AGCDE)

Rule 3: Sentences must have an E-word
mib sig tiz jux (ACGE)/ mib sig tiz (ACG)
hep klor cav dupp (ADCE)/ hep klor cav (ADC)
biff sig pilk dupp (ACGE) / biff sig pilk (ACG)
rud neb pilk jux (ACGE) / rud neb pilk (ACG)
mib pell sig loke (ADCE) / mib pell sig (ADC)
biff neb pilk vot (ACGE)/ biff neb pilk (ACG)

Rule 4: C-phrases must precede E-words
rud neb vot (ACE)/ rud vot neb (AEC)
mib sig vot (ACE) / mib vot sig (AEC)
hep neb loke (ACE)/ hep loke neb (AEC)
hep pell lum jux (ADCE)/ hep pell jux lum (ADEC)
biff pell neb dupp (ADCE)/ biff pell dupp neb (ADEC)
rud klor sig pilk loke (ADCGE)/ rud klor loke sig pilk (ADECG)

Rule 5: If there is a G-word, there must be a C-word
biff pell cav pilk loke (ADCGE)/ biff pell pilk loke (ADGE)
rud pell lum tiz loke (ADCGE)/ rud pell tiz loke (ADGE)
hep klor sig pilk jux (ADCGE)/ hep klor pilk jux (ADGE)
biff klor lum tiz vot (ADCGE)/ biff klor tiz vot (ADGE)
mib pell lum pilk dupp (ADCGE)/ mib pell pilk dupp (ADGE)
mib klor neb tiz dupp (ADCGE)/ mib klor tiz dupp (ADGE)

Idiomatic Construction rules
Rule 6: An E-word and a C-phrase (in that order) precede “wug”
loke neb pilk wug sig (ECG WUG C)/ neb pilk loke wug sig (CGE WUG C)
dupp neb wug cav (EC WUG C) / dupp wug cav (E WUG C)
dupp lum tiz wug cav (ECG WUG C)/ lum tiz dupp wug cav (CGE WUG C)
jux sig pilk wug neb (ECG WUG C)/ sig pilk jux wug neb (CGE WUG C)
vot lum wug sig (EC WUG C)/ vot wug sig (E WUG C)
vot neb wug lum (EC WUG C)/ neb vot wug lum (CE WUG C)
dupp neb wug sig (EC WUG C)/ neb dupp wug sig (CE WUG C)
[dupp pilk wug sig (EG WUG C)/ pilk dupp wug sig (GE WUG C)]
loke sig tiz wug neb (ECG WUG C)/ sig tiz like wug neb (CGE WUG C)
[loke tiz wug neb (EG WUG C)/ tiz loke wug neb (GE WUG C)]
vot lum pilk wug cav (ECG WUG C)/ lum pilk wug cav (CG WUG C)
[vot pilk wug cav (EG WUG C)/ vot wug cav (E WUG C)]

jux lum tiz wug sig (ECG WUG C)/ lum tiz jux wug sig (CGE WUG C)
[loke tiz wug sig (EG WUG C)/ tiz loke wug sig (GE WUG C)]
loke neb wug lum (EC WUG C)/ neb loke wug lum (CE WUG C]
[loke pilk wug lum (EG WUG C)/ pilk loke wug lum (CE WUG C)]
jux lum wug neb (EC WUG C)/ lum jux wug neb (CE WUG C)
[jux pilk wug neb (EG WUG C)/ jux wug neb (E WUG C)]

Rule 7: The final C-phrase must be a C-word only (no G-words in sentence final position)
loke sig wug neb (EC WUG C)/ loke sig wug neb pilk (EC WUG CG)
dupp sig pilk wug cav (ECG WUG C)/ dupp sig pilk wug loke (ECG WUG E)
vot sig wug cav (EC WUG C)/ vot sig wug tiz (EC WUG G)
loke neb wug cav (EC WUG C)/ loke neb wug cav vot (EC WUG CE)
jux cav wug lum (EC WUG C)/ jux cav wug tiz (EC WUG G)
jux cav pilk wug sig (ECG WUG C)/ jux cav pilk wug pilk (ECG WUG G)
dupp neb wug neb (EC WUG C)/ dupp neb wug neb tiz (EC WUG CG)
[dupp pilk wug neb (EG WUG C)/ dupp pilk wug tiz (EG WUG G)]
vot cav wug sig (EC WUG C)/ vot cav wug sig pilk (EC WUG CG)
[vot tiz wug sig (EG WUG C)/ vot tiz wug pilk (EG WUG G)]
loke lum wug cav (EC WUG C)/ loke lum wug cav pilk (EC WUG CG)
[loke tiz wug cav (EG WUG C)/ loke tiz wug cav pilk (EG WUG CG]
dupp cav wug lum (EC WUG C)/ dupp cav wug lum tiz (EC WUG CG)
[dupp pilk wug lum (EG WUG C)/ dupp pilk wug tiz (EG WUG G)]
jux sig wug neb (EC WUG C)/ jux sig wug neb pilk (EC WUG CG)
[jux tiz wug neb (EG WUG C)/ jux tiz wug neb loke EG WUG CE]
vot lum wug sig (EC WUG C)/ vot lum wug sig tiz (EC WUG CG)
[vot pilk wug sig (EG WUG C)/ vot pilk wug dupp (EG WUG E)]