

Phonetic reality and phonological prediction:  
Stress clash and rhythm in English

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1. Introduction

In a recent paper Cooper and Eady(1986) tested some claims of a metrical approach to phonology. These claims have to do with speech rhythm and in particular the hypothesis that the intervals between stressed syllables tend toward isochrony.

The research which is reported in this paper replicates and extends that of Cooper and Eady's experiment 1, which was a test of a hypothesized rhythmic phenomenon called stress clash. Given two assumptions about rhythmic structure in English, stress clash is to be expected. The two assumptions are: (1) word level stressed syllables define units of rhythmic structure in English (stress feet), and (2) syllables within stress feet are durationally adjusted to approach isochrony. A view of speech rhythm in which these assumptions play a part predicts that when stresses occur in adjacent syllables (ie. without any intervening syllables) the first of the two stresses will be of greater duration than it would be in an identical utterance in which there were intervening syllables. This is illustrated below:

x	x		x	x	lexical stress
x	x		x	x x x	syllable
Chris	Bell		Chris	Belinski	

Cooper and Eady tested this hypothesis by constructing a set of sentences which contained the monosyllabic name 'Chris' followed by a last name which was either stressed on the first syllable or some later syllable ('Burn, Burninski'). In the case of first syllable stress a stress clash condition was set up. Thus, it was expected that the duration of 'Chris' would be greater in this case than in the case of second syllable stress. Contrary to the prediction of the stress clash hypothesis Cooper and Eady found that there was no duration difference between the clash condition and the no clash condition.

2. Experiment

We have conducted a replication of Cooper and Eady's experiment and included two factors which we hypothesized might contribute to the difference between Cooper and Eady's findings and linguists' intuitions about stress clash.

We hypothesized that the reducibility of the syllable following the test word might affect the realization of stress clash. Two types of name pairs were used by Cooper and Eady (without being distinguished). In the example above the destressed vowel is normally reduced ([bɛl], [bɛlɪnski]). In a pair such as 'Barr', 'Bartowski' this is typically not the case ([bar], [bartɔʊski]). There are two possible predictions concerning the effect of this difference between test items. These predictions depend on whether the unreduced [ar] in 'Bartowski' is to be treated as lexically stressed or phonologically identical to the reduced vowel of 'Belinski'. (In terms of a Trager and Smith(1951) type of transcription the stress marking would be Chris B̂artówski and Chris B̂artówski. Where ˆ is primary stress, ^ is secondary stress, and \ is tertiary stress.)

x	?	x		lexical stress
x	x	x	x	syllable
Chris Bartowski				

If the ? in the grid above is to be taken as x (indicating tertiary stress) then we would predict a stress clash condition comparable to that hypothesized for 'Chris Barr'. Hence, we would expect greater duration for the test word before 'Bartowski' than before 'Belinski'. If, on the other hand, the ? is correctly left blank (unstressed) then we would expect a no clash condition phonologically comparable to that in 'Chris Belinski'. Phonetically, we might expect in this case the unreduced vowel [ar] to be longer than the reduced [ə] and thus, if any interaction between the clash and reducibility conditions is found we would expect the test words to be shorter when they are in the environment of unreduced following syllables than when the following syllable is reduced. We divided our experimental items into two groups: those with reducible first syllables in the name after the test word and those with unreducible first syllables in this position (4 items in each group).

We also hypothesized that the tendency toward isochrony which is often reported in the linguistic literature may be a property of careful, hyperarticulated speech more than of normal speech. This hypothesis carries with it also the speculation that linguists when introspecting about speech rhythm are hyperarticulating and end up analysing careful speech. To test this hypothesis we had our subjects read the list of test sentences once with the instructions to speak naturally and normally, then we surprised them by asking for another reading, this time instructing them to speak carefully 'as if to a non-native speaker of English'.

Following Cooper and Eady's procedure in their experiment 2 we used two different test words (Chris vs. Klauss). This introduced at least one factor into the experiment that we would expect to produce a reliable effect on test word duration since they are phonologically similar with the exception of the nuclear vowel. The duration difference between [I] and [aU] has been demonstrated previously (Peterson and Lehiste, 1960) and thus we expect the duration difference between 'Chris' and 'Klauss' to be reliable.

## 2.1 Methods

The dependent variable was the duration of the test word (either 'Chris' or 'Klauss'). The model for this experiment included the following factors:

- (1) Deliberate-normal speaking style.
- (2) Reducible-unreducible syllable following the test word.
- (3) Clash-nonclash (Burn vs. Burninski).
- (4) Word (Chris vs. Klaus).

Four subjects read each of 32 test sentences (2 test words X 2 clash conditions X 2 reducible conditions X 4 items in each combination) once normally and once carefully. The sentences had identical syntactic structure with the test word and its associated conditioning context located sentence medially (see the appendix). Recordings were made in an anechoic chamber and measurements were made from spectrograms.

## 2.2 Results

MinF' values were computed from a repeated measures ANOVA. There were two main effects. The word factor (#4 above) was reliable (MinF'(1,13)=117.5,  $p < .01$ ) as was speaking style (#1) (MinF'(1,3)=24.63,  $p < .05$ ). No other main effects and no interactions were significant.

## 3. Discussion

As expected the identity of the test word proved to be a significant factor. It is also not surprising that style of speaking turned out to be a reliable effect. This would indicate first of all that the subjects did make a distinction in style of speaking and the average durations of the test words in the two styles (normal 313 ms, deliberate 382 ms) indicates that one aspect of the change was to speak more slowly.

Evidently the reducibility of intervening syllables does not promote or block stress clash. Likewise our results seem to suggest that stress clash does not occur more in careful speech than it does in normal speech. It is equally absent in both.

What then are linguists talking about when they claim the existence of phenomena such as stress clash? One logical possibility is that instead of isochrony of lexically specified stresses they are looking at intervals between intonationally prominent stresses. These are lexically specified stressed syllables which receive intonational accents in the production of utterances. (We are here following the intonational analysis and notation of Pierrehumbert (1980). The approach to matching grid and intonational analysis is that used by Beckman and Edwards (1987).) In sentence contexts the location of lexical stress is not identical with the locations of intonational accents. For example, one of the sentences that we used in the experiment might have the following metrical structure:

x		x			x			x	nuclear accent
x	x		x	x		x	x	x	pitch accent
x	x	x		x	x		x	x	lexical stress
x	x	x		x	x		x	x	syllable
Tom wanted Chris Burn to wash his car.									
H*			H*				H*	L L%	

At the level of intonational prominence (pitch accent) 'Chris' and 'Burn' are not equal.

When linguists investigate the rhythm of phrases like 'Chris Bell' and 'Chris Belinski' they usually listen to them in isolation. Thus, lexical stress is confounded with intonational prominence:

	x			x				x	nuclear accent
x	x			x	x			x	pitch accent
x	x			x	x			x	lexical stress
x	x			x	x	x	x	x	syllable
Chris Bell			Chris Belinski						
H*	H*	L L%	H*		H*	L L%			

Therefore we might expect to find stress clash in utterances in which the lexical stresses of the test tokens coincide with pitch accents when the tokens are produced (for instance when the name pairs are produced in isolation). This study is now under way.

### References

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- Pierrehumbert, J.B. 1980. The Phonology and Phonetics of English intonation. Unpublished Ph.D. dissertation, MIT.
- Trager, G.L. and Smith, H.L. 1951. An Outline of English Structure. Norman, Okla.: Battenburg Press.

## Appendix

The following is a listing of the sentences used in the experiment reported here.

1. Mary asked (Chris,Klauss) (Barr,Bartowski) to answer the question.  
(Bell,Belinski)
2. George took (Chris,Klauss) (Fern,Fernandez) to watch a baseball game.  
(Rubin,Rubinski)
3. Liz told (Chris,Klauss) (Kirk,Kirkpatrick) to visit the museum.  
(Mack,Mackenzie)
4. Tom wanted (Chris,Klauss) (Burn,Burninski) to wash his car.  
(Carr,Carruthers) to feed his cat.