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Published in:
Proceedings 1st International Seminar on the Foundations of Speech

Publication date:
2019

Document version:
Final published version

Alternative phrase boundary symbolization and its effect on pause duration

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This study aims to find alternative phrase boundary symbolizations in written text to enable consistent pause production. Shorter phrases and many pauses are beneficial for successful presentations and the communication of information structure. Texts with alternative symbolizations (dashes, bars, spaces, line breaks, hashtags, and arrows) are used to indicate minor and major phrase boundaries. Results suggest that these methods can elicit more consistent pause production than normal punctuation, especially using line breaks.

INTRODUCTION

Research concerning the effect of intended pauses in public speaking contexts has revealed that many pauses with shorter phrases are advantageous, for example for charisma perception [1]. It would therefore be helpful to develop methods that can consistently elicit many pauses of differing lengths and a system to help parse longer sentences into smaller units based on content and emphasis rather than punctuation and syntax.

In 16th century England, today's punctuation marks (, ; : . ?) were already in use, primarily for reading aloud, even though some first indications of syntactic usage were clearly apparent [2]. By the 18th century, punctuation was mostly seen as syntactic, while scholars still attested a role for pausing, suggesting that only about half of spoken pauses are represented in written symbolization (cf. [3], p. 75). At the same time, an alternative to syntactic punctuation called 'rhetorical' or elocutionary punctuation appeared, with "the purpose of regulating the pauses of the voice in reading" ([4] cited in [2], p. 60). However, this kind of punctuation never took hold [2].

Some studies have investigated the influence of sentence formatting (commas, spaces, line breaks) on the information parsing and readability of a text. [6] found that the isolation of individual constituents using large spaces is conducive for readability, while inserting larger spaces in the text at prosodically-informed places made the text less readable "because it evokes auditory processing strategies" ([6], p. 83). Nevertheless, [6] generally showed that "isolating major phrases within extra spaces facilitates reading" (p. 83). According to [5], inserting commas in ambiguous sentences can "enhance the awareness of constituent structure and phrasal boundaries, both physically, in terms of eye movements, and mentally, in terms of processing […] with the added benefit of reducing the need to reread the sentence" (p. 585). Double spaces instead of commas did not affect processing but showed "a similar effect on many eye-movement parameters regardless of processing implications" ([5], p. 586). Line breaks also have "a powerful influence on the reader's behavior" ([7], p. 70) and "cue clausal segmentation" ([5], p. 568).

The present study is part of a research initiative named INSPECT (**I**nnovating **Sp**eech **E**li**C**itation **T**echniques) which focuses on researching the influence of outside factors on the elicitation of specific phenomena (see [8; 9] for text formatting studies; see [10] for a general summary).

The aim of this study is to return to the idea of 'rhetorical punctuation' for public speaking training and to develop methods to elicit systematic minor and major phrase boundaries resulting in shorter and longer pause durations using symbols in a printed text. These methods can be used to help speakers consistently produce a minimum of two different pause durations on-line during reading aloud or presenting, leading to the main question: Can we get speakers to produce a specific, consistent style of speech?

METHOD

A reading text ("Mobile App Developer", [11], an example of a well-made elevator pitch) was slightly altered by the authors. It was set with Times New Roman, 16 pt, double line spacing and block setting.

The third author (English L1 speaker) set minor and major phrase boundaries in the text based on an auditory interpretation of a recording of her voice. There is clear evidence for more than one level of phrase boundary, often referred to as *intermediate phrase* and *intonational phrase* [12,13]. Major phrase boundaries were set at full stops or question marks in the original text (N=13). Minor phrase boundaries were set where short pauses or phrase breaks should occur to structure the text more efficiently—this was the case where the original text had commas, but also when there was no punctuation (N=22). The phrase boundaries were symbolized using six methods in addition to normal punctuation (which served as a baseline condition). Table 1 summarizes and justifies the different conditions used for recordings and analyses.

Per condition, 8 participants were recorded in an empty, quiet lecture room at the University of Southern Denmark, resulting in 48 participants total; all were first-semester students of the Master programme "Innovation & Business" and English L2 speakers. All speakers read the *Baseline* condition first and then one of the six (randomly

assigned) test conditions with a one-hour break in between, and the opportunity to familiarize themselves with the text for ten minutes before each reading.

Tab. 1: Summary of the symbols used for the different conditions with justifications.

Condition	Symbols		Justification
	Minor PB	Major PB	
Baseline	,	. ?	normal punctuation
Bar	|	||	subtle, but visible break
Arrow	>	>>	might lead the eye to a new constituent
Hashtag	#	##	might indicate new constituents (inspiration: social media)
Enter	line break	empty line	inspired by poem formatting
Dashes	–	—	more subtle, normal in writing
Space	3 spaces	5 spaces	in theory; block setting resized the spaces; included as an inconsistent symbolization.

RESULTS

Measurements were analyzed using linear mixed-effects models, with pause duration as the dependent variable. Only pauses within a time window of 200-1000 ms were included in the statistical models. The lower value was chosen with respect to the perceptual detection threshold of silent pauses in speech and to avoid inclusion of plosive closures. The upper value was small enough to avoid including any disfluent, hesitation pauses in the results (cf. [14], p. 40). Therefore, this study does not deal with a difference in presence or absence of pausing at phrase boundaries—phrase boundaries marked by different prosodic parameters other than silence are not included here—and only investigates pause duration at phrase boundaries when pauses arise. Figures were created using [15].

The first model included two fixed factors, i.e. *Boundary* (minor vs major, within-subjects variable) and *Group* (1-6, between-subjects variable), and *Speaker* as a random factor. The model was run only for the baseline condition (i.e., normal punctuation) to check whether speakers produce different silent-pause durations at minor and major phrase boundaries and/or in connection with regular punctuation marks and, moreover, whether there are significant differences in the pausing habits between the six groups of participants.

Results show a significant difference of about 175 ms between the silent pauses associated with minor and major phrase boundaries ($F[1,42]=422.07$, $p<.001$, $\eta_p^2=0.91$). Minor phrase boundaries were on average shorter (514 ms) than major phrase boundaries (689 ms), yet there was considerable overlap between minor and major pause durations, see Fig.1a. Pause durations between groups differed on average by about 30 ms, but this factor was not significant ($F[5,1536]=0.69$, $p=.625$, $\eta_p^2=0.01$), nor were any interactions. Thus, any significant differences between the compared pause-marking strategies are not due to artifacts of between-group differences in pausing habits but represent genuine effects of the pause-marking strategies.

The second model had two fixed factors, *Boundary* (minor vs major, within-subjects variable) and *Marking* (six pause-marking conditions, between-subjects variable), with *Speaker* as a random factor. The model yielded significant main effects of both *Boundary* and *Marking* as well as a significant interaction between them ($F[5,35]=64.01$, $p<.001$, $\eta_p^2=0.90$). There was no significant main effect of *Speaker*, but a significant interaction arose between *Speaker* and *Boundary* ($F[7,35]=2.34$, $p=.046$, $\eta_p^2=0.32$). A subsequent t-test comparing the difference between minor and major pause durations for each speaker shows that the *Dashes*, *Arrows*, *Hashtags* and *Enter* conditions create a clearer differentiation between minor and major boundaries than the baseline.

On this basis, the key results can be summarized as follows. For some marking conditions, the elicited minor and major pause duration differences were larger and more consistent across speakers than others. This applies to the *Arrow* (see Fig.1c) and *Hashtag* markings and, in particular, to the *Enter* markings, see. Fig.1b. In contrast, the *Space* marking performed worst in these respects, see Fig.1d. The *Bar* condition performed similarly poorly and, together with the *Space* condition, led to the greatest variation (i.e. inconsistency) between speakers. *Hashtag* markings, in turn, were worse than *Arrow* and *Enter* markings as they elicited relatively long minor pause durations; the *Dashes* markings were still worse in this respect. Pauses elicited by dashes were generally the longest (743 ms), about 30 % longer than those elicited by arrows (479 ms). The *Enter* markings, in contrast, elicited pausing behavior that was on average closest to that of the regular orthographic punctuation marks (570 ms) but with less internal variability.

DISCUSSION

Overall, the results suggest that there is a hierarchy of effectiveness of different symbolization methods for separating shorter from longer pauses and eliciting natural and unmarked pause durations. The method that was most effective in this first study was using line breaks (*Enter* condition), followed by *Arrows*, *Hashtag*, *Dashes*, *Bars*, and the completely ineffective *Space* condition. Altogether, symbolizations that performed well were typical in typesetting like the *Enter* condition, except for the *Arrows* condition. A disadvantage of the *Enter* condition is the number of pages necessary, which is not convenient for reading tasks on paper. A possible application would be to mix systems with each other and with 'normal' orthographic punctuation. For example, dashes can be inserted in unusual places alongside normal punctuation to increase some pause durations for dramatic effect in a speech. Future studies should conduct field surveys with actual presentations and presentational training in order to improve further the consistency and efficiency of this version of a rhetorical punctuation.

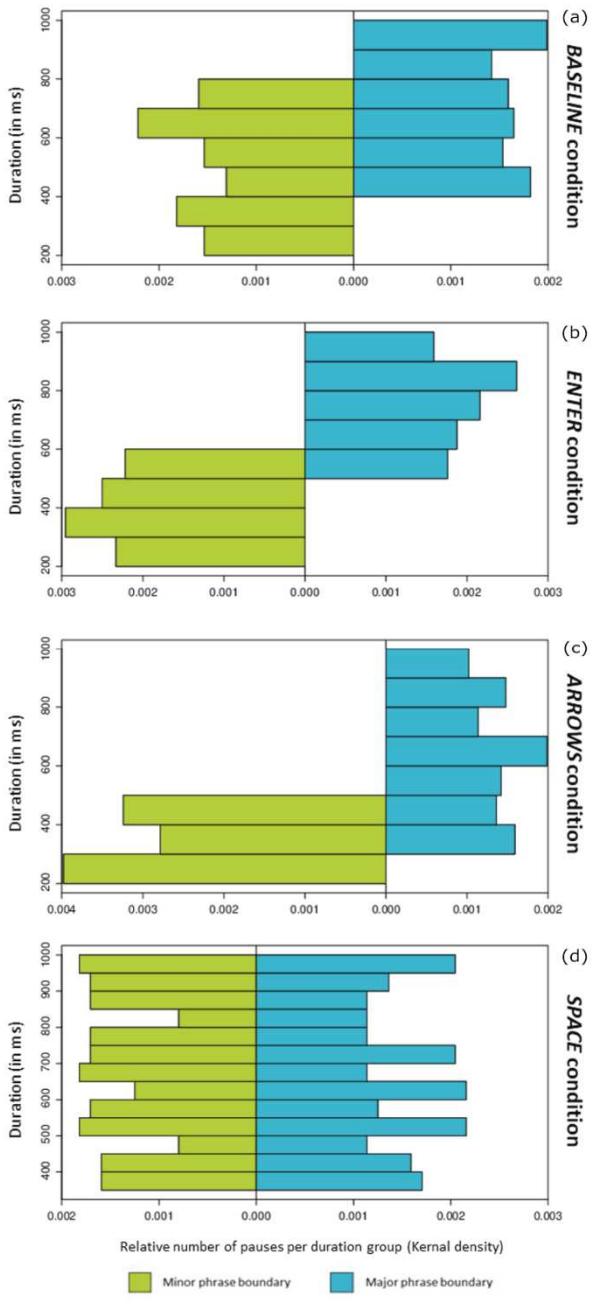

Fig. 1. Kernal Density plots for (a) the Baseline condition, as well as three test conditions: (b) Enter condition, (c) Arrows condition, and (d) Space condition. The relative number of pauses per duration group was used to account for the difference between minor phrase boundaries (N=22) and major phrase boundaries (N=13) per text (x48 in the Baseline condition; x8 in each of the test conditions). Note also that no pauses shorter than 200 ms and longer than 1000 ms are included.

ACKNOWLEDGMENTS

The authors would like to thank Nele Kiupel for her helpful comments. Thank you also to the participants of the study. The work of the first author was supported by the Federal State Grant Schleswig-Holstein of the University of Kiel.

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