

## SHOULD WE INCLUDE TERMS IN READABILITY FORMULAS OF SLAVONIC TEXTS?

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**Abstract:** In this article we show how readability depends on the number of terms. We compare two different physical-didactical texts. We explain what readability means and how readability of some didactical text can be checked. We will analyze texts of natural science. First, we use an eye tracker for measuring the time to read long terms average sized terms, and words that are not terms. We perform a cloze test. A comparison of results defined a variable of the readability formula of Slavonic physical texts.

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### Introduction and methods

Readability of didactical text of natural science is not the same like a readability of newspaper article and we can say, that readability of school text is difficult for students. It is well known that physical, biological, and mathematical texts are full of terminology or long words. The term, a technical term or terminological word denoting expressions are linguistic expression (word) that is in a particular field, craft or profession-specific, sharply defined meaning, for example: density, angle, etc. Moreover in Slavonic languages we have longer words than in English language (Škorecová, 2014).

In this article, we will show that long words and terms are important in didactical texts of natural science; though they require time to read. We define a variable of readability formula for Slavonic texts. In the next part, we choose two different didactical physical texts, each with a different number of terms. We then analyze by cloze test and show how readability depends on the number of terms.

### Eye Tracking

Eye tracking is the process of measuring either the point of gaze (where one is looking) or the motion of an eye relative to the head. Cambridge dictionary (2016) define eye tracker like “the activity of studying the way that people's eyes move in order to discover what, especially in advertisements, attracts their attention”. An eye tracker is a device for measuring eye positions and eye movement. Eye trackers are used in researching the visual system, in psychology, in cognitive linguistics, marketing and in study of natural sciences, too. Other methods use search coils or are based on the electrooculogram by Bulling (2009), Gneo, Schmid, Conforto, and D’Alessio (2012), and Ramiréz (2011).

### Readability

Readability is what makes some texts easier to read than others. If the readability of some text high, this text is more readable than some text with low readability. It is often confused with legibility, which concerns typeface and layout. Klare in 1963 defined readability like an easy way to understand a text because of typeface and style of writing. From similar point of view Gretchen Hargis and her colleagues at IBM defined readability in 1998 like. They said that readability is an ease of reading words and sentences (DuBay, 2004 & Hargis, 2000).

The creator of the SMOG readability formula G. Harry McLaughlin in 1969 say that readability depends on group of reading persons and how much this persons understand the text. ” This definition accent the interaction between the text and a class of readers of known characteristics such as reading skill, prior knowledge, and motivation (DuBay, 2004).

Edgar Dale and Jeanne Chall, in 1949, wrote other type of definition, more comprehensive: “The sum total (including all the interactions) of all those elements within a given piece of printed material that affect the success a group of readers have with it. The success mean, how much they understand text,

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read text at an optimal speed, and find main idea of text” (DuBay, 2004, The Principles of Readability).

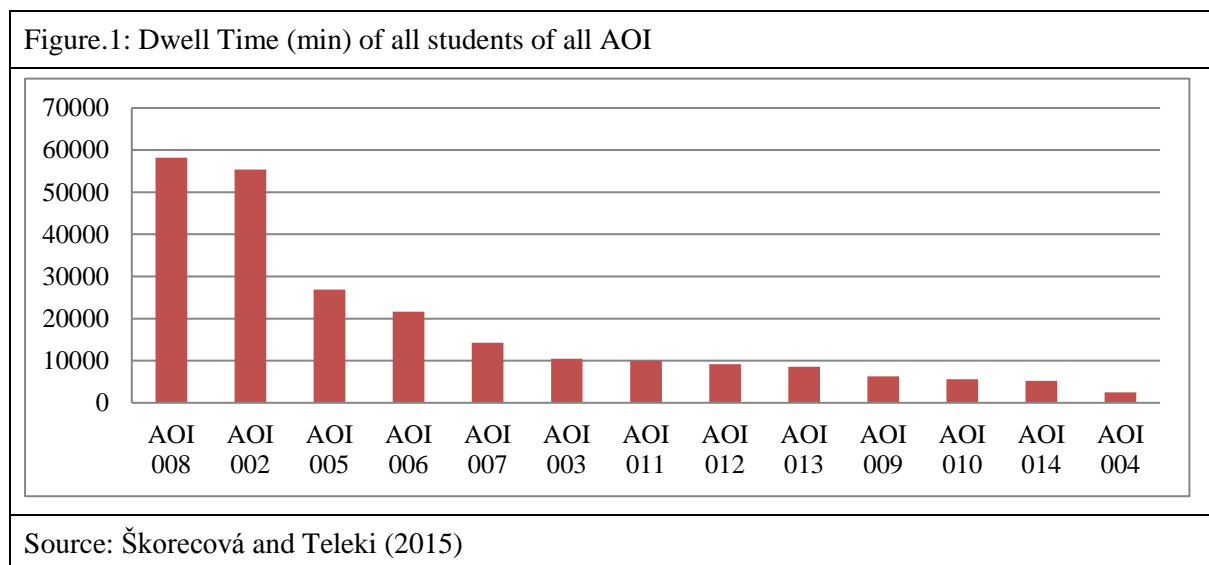
### Eye Tracking in Study of Readability

We used eye tracker to analyze part of readability of physical text. It is well known that analysis of readability components is very difficult. It depends on language and structure. It is known that analyzing poetical text is not the same as didactical or physical text. One question about analyzing physical text is: “Students give more attention of read long words? Long word is word with more than six letters. We try to offer answer on this question and our results we will present in next part. We choose didactical text and then we choose 15 areas of interest” (Gneo et al., 2012).

AOI	Word*	Number of letters
2	Termoreceptorami - thermoreceptors	16 ***
3	Zmysl - sense	5
4	Dotyku - touch	6
5	Zakończenia -finish	11 ***
6	Receptory bóli - pain receptors	13 ***
7	Receptory - receptors	9 **
8	Termoreceptory - thermoreceptors	14 ***
9	Twojej - your	6
10	Ucisk - pressure	5
11	Wrażliwe -sensitive	8 **
12	Zimny - cold	5
13	Chłodniej - cooler	9 **
14	Ruchy - movements	5

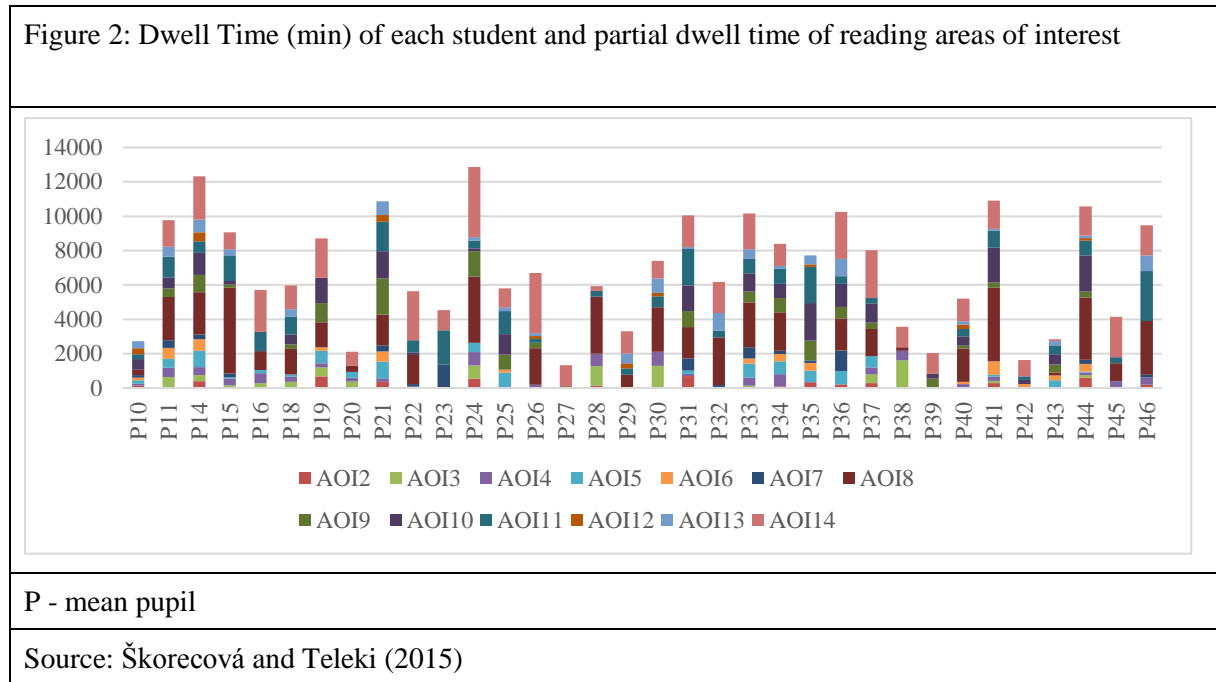
\* Short words, words with more than 6 letters and less than 10\*\*, words with more than 10 letters \*\*\*.

Source: Škorecová and Teleki (2015)



We noted that student spent a long period of time reading words with more than 10 letters. Analyzing the attention of interest (AOI, see Table 1), AOI-2, -5, -6, and -8. AOI-7 was remarkable, because they were terms. Our goal was to include terms into the readability formula. Figure 1 confirms our hypothesis.

The length of time spent for each student to read these areas of interest are shown in Figure 2.



In Figure 2, the AOI-2 and AOI-8 are shown as orange and dark brown color and in the Figure 5 is comparison of the dwell time of AOI 2 and AOI 8. We conclude that each student spent a long period of time to read this text, apart from students P20, P27, and P42. In our opinion these students did not read the text attentively. Because of this, we chose to exclude these three students from the statistics.

**Areas of interest (AOI)**

AOI-3 (Figure 3.) is word ‘zmysl’ with five letters. It is a short word, but is the first word of the title. Thus, we expected this word would require more attention of the students. However, this word was shorter than the next word ‘dotyku’, which would take more attention. From another point of view ‘zmysl’ is a term, so we plan to include this type of word into readability formula.

AOI-5 (Figure 4.) is word ‘zakończenia’ with 11 letters. It is a long word, but not a term. More than 50% of students spent more than 500 min to read this word. Thus, this type of word should be included into the readability formula.

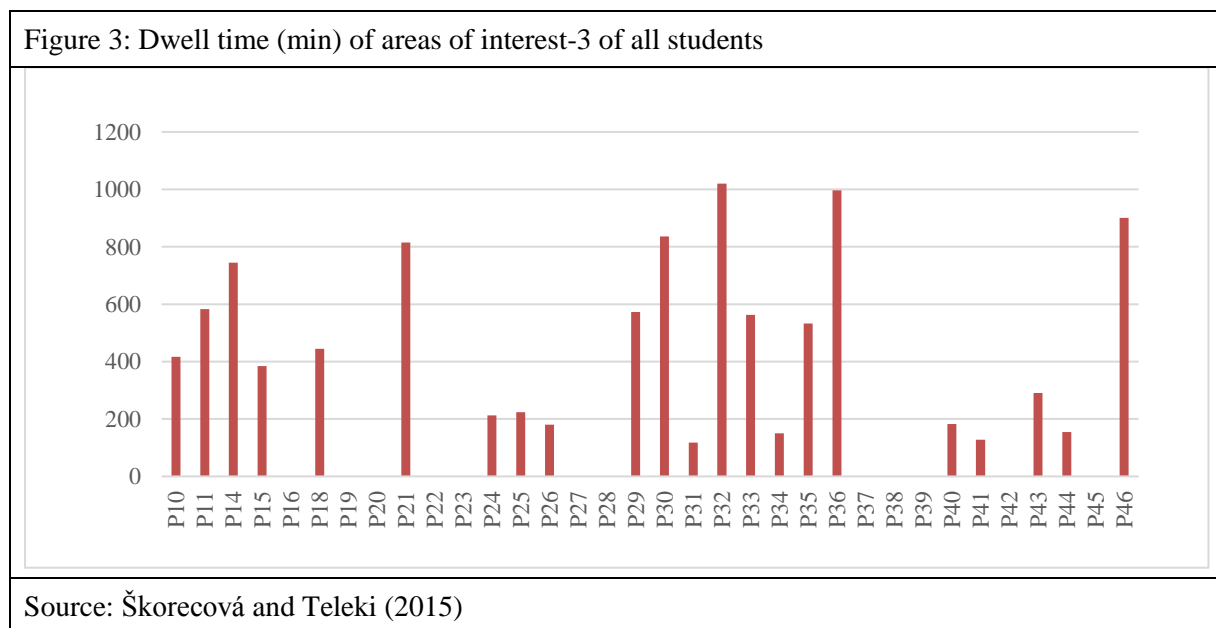
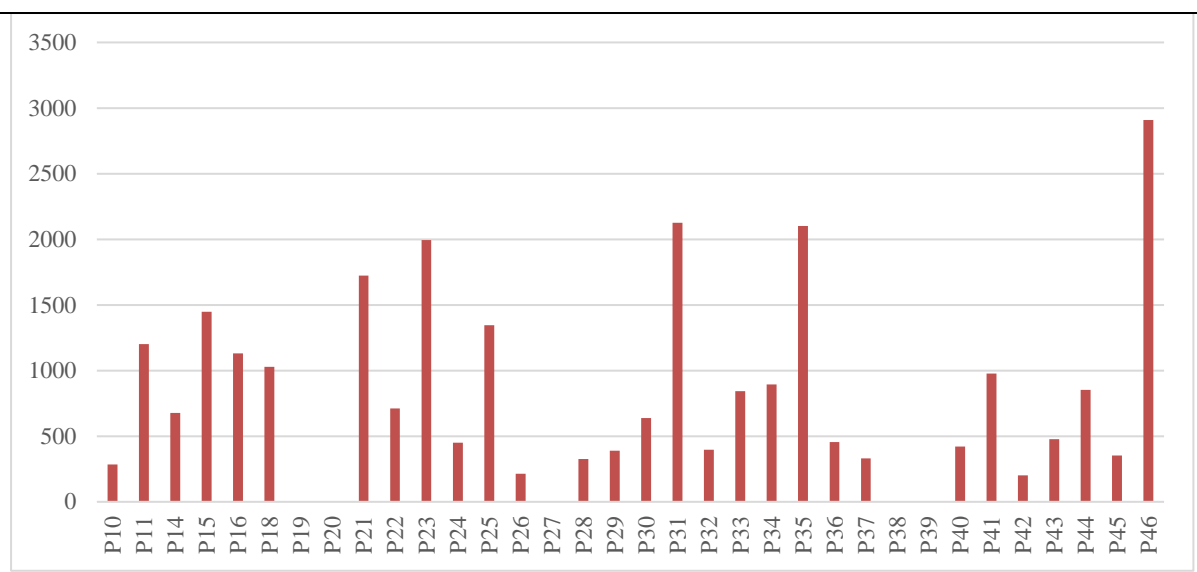


Figure 4: Dwell Time [ms] of AOI 5 of all students



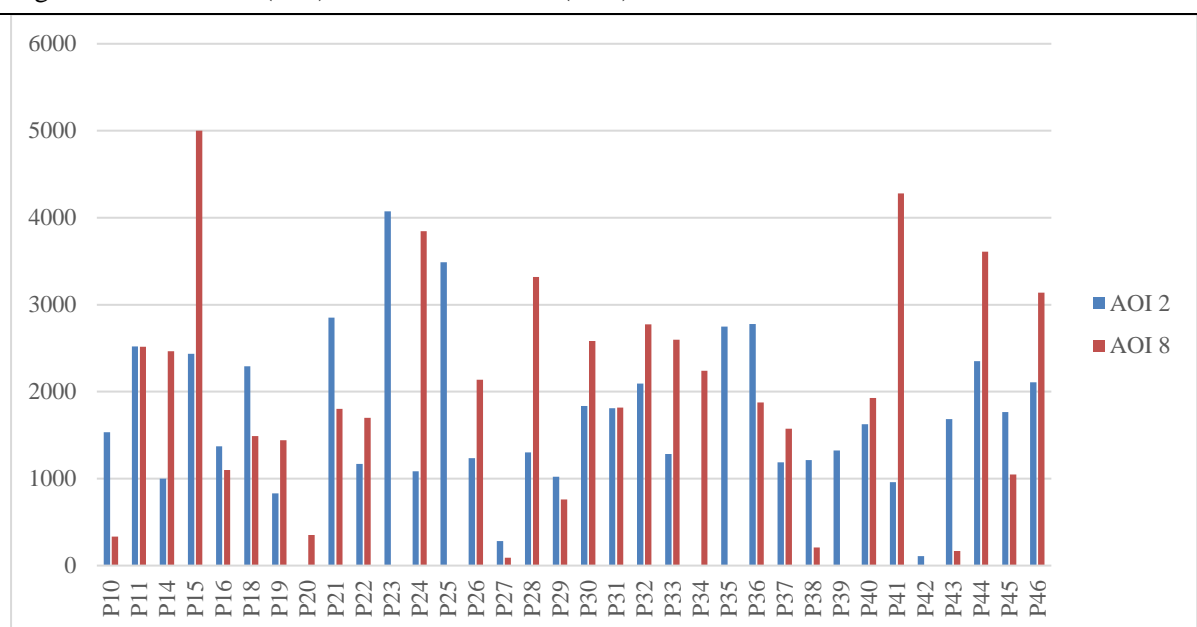
Source: Škorecová and Teleki (2015)

#### Comparison of AOI-2 and AOI-8

The results show AOI-2 and AOI-8 are similar. In these areas, the words ‘termoreceptorami’ and ‘termoreceptory’ occur.

In conference some persons said, that where a student reads the same word a second time or more, they need less time to read the word. We can’t accept this idea without some measure, Figure 4 shows the results of our measurement.

Figure 5: Dwell time (min) of areas of interest (AOI)2 and AOI-8 of all students



Source: Škorecová and Teleki (2015)

In the group of 34 students, two students needed equal time and 13 needed more time to read AOI-2, compared to that for AOI-8. However, 19 students needed more time to read AOI-8. In some cases, namely for student, P 15, P 28, and P 41, the time needed was more than three times greater.

Therefore, we expect that the frequency of long words and terms are important from the view point of readability. In addition, where a word is mentioned in the text two to four times, to the word should be included into the formula to attract the attention of the reader.

### Readability of Physical Didactical Text

In this part, we chose two didactical physical texts. Both are about the same topic, but contain a different number of terms. We analyse the readability using the method of cloze tests (Klare,1984; Šrajerová & Gavora, 2008, p. 209).

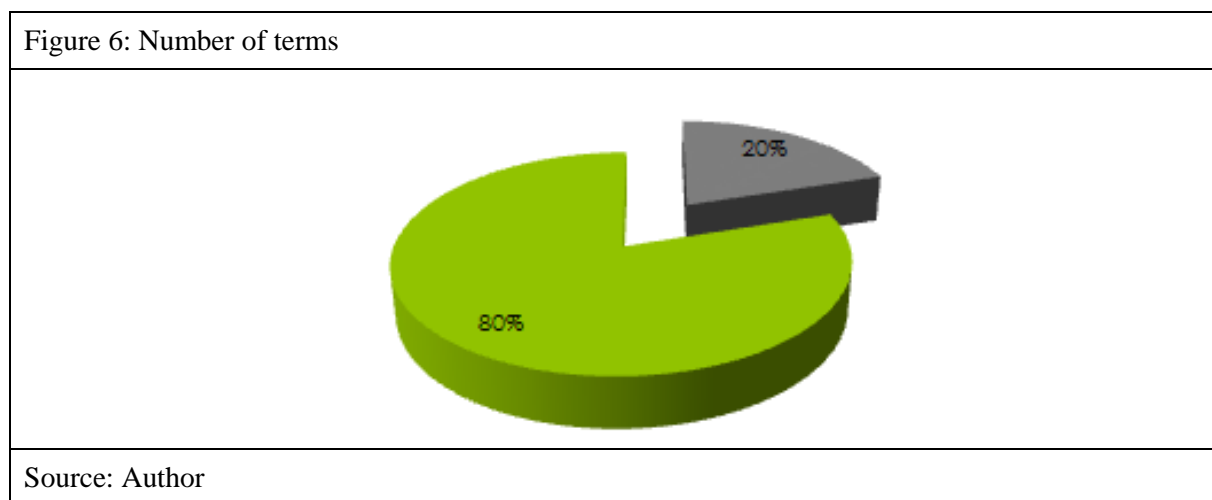
The first text is from the textbook for high school students and second, from a textbook for undergraduate students, as follows:

1. JÁN PIŠÚT, VÁCLAV FREI Et al.- Physics for 4<sup>th</sup> grade of high schol (Pišút, 1993)
2. R. P. FEYNMAN, R. B. LEIGHTON, M. SANDS: The Feynman Lectures on Physics in Slovak language (Feynman, 1986)

#### The Pišút's Text

This text (Pišút, 1993, pp. 15-17) is about reflection and refraction of light, including the refractive index. We highlighted the physical terms in yellow shading.

Table 2: Statistical analyze of the Pišút 's text	
<b>Syllable Count</b>	896
<b>Word Count</b>	528
<b>Sentence Count</b>	38
Source: Author	

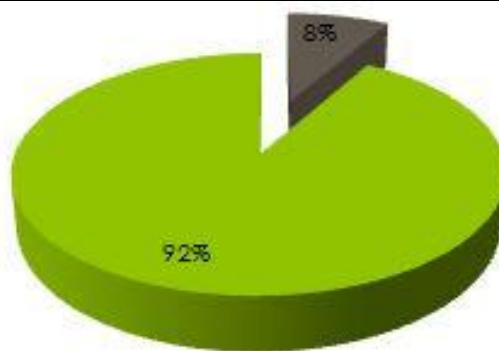


#### The Feynmann's Text

This text (Feynman, 1986, p.8-10) is about reflection and refraction of light, also. We highlighted physical terms also.

Table 3: Statistics of the Feynmann 's text	
<b>Syllable Count</b>	870
<b>Word Count</b>	495
<b>Sentence Count</b>	43
Source: Škorecová, 2016	

Figure 7: Number of terms

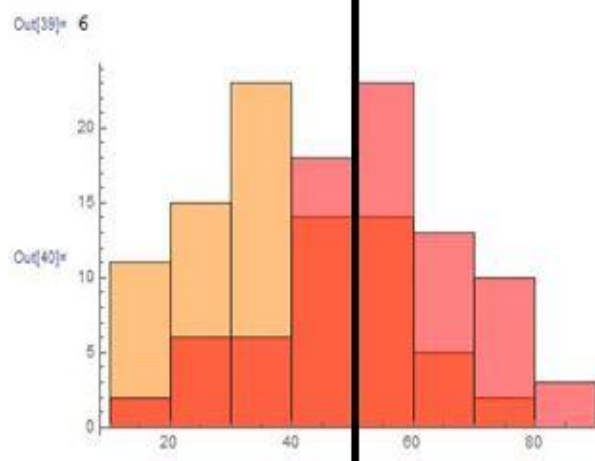


Source: Author

### Cloze Test

We analyzed the readability using the cloze test, which is a test of the ability to comprehend text in which the reader has to supply the missing words that have been removed from the text at regular intervals (Dubay, 2004; Šrajerová & Gavora, 2009). We performed the test on results from a group of 150 students. The ‘right answer’ in the cloze test was deemed to be the same word as in the original text, or its synonym as well as without grammatical error.

Figure 8. Results of cloze test



Source: Author

The orange bars in Figure 8 presents the readability of the first text (Pišút), expressed by the success of students, based on the cloze test. Most students had success between 30 and 40%. The red areas in Figure 8 show the readability of the second text (Feynman) and most students had success between 50 and 60%.

A maximum of this function lying on the right side of the graph, indicates the text is more readable. Thus, the second text (Feynman) is shown as more readable than the first (Figure 8).

### Definition of Variable

We suggest there is a need to include terms (short and long) into the readability formula, based on the results of this study.. These words (terms) required a greater length of time for reading. Therefore, long ‘non-term’, for example: your, put, take (those words are longer in Slavonic languages) words need inclusion into the readability formula, also. Including terms is the difference between the Flesch Kinkaid readability formula and new readability formula for Slavic didactical texts.

## Conclusion

In accordance with our expectations, long words and terms need inclusion in a readability formula for Slavic didactical texts. A text of natural science is difficult text containing numerous terms and where the author uses several terms and long words, the text will become unreadable for 90% students. The eye tracking method showed how a long word or term require attention. Long words and terms need to be included in a readability formula for Slavic texts. We showed, that higher frequency of terms resulted in the text being less readable and that Feynman's texts was more readable than Pišút's. This method allows teachers, authors, or other individuals to check text for readability. This method takes less time to perform than the cloze test method. In a short time, the program provided a graph of the results.

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