An Analysis of Articulation Rates in Movies

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1. Introduction

We analyzed the articulation rates (AR), i.e., the speed of speaking determined by measuring the speaking rate (SR) in a unit of speech and subtracting any long pauses, in a number of selected movies and other media in an investigation of the following problems:

- What is the AR in various movies?
- What is a natural speaking rate?
- Is the AR different in recent movies and in older movies?
- Is the AR different in different movie genres, and in live-action and animation?
- How does the AR in movies compare with other spoken media, such as standard news programs, news programs for language learners, and stories for children?

The perception of how fast people are speaking can be quite subjective, and is related to the amount of exposure to and experience in the language spoken. “People speak really fast in action movies and comedies,” and “I can’t follow what is being said in recent movies; they spoke slower in the old movies” are typical comments we as language teachers have often heard. However, as there has been no data-base available of movie speech speeds, to the best of our knowledge, we have been unable to either commiserate or clarify.

This research hopes to remedy the situation, with an objective study of AR in 11 movies: 3 “human drama” films (A Beautiful Mind, The Hours, Out of Africa), 1 action film (The Bourne Identity), 2 animation films (Ratatouille, Monsters Inc), 3 classics (Roman Holiday, The Seven Year Itch, The Apartment), and 2 comedies (Back to the Future, Legally Blonde), as well as 1 episode each from 3 TV dramas (Sex and the City, Full House, Columbo). We further compare the results with speeds recorded from VOA and CNN English news, VOA Special English (for language learners), and the children’s story, Frog and Toad Together by Arnold Lobel.

2. Method

A number of analytical units have been used in language research, which Foster, Tonkyn, & Wigglesworth (2000) described as based on semantics, such as the proposition, c-unit (communication unit), and idea unit (with semantic focus), or on intonation, such as the tone unit, idea unit (with intonation focus), and the utterance, or on syntax, such as the sentence, the idea unit (with structure focus), and the T-unit
Foster, Tonkyn, & Wigglesworth (2000) were unsatisfied with any of these and recommended the analysis-of-speech unit (AS-unit), where they counted as two units any sentence which contained a falling intonation plus a pause of over 0.5 seconds, and eliminated from the calculation false starts and self-corrections. Other units of speech have also been used for measurement, such as the turn unit, the clause, the clause complex, and fragments.

It is often difficult to decide where sentence boundaries appear in spoken language, and speech is often very fragmented in incomplete phrases, so researchers who analyze the development of children’s or other language learners’ discourse -- the complexity and length of their grammar usage -- need to use such discrete units. We, on the other hand, were primarily interested in studying how fast people are speaking, not the complexity of their speech, so we chose for the base of calculation the unit of speech which could most easily be identified as a sentence, whether it was grammatically correct or not. Thus, phrases without subjects or verbs, and uncompleted sentences were included. The sentence, in this loose definition, we decided, would produce the most useful data for our target language learners and teachers, who are interested in knowing how fast sentences are spoken; the sentence being the unit of measurement that they are most familiar with. We referred to the printed text of the scenario when in doubt about what constituted a sentence. We did not measure utterances of less than 4 syllables, because we did not feel they were useful to our purpose. We counted as one unit any sentence which had sections connected with “and” or “or.” (Measured by T-unit, etc., the sections would be counted as separate units.) We did not eliminate false starts, self-corrections, stumbles, etc. We eliminated from calculation any pause of over about 0.5 seconds within the sentence. In our research, a total of 11,877 sentences were analyzed.

These are some sentences from The Seven Year Itch: *Gotta get back to the office. *Oh, thank you, sir. *So much nicer here. *Why, thanks, I’d love it. *Ice, ice, we’ll need ice! *Oh, of course, the tomato. *No sugar in a martini, ever. *And furthermore, may I point out to you, sir, that all of Meyerheim’s victims were middle-aged women! *You wouldn’t believe this, but last night, I found myself...terrorizing a young lady. *He happens to be a private eye...named Johnny Dollar. *She said, “Darling, what’s that on your collar? Cranberry sauce?”

A common unit of measurement of speech rate is words per minute (e.g., Griffiths 1990); however, misinterpretations in measurement may result, particularly when the length of a run of speech between pauses, is under a minute, as is often the case in conversations. Phonemes per second (e.g., Smith, Brown, Strong, & Rencher 1975), and syllables per second (e.g., Kowal et al. 1983), are more suitable to measure short speech. We chose syllables per second (sps) as they were easier to count than phonemes.

We compiled our data using WaveSurfer, an Open Source software for sound visualization and manipulation, developed by the Centre for Speech Technology (CTT) at the KTH Royal Institute of
Technology, Stockholm. *Figure 1* shows a representation of a speech sample on the WaveSurfer. We counted the syllables uttered in a run of speech (measured in sentences), deducted the pauses, and divided by the speech time in seconds, to obtain the SPS.

![WaveSurfer screenshot](image)

*Figure 1. Measuring the speech time of a sentence on the WaveSurfer.*

Measurement

1. We looked for the beginning of the sentence (a) and the end (b), and calculated the length in seconds measured to two decimal points.
2. We counted the syllables, not from a written source, but as much as possible practically from what was heard.
3. We calculated the syllables spoken per second, with fractions rounded up to one decimal point.
4. In runs of speech, there are often pauses, indicating breaks for thinking, intentional pauses, etc. To calculate a more accurate “natural” speed, we eliminated these pauses in the calculations. As shown in *Figure 2*, the silent section (cd) within the total run of speech (ab), was deducted. In cases of multiple pauses, their total length was deducted.
5. Only runs of over 4 syllables were counted. Thus phrases like “I know,” “I don’t know,” “Sure I will,” “I think so,” and “I could tell,” were not included in the survey. Also excluded were the following types of utterances: shouts, repetitions of the same word, background voices, and utterances overlapping other utterances and therefore difficult to distinguish.
3. Result

The results of our calculations are shown in the following histograms and boxplots.

**Figure 2.** Eliminating the silent section from the total speech time.
### Out of Africa

**Quantile**
- 100.0% Maximum Value: 8.5000
- 99.5%: 8.2000
- 97.5%: 7.5875
- 95.0% Upper quartile: 6.8000
- 50.0% Median: 4.9000
- 25.0% Lower quartile: 4.2000
- 10.0%: 3.4000
- 2.5%: 2.9000
- 0.5%: 2.5000
- 0.0% Minimum Value: 2.2000

**Moments**
- Mean: 5.0260956
- Standard Deviation: 1.2238068
- Standard error of the mean: 0.038623
- Upper confidence limit for the mean (95%): 5.1018868
- Lower confidence limit for the mean (95%): 4.9503045
- N: 1004

**Probit Analysis / Parameter Estimation**
- Location: 
  - Mu: 5.026096
  - 95%LCL: 4.950304
  - 95%UCL: 5.101887
- Dispersion: 
  - Sigma: 1.223807
  - 95%LCL: 1.172520
  - 95%UCL: 1.279820

**Goodness-of-Fit Test**
- Shapiro-Wilk W test: 0.971086

### Seven Year Itch

**Quantile**
- 100.0% Maximum Value: 8.7000
- 99.5%: 8.0000
- 97.5%: 7.9955
- 95.0% Upper quartile: 7.5025
- 50.0% Median: 6.6000
- 75.0% Lower quartile: 5.9000
- 10.0%: 3.7000
- 2.5%: 3.0000
- 0.5%: 2.5000
- 0.0% Minimum Value: 2.0000

**Moments**
- Mean: 5.159233
- Standard Deviation: 1.111643
- Standard error of the mean: 0.029625
- Upper confidence limit for the mean (95%): 5.217348
- Lower confidence limit for the mean (95%): 5.101118
- N: 1408

**Probit Analysis / Parameter Estimation**
- Location: 
  - Mu: 5.159233
  - 95%LCL: 5.101118
  - 95%UCL: 5.217348
- Dispersion: 
  - Sigma: 1.111643
  - 95%LCL: 1.072048
  - 95%UCL: 1.154297

**Goodness-of-Fit Test**
- Shapiro-Wilk W test: 0.984218

### Bourne Identity

**Quantile**
- 100.0% Maximum Value: 8.5000
- 99.5%: 8.2000
- 97.5%: 7.5875
- 95.0% Upper quartile: 6.8000
- 50.0% Median: 4.9000
- 75.0% Lower quartile: 4.2000
- 10.0%: 3.4000
- 2.5%: 2.9000
- 0.5%: 2.5000
- 0.0% Minimum Value: 2.2000

**Moments**
- Mean: 5.3037604
- Standard Deviation: 1.0864448
- Standard error of the mean: 0.040546
- Upper confidence limit for the mean (95%): 5.3835831
- Lower confidence limit for the mean (95%): 5.2241378
- N: 718

**Probit Analysis / Parameter Estimation**
- Location: 
  - Mu: 5.303760
  - 95%LCL: 5.224158
  - 95%UCL: 5.383583
- Dispersion: 
  - Sigma: 1.0864448
  - 95%LCL: 1.030510
  - 95%UCL: 1.145754

**Goodness-of-Fit Test**
- Shapiro-Wilk W test: 0.973275

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Ratatouille

Quantile
- 100.0% Maximum Value: 7.5000
- 99.5% : 7.3000
- 97.5% : 6.8000
- 90.0% Upper quartile: 5.8000
- 75.0% Median: 4.9000
- 25.0% Lower quartile: 3.5000
- 5.0% : 2.5000
- 0.5% Minimum Value: 1.7500
- 0.0% : 1.5000

Moments
- Mean: 4.337864
- Standard Deviation: 1.117182
- Standard error of the mean: 0.0355243
- Upper confidence limit for the mean (95%): 4.377598
- Lower confidence limit for the mean (95%): 4.238175
- N: 989

Probit Analysis / Parameter Estimation

Goodness-of-Fit Test: Shapiro-Wilk W test
- W: 0.978098
- P Value(Probs(W)): <.0001

Roman Holiday

Quantile
- 100.0% Maximum Value: 8.5000
- 99.5% : 7.9440
- 97.5% : 7.5000
- 90.0% Upper quartile: 6.5000
- 75.0% Median: 5.6000
- 25.0% Lower quartile: 4.3000
- 10.0% : 3.1000
- 5.0% : 2.4000
- 0.5% Minimum Value: 2.1280
- 0.0% : 2.0000

Moments
- Mean: 4.730992
- Standard Deviation: 1.287045
- Standard error of the mean: 0.050289
- Upper confidence limit for the mean (95%): 4.829739
- Lower confidence limit for the mean (95%): 4.632245
- N: 655

Probit Analysis / Parameter Estimation

Goodness-of-Fit Test: Shapiro-Wilk W test
- W: 0.966971
- P Value(Probs(W)): <.0001

Legally Blonde

Quantile
- 100.0% Maximum Value: 7.9000
- 99.5% : 7.8000
- 97.5% : 7.0000
- 90.0% Upper quartile: 6.1000
- 75.0% Median: 5.3000
- 50.0% Lower quartile: 4.9000
- 10.0% : 3.4000
- 5.0% : 2.4000
- 0.5% Minimum Value: 2.1280
- 0.0% : 2.0000

Moments
- Mean: 5.391702
- Standard Deviation: 1.116342
- Standard error of the mean: 0.052759
- Upper confidence limit for the mean (95%): 5.492461
- Lower confidence limit for the mean (95%): 5.290433
- N: 470

Probit Analysis / Parameter Estimation

Goodness-of-Fit Test: Shapiro-Wilk W test
- W: 0.967943
- P Value(Probs(W)): <.0001
### A Beautiful Mind

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### Columbo

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#### Probit Analysis / Parameter Estimation

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#### Goodness-of-Fit Test

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### VOA/CNN

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#### Probit Analysis / Parameter Estimation

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Median of 14 movies: 5.10 sps

3 “human drama” films (A Beautiful Mind 5.4 sps, The Hours 4.9 sps, Out of Africa 4.9 sps)

1 action film (The Bourne Identity 5.2 sps)

2 animation films (Ratatouille 4.3 sps, Monsters Inc 4.6 sps)

3 classics (Roman Holiday 4.7 sps, The Seven Year Itch 5.1 sps, The Apartment 5.8 sps)

2 comedies (Back to the Future 5.3 sps, Legally Blonde 5.3 sps)

3 TV dramas (Sex and the City 5.0 sps, Full House 4.9 sps, Columbo 5.3 sps)

VOA and CNN English news 4.7 sps

VOA Special English 3.2 sps

Frog and Toad Together 2.9 sps
4. Discussion

General Discussion.

The median AR in the 14 movies, calculated from over 10,963 sentence units, was 5.1 sps. This figure cannot be assumed as the normal distribution (Kolmogrov-Smirnov Lilliefors Test P=0.0100); but, as the average and the median are close, and the distribution is relatively symmetrical on both sides. Robb et al. (2004) list a number of research works showing that adult speakers of American English have an overall SR of about 4.2 sps and an AR of about 5.3 sps. Our result is quite similar.

Looking at the individual movies, the median ranges from 4.3 sps to 5.8 sps. Five movies can be considered as conforming to this normal distribution and 9 cannot. The lines of dialogue in movies for the most part are spoken by the actors in the leading roles, and, next, by the actors in supporting roles. How the characters are depicted is of course a major feature of movies. A character in a leading role who speaks very slowly makes the entire movie AR slow, and the reverse is also true. As there is an endless variety in the leading and supporting characters, we imagine that there will be various graphs of speech speed. It would nonetheless fall within the scope of argument that many and perhaps most movies of the same genres would be represented by more or less similar graphs.

For other media, there may be a narrower range of normal distribution. *Frog and Toad Together*, a story read for children at 2.9 sps, may be similar to other children’s stories. VOA Special English, for adult learners of English at 3.2 sps, may be similar to other language learning media. VOA/CNN news programs at 4.7 sps may be similar to other news programs. Maeda (2000) investigated AR in English language learning media, and found ranges of 3.53 to 4.24 sps in 4 products produced for Japanese junior high school classes, ranges of 4.09 to 4.86 in 5 “false beginner” products, and ranges of 4.59 to 5.02 in 3 intermediate products. Maeda also recorded 6.00 sps for a CNN interview.

From studying the graphs, one thing seems certain: there is no speed for conversation which may be called definitely “normal.” We may imagine that news is read at a constant speed, but our graph shows a range of 2.9 to 7.0 sps for VOA/CNN, and from 2.2 to 4.5 sps for VOA Special English. A characteristic of conversation is obviously that it is sometimes slow and sometimes fast. While our study was based on measuring the speed of sentences as units, we noticed that even within sentences there could be a range of speech speed. Figure 3 shows an example from The Apartment.

![Figure 3. Speech rate varies within a sentence.](image-url)
This phenomenon is easily understandable, in that when a character speaks with excitement or urgency, the speed is fast, and when a character wants to calm someone down or wants to convey momentous information, the speed is slow. It is obvious that emotions are expressed not just by pitch and stress but also by speed of speech. Speech with no pitch and stress and at a constant speed is the way 1950s sci-fi movie robots speak, and sounds unnatural and artificial.

While we had rather hoped to find a “natural speed” and claim that this is the speed of natural conversation, we must admit that natural speed comes in slow and fast versions, and is distributed in a range. We may suggest that 5.1 sps is nearest to an average speed, but do not suggest that only speeds near 5.1 are natural, and others are unnatural. However, we do not consider as “natural” the speed of speech in media such as *Frog and Toad Together* and VOA Special English which are intentionally spoken slowly.

We need to further investigate where a “natural speed” distribution might lie, together with where the median may be, and what may be considered as “slower than natural” and “faster than natural.” *Figure 4* shows what a natural speed distribution might look like, though we were unable to determine the limits in the current study.

![Figure 4. Where is the “natural speed”?](image)

Comparison of Movie Genres

“Comedies and action films are fast, so they are not the best choice for beginners” is a general comment we have often heard. In this study, we attempted to see if we could find differences in speaking speeds in different genres. It is necessary to analyze a large number of movies to get a reliable result. With a small number of selected movies, the results will be dependent on the actual movies and
episodes selected, and perhaps not be especially valid. However, for our study we have proceeded with just a small sample to try to obtain at least a preliminary result. The comedies we analyzed, *Seven Year Itch* (5.1sps), *Back to the Future* (5.3sps), and *Legally Blonde* (5.3sps), all have similar rates, and not too different from the median of all 14 films. The action film, *The Bourne Identity* (5.2sps), also was a similar rate. We consider these rates do not support a theory that comedies and action films are necessarily fast just because they are in those categories. The scenes in these movies may appear to develop rapidly, and there are many intense scenes, as well as certain characters who speak rapidly, so we think that the movies overall may give an impression of speed.

As for classic movies, *Roman Holiday* (1954) was a relatively slow 4.7sps, while *The Seven Year Itch* (1955) at 5.1sps was completely average. *The Apartment* (1960) at 5.8sps was quite a bit faster than the 14 film average. We thus cannot say that an old movie, just because it is old, is slower than a newer movie. We must look for other explanations for the impression, such as older movies are easier to understand than newer ones.

The animation films, *Monsters Inc* (4.6sps) and *Ratatouille* (4.3sps), were clearly slowly than the average, so we might be able to state that animation films are relatively slow, compared to other films. However, with VOA/CNN news at 4.7sps, we must keep the condition as “compared to other films.” We can also understand that non-native speakers may not get the impression that animation films are slow.

Some people may have the impression that TV dramas are relatively slow. However, *Full House* (4.9sps), *Sex and the City* (5.0sps), and *Columbo* (5.3sps) were not much different from the average.

The human dramas, *Out of Africa* (4.9sps), *A Beautiful Mind* (5.4sps), and *The Hours* (4.9sps) were also quite average speed. One of the main characters in *Out of Africa*, a Danish non-native English speaker, spoke at a median speed of 4.7 sps, and African characters also spoke rather slowly, but the movie in its entirety was near the average of all the films.

5. Conclusion

We measured and analyzed the speaking rates in a number of films and other spoken media. We found a median rate of 5.1 sps, but were unable to confirm if this may be considered to be a natural speaking rate. Rather, we conclude that natural speed contains a range of slower and faster speeds. The combination and arrangement of sometimes slower and sometimes faster may give an impression of a natural speed. Consequently, it is not easy to judge if the speed of speech is natural or not just by looking at the speed rate. Our data does not support the general impression some people may have that comedies are fast, and older movies are slow. Our data does suggest that animation films, whose audience can be supposed to be mainly children, are a little slower than average. As could be expected, news for language learners and audio recordings aimed specifically at children, were relatively quite slow. That standard
news programs are also relatively slow suggests that they are aimed at providing information in a deliberate fashion so that viewers can comprehend the information more easily, and their relatively narrow range of speed suggests that news announcers do not purposely get excited, etc., and speak fast, or get tired or moody, etc., and speak slowly. We would like to analyze more films to develop and confirm the findings from this present research and to provide useful information for teachers and learners who want to choose films appropriate to levels of ability.

**Acknowledgments**

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**References**


**Appendix**

Movies and TV shows analyzed, in alphabetical order. They were selected rather randomly from movies that are readily available and fairly well-known in Japan, and from TV shows that have been broadcast several times on TV and are also available on DVD.

<table>
<thead>
<tr>
<th>Title</th>
<th>Country</th>
<th>Release Year</th>
<th>Director</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apartment, The</td>
<td>USA</td>
<td>1960</td>
<td>Billy Wilder</td>
</tr>
<tr>
<td>Back to the Future</td>
<td>USA</td>
<td>1985</td>
<td>Robert Zemeckis</td>
</tr>
<tr>
<td>Beautiful Mind, A</td>
<td>USA</td>
<td>2002</td>
<td>Ron Howard</td>
</tr>
<tr>
<td>Film Title</td>
<td>Country</td>
<td>Year</td>
<td>Director</td>
</tr>
<tr>
<td>------------------------------------------</td>
<td>---------</td>
<td>-------</td>
<td>-------------------</td>
</tr>
<tr>
<td>Bourne Identity, The</td>
<td>USA</td>
<td>1988</td>
<td>Roger Young</td>
</tr>
<tr>
<td>Columbo (Etude in Black)</td>
<td>USA</td>
<td>1972</td>
<td>Nicholas Colasanto</td>
</tr>
<tr>
<td>Full House (Silence is not Golden)</td>
<td>USA</td>
<td>1993</td>
<td>Joel Zwick</td>
</tr>
<tr>
<td>Hours, The</td>
<td>USA</td>
<td>2003</td>
<td>Stephen Daldry</td>
</tr>
<tr>
<td>Legally Blonde</td>
<td>USA</td>
<td>2002</td>
<td>Robert Luketic</td>
</tr>
<tr>
<td>Monsters Inc</td>
<td>USA</td>
<td>2002</td>
<td>Peter Docter</td>
</tr>
<tr>
<td>Out of Africa</td>
<td>USA</td>
<td>1986</td>
<td>Sydney Pollack</td>
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<tr>
<td>Ratatouille</td>
<td>USA</td>
<td>2007</td>
<td>Brad Bird</td>
</tr>
<tr>
<td>Roman Holiday</td>
<td>USA</td>
<td>1954</td>
<td>William Wyler</td>
</tr>
<tr>
<td>Seven Year Itch, The</td>
<td>USA</td>
<td>1955</td>
<td>Billy Wilder</td>
</tr>
<tr>
<td>Sex and the City (Season 1 Episode 1)</td>
<td>USA</td>
<td>1998</td>
<td>Susan Seidelman</td>
</tr>
</tbody>
</table>

**Abstract**

We analyzed the speaking speed in 11 movies, 3 TV dramas, and TV news programs and children’s stories. We found a median rate of 5.1 for the movies and dramas; however, we were unable to confirm that 5.1 is a natural speed, because different scenes and different characters were faster and slower. We did not find that comedies, action films, or classic movies were necessarily faster or slower than the average, though a preliminary finding was that animation films were somewhat slower. We found that news programs were also relatively slower than films.