

# On Fluency: Perspectives From Aphasiology and Second Language Acquisition Research

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## Abstract

Fluency is a long-debated notion in linguistics, as it plays a crucial role in second language acquisition (SLA) research and applied linguistics. Starting from some recent discussions on the topic, this paper examines whether aphasiology could benefit from insights from these fields of study. First, we will summarize the most relevant views on fluency concerning aphasic speech. As we will see, every account of fluency has two common features: some reference to speech timing, and some reference to anomia. Nonetheless, fluency as a whole still remains nothing more than an intuition, since no model has implemented a satisfactory definition of it. We argue that the reason behind this decades-long uncertainty is because its two main components -time and retrieval- pertain to two distinct levels -namely speech and language- and therefore cannot be judged on the same scale. To show our point, we will briefly pass in review studies on time patterns in aphasic speech and see whether it is possible to draw a distinctive behavior compared to non-pathological speech. We will then move to anomia and see how the matter has been approached in second language research, especially in fluency modeling. While certainly not relatable on several issues, we believe that some key outcomes in linguistic fluency can be adapted to aphasia research, and offer new perspectives on aphasic speech evaluation and understanding.

**Keywords:** Fluency, Aphasia, Second language acquisition

## 1. Introduction

### 1.1 Fluency in Aphasiology

Diagnostic tests like the BDAE (Goodglass et al. 2001), the AAT (Hueber et al., 1984), and the WAB-R (Kersetz, 2006) all come with some fluency scale or measurement. Researchers have compared different scales among test batteries (Wertz et al. 1984), ratings within the same test (Trupe, 1984), and between test scores and auditory perception (Swindell et al. 1984; Holland et al. 1986; Gordon, 1998; Clough, Gordon, 2020). In most cases, they found no agreement on fluency across different scales and methods, and, as we know, results can rely on the experience of raters and clinicians.

Most of the time, fluency has been associated with other traits, which are generally symptoms of underlying issues. The BDAE fluency scale covers melody, utterance length, articulation, grammaticality, paraphasias, and word-finding ability. The WAB rates grammatical competence, paraphasia, and fluency -that includes prosody, word-finding ability, grammaticality, and articulatory effort as well (for a review, see Clough, Gordon, 2020). Casilio et al. (2019) suggest that four macro categories encompass the most relevant features in the perception of fluency: Paraphasia, Logopenia, Agrammatism, and Motor Speech. Some features may overlap (e.g., neologisms, and both semantic and phonological paraphasias), and raters are asked to judge the surface features rather than the underlying deficit that may cause them: short and simplified utterances and reduced speech rate both can result from either speech or language deficits. Features strongly associated with Paraphasia are abandoned utterances, empty speech, semantic and phonemic paraphasias, neologisms, jargon, paragrammatism, retracing, and false starts: the authors argue that all these features stand for some incorrect semantic, syntactic, or phonological selection and that they mostly occur in fluent aphasia, but they can also be observed in non-fluent patients as well. Non-fluent speech appears to be characterized by Agrammatism, Logopenia, and Motor Speech: it is important to note that, except for anomia in Logopenia and apraxia in Motor Speech, these last two categories largely overlap, since halting and effortful speech, reduced speech rate, and pauses both between and within clauses are all common features between the two. On the other hand, agrammatism seems to be a constant factor among clusters, while the Speech Motor cluster really is just a set of surface features, so that the framework conflates peripheral traits and underlying language processes into one level.

The issue with suprasegmental analyses, especially above the lexical unit level, is that most of the time there is no real one-to-one relationship between speech production and different language domains so that it is almost impossible to demonstrate that one feature, say silent pauses or speech rate, is the one correlate of that one specific deficit. The disentanglement is so hard but at the same time so needed, that we oftentimes fail to make a distinction between the issue itself and the strategy one adopts to bypass it. In other words, we seem to lose the cause-effect relationship along the way, so much so that the very same impairment can have more “fluent” outcomes, like paraphasia or neologisms, or less “fluent” -namely non-fluent-outcomes, such as long pauses and effortful speech. Furthermore, there can be a tendency at overlooking linguistic theory from a purely diagnostic point of view, and that entails

seemingly circular definitions. The mean length of utterance, for example, is believed to heavily depend on grammatical complexity in Clough, Gordon (2020), whereas their definition of “grammatical complexity” strikingly describes syntactic complexity instead, so that the more clauses there are, the lengthier the utterance is. Eventually, it doesn’t tell much about the actual grammatical relationships which, depending on the language, could perhaps better be measured in morphemes, rather than words. Finally, it is also worth noting that in Gordon (1998), raters find fluency most directly tied to grammatical and syntactical features (42%), articulatory effort (37%), and semantic or content retrieval deficits.

## **2. Timing and Breaks in Aphasic Speech**

### *2.1 Relevant Literature*

Acoustic phonetics analyses have delved into several measures: fundamental frequency (Danly et al., 1983), voice onset time, and vowel duration (Blumstein et al., 1977; Tuller, 1984; Blumstein et al. 1980; Baum et al., 1990; Gandour, Dardaranada, 1984; Van Lancker Sidtis et al., 2010); fricative duration in Broca’s aphasia (Harmes et al., 1984); segment duration in both apraxia and aphasia (Kent, McNeil, 1987; McNeil et al., 1990), lexical accent again in both apraxia and aphasia (Marquardt et al., 1995; Vergis et al., 2014). Furthermore, Laganaro, Zimmerman (2010), Buckingham et al. (1978), and Marotta (2009) are more concerned with phonological investigations.

In an attempt to better understand the temporal features of connected speech in aphasia, we are going to review here all the studies that are relevant to prosody; therefore, studies on perception (e.g., Baum, Diwedi, 2003; Seddoh, 2006) and the above-mentioned papers on fricative and voice onset time durations will not be included.

#### **2.1.1 Participants**

Out of the 42 papers reviewed, 4 do not have a control group for participants (Kreindler et al., 1980; Gandour et al. 1989; Baum et al. 1990; Niemi, 1998). Keindler et al. (1980) investigated fluency in two groups of patients, one with Broca’s (12 subjects) and the other with Wernicke’s aphasia (8 subjects). Baum et al. (1980) show a control baseline without specifying where it came from. Finally, Niemi (1998) and Gandour et al. (1989) are single case studies. Every other study has a patients’ group matched to a control group by age and gender, except for Ryalls (1986) and Gandour, Dardaranada (1984). Age-related effects on durations have been observed in Gandour et al. (1993; 1994), who differentiated the control group between students (average 26.4 years old) and adults (56.9 years old on average), which produced longer syllables compared to the former subgroup. In Ryalls (1986) the average of the subjects is 59.8 for people with anterior aphasia; 66.8 for people with posterior aphasia; 39.4 for the control group. As the author suggests, age could be a factor when looking at vowel duration; however, longer vowels in aphasia had been previously observed in Ryalls (1981; 1982) in polysyllables and short sentences, but also in Williams, Seaver (1986) in naming tasks and isolated word repetition -monosyllable for the most part, and in Baum et al. (1990) in a reading and repetition task of monosyllables. Van Lancker et al. (2010) find a general increase of the stem vowel duration in people with Wernicke’s aphasia even in

derived forms with polysyllabic shortening. The only study that does not confirm this tendency appears to be Vergis et al. (2014), both in reading and repetition tasks. As for Gandour, Dardaranada (1984), the control subjects span from age 28 to 33, while the patients are 55.4 years old on average. Absolute durations are shown to be longer in people with aphasia, who also exhibited less difference between short and long vowels, compared to controls. However, the authors found no significant difference in relative durations, so that age does not appear to be a factor in contrastive vowel length in Thai.

### 2.1.2 Languages, Diagnostic Tests, and Aphasia Subtypes

Most of the research has been done on American English, while other languages are: Italian (1), Palestinian Arabic (1), German (1), Dutch and German (1), Thai (3), Australian English (1), Canadian English (1), French (3), Mandarin (1), Cantonese (1) and Finnish (1). Patients were assessed using the Boston Diagnostic Aphasia Examination (BDAE) in 8 studies (3 of them using the adapted Thai version and 1 using the Arabic adaptation), while in 4 more studies it's used in combination with other tests. The Psycholinguistic Assessment Test (PAL) is used in 3 studies, and in one of them, it's not the only assessment. The Western Aphasia Battery (WAB) is used as the only assessment in 2 studies, and in 3 more it's in combination with other tests. The Porch Index of Communicative Ability (PICA) is used in 2 studies with other tests as well, the Word Fluency Measure (WFM), the Multilingual Aphasia Examination (MAE), and the Discourse Comprehension Test (DCT) appear in 1 study each, among other tests. The Aachen Aphasia Test (AAT) is found with German patients (2), Ryalls (1981, 1982) used the standard assessment of the Laboratoire de pathologie du langage in Paris, and finally, Italian was tested through the Test Milano II (1). 8 papers only show the clinicians' diagnostic evaluation, without any reference to standardized tests. The papers in this review cover Broca's syndrome (61%), Wernicke's syndrome (46%), conduction aphasia (26%), and anomic aphasia (24%). Out of the 42 papers, 5 used the fluent-non fluent distinction only.

### 2.1.3 Phonetics Features

Fundamental frequency (lexical accent and utterance modulation) and durations (vowels, syllables, words, and utterances) are the main features investigated. Spontaneous speech is analyzed in 9 out of 42 cases; other elicitation methods are reading, repetition -sometimes both, when reading is not available- picture naming, picture description -both for words and sequences- in this order.

Results show a clear temporal deficit, more severe on certain levels than others. Phones, syllables, words, clauses, and silent pauses are longer; people with Broca's aphasia also tend to produce more silent pauses. Nevertheless, relative durations show that contrastive and intrinsic durations are spared, which indicates a normal functioning of lexical rhythmic rules. Stress shifts also occur, but there is a tendency of signaling stress more by fundamental frequency changes than by time variations. Yet again, rhythmic rules seem to be spared in aphasic speech. Aphasic patients also produce more pauses, and their different durations signal syntactic boundaries. However, there is no evidence of prepausal lengthening (partially shown in Baum et al. 1997), which leads to more ambiguous interpretations. Final lengthening is found only in Baum, Boyczuk (1999) for fluent aphasic speakers, and in

Seddoh (2004). Declination is generally spared, with some variations depending on the severity of the impairments and the length of the utterance (Danly, Shapiro, 1982; Danly, Cooper, Shapiro 1983; Adam, 2014 in Arabic; Marotta et al. (2008) in Italian).

## 2.2 Results

Wernicke's aphasia patients' performances can be related to those of control subjects. On the other hand, Broca's aphasia patients' speech is more severely impaired, as it shows longer pause and segment durations, frequent pauses, abnormal  $F_0$  contours at the sentence level, abnormal resettings and continuation rises. Length effects have been observed on many occasions: Grela, Gandour (1998) note that at the lexical level rhythmic rules are preserved, but as more syllables are added, performances tend to fail. Furthermore, in stress clash conditions, non-fluent speakers and patients with right hemisphere damage do not exhibit any stress shift, while fluent and control speakers weaken the final stress. The authors argue that in the former group of patients the phonetic-articulatory buffering can function at the word level only so that all the parameters are set within the boundaries of the current word. Danly, Shapiro (1982) and Danly, Cooper, Shapiro (1983) also argue that frequent continuation rises and  $F_0$  resets result from either programming of shorter units, or a lack of selection among different syntactic boundaries. In both studies, the authors suggest that Broca's patients' productions can be explained by semantic and pragmatic factors, while in Wernicke's speech  $F_0$  rises and resets appear to be syntactically motivated. Seddoh (2000) does not point to a length effect, arguing that  $F_0$  is rather influenced by syntactic complexity and that there could have been an overlapping of both factors in previous studies. In another paper (Seddoh, 2004),  $F_0$  contours are comparable to the norm despite abnormal durations, in agreement with previous literature on rhythmic rules.

Longer durations have been observed in vowels, consonants, syllables, words, and sentences, in various tasks- reading, repetition, spontaneous speech (Ryalls, 1981; Danly et al. 1983; Cooper et al. 1984; Williams, Seaver, 1986; Ryalls, 1984; Gandour, Dardaranada, 1989; Baum et al. 1990; Gandour et al. 1994; Seddoh, 2004, 2008; Van Lancker Sidtis et al. 2010; Adam, 2014). Phonological contrasts are preserved in Ryalls (1986) and Van Lancker Sidtis et al. (2010), while mixed results arise from polysyllabic shortenings and stress clash cases. Declination is found in Niemi (1998) and Adam (2014) in languages other than English, and in Danly et al. (1982, 1983) it appears to be depending on the severity of the disorders and the utterance length.

Pauses seem to play a role in syntactic and semantic disambiguation, while final lengthening is only observed in Baum et al. (1997) and Baum, Boyczuk (1999) in fluent aphasic speech. Frequent  $F_0$  resets and continuation rises are a constant of aphasic speech.

## 3. Linguistic Fluency

### 3.1 Insights From SLA Research

Aphasic productions appear to be clustered in two main groups, both defined by different time patterns, i.e., longer durations when compared to non-pathological speech.  $F_0$  behavior is somewhat more blurred, as it's also less investigated. Taken together, these studies suggest

that among aphasic patients, fluent speech differs from non-fluent speech and that some prosodic functions -e.g., syntactic parsing, phonological contrasts- can be spared. Furthermore, fluent aphasia is closer to non-pathological speech regarding durations and  $F_0$  contours. Therefore, we agree with the authors cited in the first part of this paper, that it is right to assess aphasic speech based on a variety of symptoms that are not all related to pauses and speech rate, in order not to lose the distinction between pathological and non-pathological speech. However, superficial features and underlying deficits should always be on different scales. Anomia, for example, or difficulties in lexical retrieval can be signaled by a number of features, which in turn can correlate to other deficits at the same time. Thus, filled pauses help us coordinate the turn-taking process, and silent pauses can be motivated by either syntactic or lexical issues (see also Feyersen et al. 1991).

Based on works by Goldman-Eisler (1968), Rehbein (1987), and Meisel (1987), Segalowitz (2010, 2016) addresses the need of relating speech features to language processing. His approach stands out for theorizing three different levels of fluency, and further on adding the ties between them: in doing so, it is possible to investigate each level separately, by allowing for connections rather than overlapping or random clustering. Cognitive fluency indicates the speed and efficacy of the processes involved in language production -such as semantic retrieval and working memory. Utterance fluency is more strictly connected with speech timing features. Finally, perceptive fluency relies on the auditory judgment, whose parameters can differ from the ones of the utterance fluency, depending on the pragmatic and temporal settings of a given language (Préfontaine, Kormos, 2016).

### *3.2 Lexical Competence and Fluency*

Segalowitz (2010) considers vocabulary size as part of knowledge rather than cognition. Vocabulary, however, can be seen as a part of a broader lexical competence (Meara, 1996; Henriksen, 1999), where lexical knowledge involves word retrieval and online processing as well: that is to say, in order to process language, it's not enough for us to just know words, they also need to be available to us. Lexical competence, as complex as it is, still belongs to the cognitive level, rather than to utterance manifestations. Any judgment of fluency should account for this distinction, aiming to observe the different implementations of lexical competence at the utterance level, rather than evaluating lexical retrieval as a speech feature.

While aphasiology has largely covered lexical studies to investigate specific impairments, SLA research mainly focused on correlations between vocabulary and L2 learning and assessment. Yes-no vocabulary tests, for example, were originally thought for L1, starting from works like Zimmermann et al. (1977) and Anderson, Freebody (1983), who included non-words to the list. Meara and Buxton (1987) were the first to adapt such tests for L2, and similar checklist forms were included in aphasia battery tests developed within the cognitive neuropsychological framework. As for second language testing, Harrington and Carey (2009) have compared two vocabulary lists to a multilevel language assessment test: they found the accuracy of both vocabulary tests combined consistently varying among proficiency levels, although the difference between adjacent levels only reaches significance for high-proficiency learners. Yes-no vocabulary tests have been also integrated into more

complex second language assessments -as is the case of the Dialang project ([www.dialangweb.lancaster.ac.uk](http://www.dialangweb.lancaster.ac.uk))- and have proven to be a reliable tool in psycholinguistic experiments as well (for a review see Beeckmans et al., 2001; Eyckmans, 2004). We recently adopted a vocabulary checklist for Italian (LexITA, Amenta et al. 2020) combined with a self-assessment questionnaire as a screening method for 25 native Italian speakers and 50 non-native learners within the PRIN-PHRAME Project: test scores clearly set intermediate (mean score: 38.96; median: 38) from advanced learners (mean score: 49.64; median: 51) apart, with native speakers presenting highest scores (mean: 59.12, median: 59) and minimal standard deviation (0.93).

Following seminal works on errors and hesitation phenomena (Maclay, Osgood, 1959; Batliner et al. 1995; Blankenship, Kay, 1964; Boomer, 1965; Rochester, 1973; Clark, 1994; Hieke, 1981), more recently Tavakoli, Skehan (2005) suggest three fluency measures: speed, breaking (silent and filled pauses) and repairs (such as repetitions and hesitations). Hilton (2008) and De jong, Bosker (2013) examined how dysfluencies correlate with the mental lexicon in L2 spontaneous speech. Hilton (2008) finds that 30% of breakings and repairs at utterance boundaries -and 24% at clause boundaries- stand for lexical search, while syntactic and morphological issues are do not usually cause any break. These outcomes can be matched with previous studies about word frequency effects on pauses and hesitation in lab speech (Beattie, Butterworth, 1979; Goldman-Eisler, 1958; Cook, 1971). A different perspective was adopted by Harris Wright et al. (2003), specifically for aphasic patients. The authors analyzed productive vocabulary through a measure of lexical diversity in elicited spontaneous speech samples. As one of the main issues in working with spontaneous speech in aphasia is the extreme variability between fluent and non-fluent patients in terms of abundance of speech and length of productions, a new measure of lexical diversity was introduced, which applies to the previous TTR (Type-Token Ratio) avoiding sample length problems. Even within the limits of conversational productive vocabulary -which is expected to be smaller in size relative to receptive vocabulary tests- and picture description tasks, fluent aphasia showed greater lexical diversity regardless of sample size.

#### **4. Conclusions**

We aimed to present an exhaustive state of the art of notion of fluency in speech and language disorders literature. First, we have seen that the definition itself is a troubling issue, in that there is no actual agreement on what fluency really is. Consequently, measures of fluency typically include both perceived features – such as pauses, speech rate, and every possible trait that can be linked to what’s known as “effortful speech”- and general knowledge about aphasic deficits – e.g., impaired word-finding ability. We have seen in the first paragraph that this is the case even in the most recent literature (Casilio et al. 2019; Gordon, Clough, 2020), as the latest models tend to conflate speech and language as well. From our point of view, this is the very first reason why theoretical definition and empirical models cannot be disentangled: As of today, fluency happens to be a quite fuzzy and circular concept. Since there appears to be a constant focus on changes in time patterns, the first question we addressed was whether temporal characteristics of aphasic speech were indeed different from non-pathological speech. We have reviewed all the literature we’re aware of about durations

and interruptions in aphasic speech, spanning four decades and thirteen different languages. Such a large scope doesn't come without limitations. Since our final corpus appears to be extremely heterogeneous, we chose to conduct a more traditional and narrative literature review, leaving out meta-analyses. This compromise allowed us to present studies on various linguistic levels -syllable, word, sentence- which naturally differ in designs and methodologies. While our aim was to show global tendencies of aphasic speech timing, it is clear that certain aspects need more fine-grained investigations. We tried to map the field and sort through phonetic studies in aphasia that may be relevant in those speech features that typically describe fluency. Within the range of studies that we were able to pinpoint, we believe that specific areas of inquiry should be targeted by further systematic reviews. The issue is particularly relevant at the sentence and phrase level, where declinations and final rises considerably vary between isolated items and connected speech. Research on pauses and dysfluencies should also systematically disentangle unit length and syntactic complexity, a topic that comes up here as well and that deserves more attention than this paper could allow for. As for now, two main aspects stood out: on one hand, patients seem to be clustered in two large categories -one being “more fluent” and the other “less fluent”; on the other, patients categorized as more fluent still show different speech behaviors than controls. All in all, aphasic speech seems to have more pauses and repairs, and longer syllable, words, and pause durations. The second question we addressed is how a theory can account for anomia -maybe the one distinctive feature of aphasic productions overall- based on speech features only. In the last part of the article, we presented linguistic fluency as viewed in second language acquisition research. The reason for this choice is that we believe that when referring to speech and language, it is useful to look at the progress made in linguistics and cognitive disciplines since their large body of work covers almost every aspect of spontaneous speech. As analyses in the second language cannot disregard the features in the first language, we believe that more attention should be paid to non-pathological speech behavior when approaching aphasic speakers. We have seen that although still very few, in language acquisition there are some interesting takes on dysfluencies and word retrieval (Hilton, 2008; De jong, Bosker, 2013). Furthermore, we found Segalowitz (2010) and Tavakoli, Skehan (2005) particularly useful in showing how cognitive, utterance, and perceived fluency can be related. Our study does not directly address the nature of hesitation phenomena in aphasic speakers and language learners' productions: while in both cases they can stem from word-finding difficulties, we are not able to state, based on the data presented here, to what extent the two populations can actually be compared. It is reasonable to think that the general pattern of longer durations found in aphasic speech could be observed also in hesitations and interruptions. However, it remains to be seen whether a difference in subtypes (breaking versus repairs) or location can be drawn, similarly to what we have seen for lexical search in second language learners.

## 5. Future Prospects

We have tried to explain how, in our opinion, any approach to linguistic fluency should involve: a) at least two different levels, speech (utterance) and language (processing); b) the analysis of each level separately and then of their connections; c) a baseline taken from the



copious literature on spontaneous speech in each language, since speed, durations, and hesitations are not universal, but rather strictly dependent on the language. In doing so, breakdowns and repairs are not solely regarded as dysfluencies, as they are -in some cases, at least- markers of well-functioning pragmatic and textual competence. Nonetheless, at least two questions arise from this discussion. First, further research is needed to see how much of SLA theory can be transferred to aphasiology. Of course, word-finding difficulties in foreign learners are not the same as those of aphasic speakers, since in the former case they come from vocabulary size and knowledge, while in the latter they stem from retrieval deficits. However, the effects of lexical search in speech may be comparable, so future research could address the outcomes of anomia on temporal characteristics of aphasic speech. A second question concerns the definition of fluency itself and its implications on clinical evaluation. It is worth noting that most of the phonetic and linguistic studies that we reviewed in the second paragraph already sort their participants between some “fluent” versus “non-fluent” categories. This leads us to question whether the great difference shown between Wernicke’s and Broca’s patients merely reflects an a priori distinction, rather than identifying two separate speech patterns. A major distinction in aphasia testing is made between classic and psycholinguistic approaches, which aim to disclose one patient’s functional deficits, rather than classifying syndromes. This seems to be a crucial matter when discussing fluency since it allows for either a grouping or a linear model. In a linear model, fluency would resemble a scale, going from less to more impaired, whereas in a grouping model, clusters are created for each syndrome and subtype, with scores acting more like cut-offs than gradings. Based on spontaneous speech data in the neurotypical population, we have reason to think that dysfluencies are not exclusive of pathological speech, but it’s rather their duration and occurrences to differ. Speech disorders may present peculiar traits like echolalia, but it’s unclear whether these behaviors can be considered as speech features, and even if so, whether they have an impact on fluency. However, linear models can be misleading when asking for therapy and considering special needs, as they lead to regarding the less severe cases as needing minimal support if compared to the more severe cases. Therefore, another option that could be worth investigating, would be modeling fluency as a spectrum. We do not believe that the heterogeneity that the spectrum allows for should reflect any overlapping in speech and language features, but it could be useful to analyze the spikes in aphasic patients’ productions. While the idea of a spectrum has already been employed in wide-ranging syndromes like autism and hypermobility, it is not new in speech research either, especially in phoniatrics, where it’s of common use for voice disorders. It is not our place to argue for a model rather than another when it comes to language disorders and clinical evaluations. Nevertheless, we hope that this overview has shown that fluency in aphasiology could be observed in a way that is relevant to the discipline and still theoretically consistent from a linguistic perspective.

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## References

- Adam, H. (2014). Dysprosody in aphasia: An acoustic analysis evidence from Palestinian Arabic. *Journal of Language and Linguistic Studies*, 10(1), 153-162.
- Amenta, S., Badan, L., & Brysbaert, M. (2021). LexITA: A quick and reliable assessment tool for Italian L2 receptive vocabulary size. *Applied Linguistics*, 42(2), 292-314. <https://doi.org/10.1093/applin/amaa020>
- Anderson, R. C., & Freebody, P. (1983). Reading comprehension and the assessment and acquisition of word knowledge. *Advances in Reading/Language Research*.
- Anderson, J. M., Gilmore, R., Roper, S., Crosson, B., Bauer, R. M., Nadeau, S., ... Hughes, J. D. (1999). Conduction aphasia and the arcuate fasciculus: a reexamination of the Wernicke–Geschwind model. *Brain and Language*, 70(1), 1-12. <https://doi.org/10.1006/brln.1999.2135>
- Batliner, A., Kießling, A., Burger, S., & Nöth, E. (1995). *Filled pauses in spontaneous speech*.
- Baum, S. R., Blumstein, S. E., Naeser, M. A., & Palumbo, C. L. (1990). Temporal dimensions of consonant and vowel production: An acoustic and CT scan analysis of aphasic speech. *Brain and Language*, 39(1), 33-56. [https://doi.org/10.1016/0093-934X\(90\)90003-Y](https://doi.org/10.1016/0093-934X(90)90003-Y)
- Baum, S. R. (1992). The influence of word length on syllable duration in aphasia: Acoustic analyses. *Aphasiology*, 6(5), 501-513. <https://doi.org/10.1080/02687039208249487>
- Baum, S. R. (1993). An acoustic analysis of rate of speech effects on vowel production in aphasia. *Brain and Language*, 44(4), 414-430. <https://doi.org/10.1006/brln.1993.1025>
- Baum, S. R., Pell, M. D., Leonard, C. L., & Gordon, J. K. (1997). The ability of right-and left-hemisphere-damaged individuals to produce and interpret prosodic cues marking phrasal boundaries. *Language and Speech*, 40(4), 313-330. <https://doi.org/10.1177/002383099704000401>
- Baum, S. R., & Boyczuk, J. P. (1999). Speech timing subsequent to brain damage: Effects of utterance length and complexity. *Brain and Language*, 67(1), 30-45. <https://doi.org/10.1006/brln.1999.2047>
- Baum, S. R., Pell, M. D., Leonard, C. L., & Gordon, J. K. (2001). Using prosody to resolve temporary syntactic ambiguities in speech production: acoustic data on brain-damaged speakers. *Clinical linguistics & phonetics*, 15(6), 441-456. <https://doi.org/10.1080/02699200110044813>
- Beattie, G. W., & Butterworth, B. L. (1979). Contextual probability and word frequency as determinants of pauses and errors in spontaneous speech. *Language and Speech*, 22(3), 201-211. <https://doi.org/10.1177/002383097902200301>
- Beckman, M. E., & Pierrehumbert, J. B. (1986). Intonational Structure in Japanese and English. *Phonology Yearbook*, 3, 255-309. <https://doi.org/10.1017/S095267570000066X>

- Beeckmans, R., Eyckmans, J., Janssens, V., Dufranne, M., & Van de Velde, H. (2001). Examining the Yes/No vocabulary test: Some methodological issues in theory and practice. *Language Testing*, 18(3), 235-274. <https://doi.org/10.1177/026553220101800301>
- Benson, D. F. (1967). Fluency in aphasia: correlation with radioactive scan localization. *Cortex*, 3(4), 373-394. [https://doi.org/10.1016/S0010-9452\(67\)80025-X](https://doi.org/10.1016/S0010-9452(67)80025-X)
- Benson, D. F. (1979). *Aphasia, alexia, and agraphia* (Vol. 1). Churchill Livingstone.
- Blankenship, J., & Kay, C. (1964). Hesitation phenomena in English speech: A study in distribution. *Word*, 20(3), 360-372. <https://doi.org/10.1080/00437956.1964.11659828>
- Boomer, D. S. (1965). Hesitation and grammatical encoding. *Language and Speech*, 8(3), 148-158. <https://doi.org/10.1177/002383096500800302>
- Casilio, M., Rising, K., Beeson, P. M., Bunton, K., & Wilson, S. M. (2019). Auditory-perceptual rating of connected speech in aphasia. *American Journal of Speech-Language Pathology*, 28(2), 550-568. [https://doi.org/10.1044/2018\\_AJSLP-18-0192](https://doi.org/10.1044/2018_AJSLP-18-0192)
- Clark, H. H. (1994). Managing problems in speaking. *Speech Communication*, 15(3-4), 243-250. [https://doi.org/10.1016/0167-6393\(94\)90075-2](https://doi.org/10.1016/0167-6393(94)90075-2)
- Clough, S., & Gordon, J. K. (2020). Fluent or nonfluent? Part A. Underlying contributors to categorical classifications of fluency in aphasia. *Aphasiology*, 34(5), 515-539. <https://doi.org/10.1080/02687038.2020.1727709>
- Cole, J., Hasegawa-Johnson, M., Shih, C., Kim, H., Lee, E. K., Lu, H. Y., ... Yoon, T. J. (2005). Prosodic parallelism as a cue to repetition and error correction disfluency. In *Disfluency in Spontaneous Speech*.
- Cook, M. (1971). The incidence of filled pauses in relation to part of speech. *Language and Speech*, 14(2), 135-139. <https://doi.org/10.1177/002383097101400203>
- Cooper, W. E., Soares, C., Nicol, J., Michelow, D., & Goloskie, S. (1984). Clausal intonation after unilateral brain damage. *Language and Speech*, 27(1), 17-24. <https://doi.org/10.1177/002383098402700102>
- Cortese, M. D., Riganello, F., Arcuri, F., Pignataro, L. M., & Buglione, I. (2015). Rehabilitation of aphasia: application of melodic-rhythmic therapy to Italian language. *Frontiers in Human Neuroscience*, 9, 520. <https://doi.org/10.3389/fnhum.2015.00520>
- Danly, M., & Shapiro, B. (1982). Speech prosody in Broca's aphasia. *Brain and Language*, 16(2), 171-190. [https://doi.org/10.1016/0093-934X\(82\)90082-7](https://doi.org/10.1016/0093-934X(82)90082-7)
- Danly, M., Cooper, W. E., & Shapiro, B. (1983). Fundamental frequency, language processing, and linguistic structure in Wernicke's aphasia. *Brain and Language*, 19(1), 1-24. [https://doi.org/10.1016/0093-934X\(83\)90052-4](https://doi.org/10.1016/0093-934X(83)90052-4)
- De Jong, N. H., & Bosker, H. R. (2013). Choosing a threshold for silent pauses to measure second language fluency. In *The 6th workshop on disfluency in spontaneous speech (diss)* (pp. 17-20). Retrieved from <http://hdl.handle.net/11858/00-001M-0000-0015-0FB8-8>

- Deloche, G., Jean-Louis, J., & Seron, X. (1979). Study of the temporal variables in the spontaneous speech of five aphasic patients in two situations, interview and description. *Brain and Language*, 8(2), 241-250. [https://doi.org/10.1016/0093-934X\(79\)90052-X](https://doi.org/10.1016/0093-934X(79)90052-X)
- Denes, G., Semenza, C., & Caldognetto, E. M. (2020). Phonological disorders in aphasia. *In Handbook of Clinical and Experimental Neuropsychology* (pp. 195-214). Psychology Press. Retrieved from <http://hdl.handle.net/11368/1688524>
- De Pijper, J. R. (1983). *Modelling British English intonation: an analysis by resynthesis of British English intonation* (No. 3). de Gruyter Mouton.
- Emmorey, K. D. (1987). The neurological substrates for prosodic aspects of speech. *Brain and Language*, 30(2), 305-320. [https://doi.org/10.1016/0093-934X\(87\)90105-2](https://doi.org/10.1016/0093-934X(87)90105-2)
- Eyckmans, J. (2004). *Measuring Receptive Vocabulary Size*. Utrecht: LOT.
- Feyereisen, P., Pillon, A., & Partz, M. P. D. (1991). On the measures of fluency in the assessment of spontaneous speech production by aphasic subjects. *Aphasiology*, 5(1), 1-21. <https://doi.org/10.1080/02687039108248516>
- Gandour, J., & Dardarananda, R. (1984). Prosodic disturbance in aphasia: Vowel length in Thai. *Brain and Language*, 23(2), 206-224. [https://doi.org/10.1016/0093-934X\(84\)90064-6](https://doi.org/10.1016/0093-934X(84)90064-6)
- Gandour, J., Petty, S. H., & Dardarananda, R. (1989). Dysprosody in Broca's aphasia: A case study. *Brain and Language*, 37(2), 232-257. [https://doi.org/10.1016/0093-934X\(89\)90017-5](https://doi.org/10.1016/0093-934X(89)90017-5)
- Gandour, J., Dechongkit, S., Ponglorpisit, S., Khunadorn, F., & Boongird, P. (1993). Intraword timing relations in Thai after unilateral brain damage. *Brain and Language*, 45(2), 160-179. <https://doi.org/10.1006/brln.1993.1041>
- Gandour, J., Dechongkit, S., Ponglorpisit, S., & Khunadorn, F. (1994). Speech timing at the sentence level in Thai after unilateral brain damage. *Brain and Language*, 46(3), 419-438. <https://doi.org/10.1006/brln.1994.1023>
- Gandour, J., Ponglorpisit, S., Khunadorn, F., Dechongkit, S., Boongird, P., & Sattamnuwong, N. (2000). Speech timing in Thai left-and right-hemisphere-damaged individuals. *Cortex*, 36(2), 281-288. [https://doi.org/10.1016/S0010-9452\(08\)70529-X](https://doi.org/10.1016/S0010-9452(08)70529-X)
- Gandour, J., & Baum, S. R. (2001). Production of stress retraction by left-and right-hemisphere-damaged patients. *Brain and Language*, 79(3), 482-494. <https://doi.org/10.1006/brln.2001.2562>
- Goldman-Eisler, F. (1958). The predictability of words in context and the length of pauses in speech. *Language and Speech*, 1(3), 226-231. <https://doi.org/10.1177/002383095800100308>
- Goldman-Eisler, F. (1968). *Psycholinguistics: Experiments in spontaneous speech*. London: Academic Press. Retrieved from <http://hdl.handle.net/11858/00-001M-0000-002B-1218-B>
- Goodglass, H., & Kaplan, E. (1972). *The assessment of aphasia and related disorders*.
- Goodglass, H., Kaplan, E., & Weintraub, S. (2001). *BDAE: The Boston Diagnostic Aphasia Examination*. Philadelphia, PA: Lippincott Williams & Wilkins.

- Gordon, J. K. (1998). The fluency dimension in aphasia. *Aphasiology*, 12(7-8), 673-688. <https://doi.org/10.1080/02687039808249565>
- Gordon, J. K., & Clough, S. (2020). How fluent? Part B. Underlying contributors to continuous measures of fluency in aphasia. *Aphasiology*, 34(5), 643-663. <https://doi.org/10.1080/02687038.2020.1712586>
- Grela, B., & Gandour, J. (1998). Locus of functional impairment in the production of speech rhythm after brain damage: A preliminary study. *Brain and Language*, 64(3), 361-376. <https://doi.org/10.1006/brln.1998.1975>
- Grela, B. (1999). Case Study Stress shift in aphasia: a multiple case study. *Aphasiology*, 13(2), 151-166. <https://doi.org/10.1080/026870399402253>
- Harrington, M., & Carey, M. (2009). The on-line Yes/No test as a placement tool. *System*, 37(4), 614-626. <https://doi.org/10.1016/j.system.2009.09.006>
- Heeschen, C., Ryalls, J., & Hagoort, P. (1988). Psychological stress in Broca's versus Wernicke's aphasia. *Clinical Linguistics & Phonetics*, 2(4), 309-316. <https://doi.org/10.3109/02699208808985262>
- Henriksen, B. (1999). Three dimensions of vocabulary development. *Studies in Second Language Acquisition*, 21(2), 303-317. <https://doi.org/10.1017/S0272263199002089>
- Hieke, A. E. (1981). A content-processing view of hesitation phenomena. *Language and Speech*, 24(2), 147-160. <https://doi.org/10.1177/002383098102400203>
- Hilton, H. (2008). The link between vocabulary knowledge and spoken L2 fluency. *Language Learning Journal*, 36(2), 153-166. <https://doi.org/10.1080/09571730802389983>
- Holland, A. L., Fromm, D., & Swindell, C. S. (1986). The labeling problem in aphasia: An illustrative case. *Journal of Speech and Hearing Disorders*, 51(2), 176-180. <https://doi.org/10.1044/jshd.5102.176>
- Huber, W., Poeck, K., & Willmes, K. (1984). The Aachen Aphasia Test. In Rose, F. C. (Ed.), *Advances in Neurology* (Vol. 42). Progress in Aphasiology. New York: Raven Press.
- John, A. A., Javali, M., Mahale, R., Mehta, A., Acharya, P. T., & Srinivasa, R. (2017). Clinical impression and Western Aphasia Battery classification of aphasia in acute ischemic stroke: Is there a discrepancy?. *Journal of Neurosciences in Rural Practice*, 8(1), 074-078. <https://doi.org/10.4103/0976-3147.193531>
- Kertesz, A. (2006). *Western aphasia battery-revised (WAB-R)*. New York, NY: Pearson.
- Kreindler, A., Mihailescu, L., & Fradis, A. (1980). Speech fluency in aphasics. *Brain and language*, 9(2), 199-205. [https://doi.org/10.1016/0093-934X\(80\)90140-6](https://doi.org/10.1016/0093-934X(80)90140-6)
- Lee, T., Lam, W. K., Kong, A. P. H., & Law, S. P. (2015, October). *Analysis of intonation patterns in Cantonese aphasia speech*. In 2015 International Conference Oriental COCODA held jointly with 2015 Conference on Asian Spoken Language Research and Evaluation (O-COCOSDA/CASLRE) (pp. 86-89). IEEE.

- Levelt, W. J. (1989). Speaking: From intention to articulation.
- Maclay, H., & Osgood, C. E. (1959). Hesitation phenomena in spontaneous English speech. *Word*, 15(1), 19-44. <https://doi.org/10.1080/00437956.1959.11659682>
- Marotta, G., Barbera, M., & Bongioanni, P. (2008). Prosody and Brocas aphasia: An acoustic analysis. *Studi Linguistici e Filologici*, 6, 79-98.
- Marotta, G. (2009). *Aspetti fonologici e prosodici nell'afasia di Broca. Neurolinguistica e disturbi del linguaggio*. Perugia: Guerra, pp. 19-38.
- McNeil, M. R., Liss, J. M., Tseng, C. H., & Kent, R. D. (1990). Effects of speech rate on the absolute and relative timing of apraxic and conduction aphasic sentence production. *Brain and Language*, 38(1), 135-158. [https://doi.org/10.1016/0093-934X\(90\)90106-Q](https://doi.org/10.1016/0093-934X(90)90106-Q)
- Meara, P., & Buxton, B. (1987). An alternative to multiple choice vocabulary tests. *Language Testing*, 4(2), 142-154. <https://doi.org/10.1177/026553228700400202>
- Meara, P. (1996). The vocabulary knowledge framework. *Vocabulary acquisition research group virtual library*, 5(2), 1-11.
- Meara, P. (1996). The dimensions of lexical competence. *Performance and competence in second language acquisition*, 35, 33-55.
- Meisel, J. (1987). A note on second language speech production. *Psycholinguistic models of production*, 83, 83-90.
- Mendez, M. F., & Benson, D. F. (1985). Atypical conduction aphasia: a disconnection syndrome. *Archives of Neurology*, 42(9), 886-891.
- Muò, R., Raimondo, S., Martufi, F., Cavagna, N., Bassi, M., & Schindler, A. (2021). Cross-cultural adaptation and validation of the Italian Aachener Aphasia Bedside Test (I-AABT), a tool for Aphasia assessment in the acute phase. *Aphasiology*, 35(9), 1238-1261. <https://doi.org/10.1080/02687038.2020.1819953>
- Murdoch, B. E. (2010). *Acquired speech and language disorders*. John Wiley & Sons.
- Naeser, M. A., Alexander, M. P., Helm-Estabrooks, N., Levine, H. L., Laughlin, S. A., & Geschwind, N. (1982). Aphasia with predominantly subcortical lesion sites: Description of three capsular/putaminal aphasia syndromes. *Archives of Neurology*, 39(1), 2-14.
- Niemi, J. (1998). Modularity of prosody: autonomy of phonological quantity and intonation in aphasia. *Brain and Language*, 61(1), 45-53. <https://doi.org/10.1006/brln.1997.1877>
- Ouellette, G. P., & Baum, S. R. (1994). Acoustic analysis of prosodic cues in left-and right-hemisphere-damaged patients. *Aphasiology*, 8(3), 257-283. <https://doi.org/10.1080/02687039408248656>
- Préfontaine, Y., & Kormos, J. (2016). A qualitative analysis of perceptions of fluency in second language French. *International Review of Applied Linguistics in Language Teaching*, 54(2), 151-169. <https://doi.org/10.1515/iral-2016-9995>
- Rehbein, J. (1987). On fluency in second language speech. *Psycholinguistic Models of*

*Production*, 97-105.

Rochester, S. R. (1973). The significance of pauses in spontaneous speech. *Journal of Psycholinguistic Research*, 2(1), 51-81.

Ryalls, J. H. (1981). Motor aphasia: Acoustic correlates of phonetic disintegration in vowels. *Neuropsychologia*, 19(3), 365-374. [https://doi.org/10.1016/0028-3932\(81\)90066-X](https://doi.org/10.1016/0028-3932(81)90066-X)

Ryalls, J. H. (1982). Intonation in Broca's aphasia. *Neuropsychologia*, 20(3), 355-360. [https://doi.org/10.1016/0028-3932\(82\)90110-5](https://doi.org/10.1016/0028-3932(82)90110-5)

Ryalls, J. H. (1984). Some acoustic aspects of fundamental frequency of CVC utterances in aphasia. *Phonetica*, 41(2), 103-111. <https://doi.org/10.1159/000261715>

Ryalls, J. H. (1986). An acoustic study of vowel production in aphasia. *Brain and Language*, 29(1), 48-67. [https://doi.org/10.1016/0093-934X\(86\)90033-7](https://doi.org/10.1016/0093-934X(86)90033-7)

Sah, W. H. (2004). The control of fundamental frequency in Chinese aphasics: Impaired or intact prosody. *Concentric: Studies in Linguistics*, 30(1), 129-149.

Seddoh, S. A. (2004). Prosodic disturbance in aphasia: speech timing versus intonation production. *Clinical linguistics & phonetics*, 18(1), 17-38. <https://doi.org/10.1080/0269920031000134686>

Seddoh, S. A. (2008a). Alignment following left and right hemisphere damage. *Aphasiology*, 22(5), 505-521. <https://doi.org/10.1080/02687030701447164>

Seddoh, S.A. (2008b). Conceptualisation of deviations in intonation production in aphasia. *Aphasiology*, 22(12), 1294-1312. <https://doi.org/10.1080/02687030701640289>

Segalowitz, N. (2010). *Cognitive bases of second language fluency*. Routledge. <https://doi.org/10.4324/9780203851357>

Shah, A. P., Baum, S. R., & Dwivedi, V. D. (2006). Neural substrates of linguistic prosody: Evidence from syntactic disambiguation in the productions of brain-damaged patients. *Brain and Language*, 96(1), 78-89. <https://doi.org/10.1016/j.bandl.2005.04.005>

Schirmer, A., Alter, K., Kotz, S. A., & Friederici, A. D. (2001). Lateralization of prosody during language production: A lesion study. *Brain and Language*, 76(1), 1-17. <https://doi.org/10.1006/brln.2000.2381>

Segalowitz, N. (2016). Second language fluency and its underlying cognitive and social determinants. *International Review of Applied Linguistics in Language Teaching*, 54(2), 79-95. <https://doi.org/10.1515/iral-2016-9991>

Sidtis, D. V. L., Hanson, W., Jackson, C., Lanto, A., Kempler, D., & Metter, E. J. (2004). Fundamental frequency (F0) measures comparing speech tasks in aphasia and Parkinson disease. *Journal of Medical Speech-Language Pathology*, 12(4), 207-213.

Sidtis, D. V. L., Kempler, D., Jackson, C., & Metter, E. J. (2010). Prosodic changes in aphasic speech: timing. *Clinical Linguistics & Phonetics*, 24(2), 155-167. <https://doi.org/10.3109/02699200903464439>

- Swindell, C. S., Holland, A. L., & Fromm, D. (1984). Classification of aphasia: WAB type versus clinical impression. In *Clinical Aphasiology: Proceedings of the Conference 1984* (pp. 48-54). BRK Publishers.
- Tavakoli, P., & Skehan, P. (2005). Strategic planning, task structure, and performance testing. *Planning and task performance in a second language*, 239273.
- Trupe, E. H. (1984). Reliability of rating spontaneous speech in the Western Aphasia Battery: Implications for classification. In *Clinical Aphasiology: Proceedings of the Conference 1984*. BRK Publishers.
- Vergis, M. K., Ballard, K. J., Duffy, J. R., McNeil, M. R., Scholl, D., & Layfield, C. (2014). An acoustic measure of lexical stress differentiates aphasia and aphasia plus apraxia of speech after stroke. *Aphasiology*, 28(5), 554-575. <https://doi.org/10.1080/02687038.2014.889275>
- Walker, J. P., Joseph, L., & Goodman, J. (2009). The production of linguistic prosody in subjects with aphasia. *Clinical Linguistics & Phonetics*, 23(7), 529-549. <https://doi.org/10.1080/02699200902946944>
- Weisenberg, T., & McBride, K. E. (1935). *Aphasia: A clinical and psychological study*.
- Wertz, R. T., Deal, J. L., & Robinson, A. J. (1984). Classifying the aphasias: a comparison of the Boston Diagnostic Aphasia Examination and the Western Aphasia Battery. In *Clinical Aphasiology: Proceedings of the Conference 1984* (pp. 40-47). BRK Publishers.
- Zimmerman, J., Broder, P. K., Shaughnessy, J. J., & Underwood, B. J. (1977). A recognition test of vocabulary using signal-detection measures, and some correlates of word and nonword recognition. *Intelligence*, 1(1), 5-31. [https://doi.org/10.1016/0160-2896\(77\)90025-3](https://doi.org/10.1016/0160-2896(77)90025-3)

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