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Breathing, Pausing and Reading

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Abstract. An analysis of the breathing patterns of speakers in a variable-rate reading task shows that the duration and frequency of breathing pauses are dependent both on the rate of speaking and the syntactic nature of the pause location. Non-breathing pauses follow the same pattern of occurrence as breathing pauses, but are always shorter and tend to occur primarily at minor constituent breaks. At slow and normal rates, speakers accommodate their need to inhale to the preplanned pause patterns. At fast rates, however, the physiological need to breathe is the sole determinant of pausing.

The research on respiration during speech can be grouped into two main categories: studies relating to respiratory physiology during articulation and studies pertaining to the linguistic organization and location of breathing pauses (BPs) in the speech stream. The former investigations, which greatly outnumber the latter studies, have explored, for example, the kinematics and dynamics of the chest wall during speech production. In these, volume displacement of the rib cage, abdomen and lung is measured during such tasks as spontaneous conversation, reading of a paragraph and of numerical strings, production of sustained vowels and syllables, and singing [Hixon *et al.*, 1973, 1976; Forner and Hixon, 1977]. Other studies have investigated subglottal pressure [Ladefoged, 1960; Mead *et al.*, 1968; Ladefoged and McKinney, 1963; Kunze, 1964], expiratory pressures and airflow [Draper *et al.*, 1960; Cooker, 1963] and the respiratory muscles used in speech [Draper *et al.*, 1959; Hoshiko, 1960].

A second set of studies has put less stress on the physiological aspects of breathing and has concentrated more on such questions as: Do people inhale at, and only at, major constituent boundaries? What is the relationship and interaction between BPs, hesitation pauses and juncture (or grammatical) pauses? Are respiratory patterns integrated with sentence-planning activities? LIEBERMAN [1967], for example, studied breathing patterns in the reading of individual sentences and found that 87% of all sentences were uttered in a single expiration. It is in this study that LIEBERMAN introduces the notion of the breath group which he defines as a prosodic pattern that is used to delimit the boundaries of unemphatic, declarative sentences in normal speech. Although the scope of the breath group is often the constituent structure, it can also occur on smaller constituents and a sentence can hence be divided into two or more breath groups.

HENDERSON *et al.* [1965] determined the locations of breath inspirations in reading and spontaneous speech and found that breathing always occurred at grammatical junctures (defined primarily as clause boundaries) during reading but that in spontaneous speech, only 69% of the breaths occurred at those locations. GROSJEAN and DESCHAMPS [1975] analyzed the temporal variables of 30 English and French radio interviews and reported a greater number of BPs at the end of sentences than within sentences in both languages: BPs accounted for about three-quarters of all pauses at sentence breaks (82% in French and 76% in English) and a bit more than half of all pauses within sentences (65 and 49%, respectively). Furthermore, BPs were found to be significantly longer than non-breathing pauses (NBPs) both at the end and within sentences in the two languages. Finally, FODOR, FORSTER, GARRETT and HAKES [reported in FODOR *et al.*, 1974] showed that speakers tend not to breathe at artificially induced pauses except when such pauses occur at major constituents. The subjects were asked to read passages which were typed in groups of five words on file cards, regardless of punctuation. They rarely breathed at a card boundary that was not also a major syntactic boundary and all breathing which was not at card boundaries was syntactically conditioned.

These studies leave unanswered a number of questions. For example, what is the interaction of hesitation and BPs in spontaneous speech? GOLDMAN-EISLER [1956] reports that there is a reduced amount of breathing during hesitation pauses but her definition of a hesitation pause is unclear [for example, she claims that NBPs in a reading task are hesitation pauses; 1968, p. 98] and GROSJEAN and DESCHAMPS [1975] divide unfilled pauses into BPs and NBPs but do not attempt to parcel out hesitation pauses from these two categories. This task in itself promises to be a difficult one, as speakers undoubtedly combine grammatical pauses, BPs and hesitation pauses in their everyday speech.

A second problem that arises concerns the linguistic analysis carried out in these studies; only the main linguistic breaks are considered, the end-of-clause and the within-clause boundaries. No attempt is made to inquire into which type of clause boundary is preferred when inserting a BP or where people breathe within clauses (as they probably do, for example, when clauses are long).

A third question, and perhaps the most interesting, is posed in the following way by FODOR *et al.* [1974, p. 428]: 'The data we have been discussing do not allow us to estimate the extent to which breathing is preplanned to match the syntactic structure of the intended message. In fact, they leave open the possibility that speakers do not preplan respiration but merely stop to breathe when they come to boundaries... But if the coincidence of breathing with clausal structure is not due to the clause-by-clause integration of the sentence, why does breathing respect the integrity of clauses?' At least three possibilities seem to exist for the speaker when he or she insert BPs into speech. The first is to combine the respiratory pattern with sentence-planning activities; this compromise solution would imply a give and take between physiological needs and linguistic continuity and fluency. A second possibility is that breathing is in command and the speaker trims his speech into regular breath groups. And a third possibility, as suggested by FODOR *et al.* [1974], would be that breathing is dependent on syntax; speakers will only breathe when allowed to do so, as it were, by the constituent structure of the utterance.

In this study, we will concentrate on the last two questions: we will examine breathing pauses in a variable-rate reading task and ask the following questions: What is the relationship between linguistic structure and breathing? Do BPs follow the same pattern as NBPs when subjects are asked to read at varying rates of speech? For example, as the rate is increased, do BPs become shorter and less frequent, disappearing totally within minor constituents and only remaining at sentence breaks? GROSJEAN [1972] and LANE and GROSJEAN [1973] showed that this was the case for pauses in general, but they did not separate out BPs from NBPs. How much time in a BP is actually devoted to breathing (inspiration) and how is this modified with change of rate? In addition to answering these questions, we will attempt, throughout the study, to find evidence as to whether inhalation controls or, on the contrary, is subservient to fluent pausing.

Method

Subjects

Six undergraduate students (three male and three female) with no reported speech or hearing defects, served individually in sessions lasting 30 min.

Materials

The following 116-word passage, previously used by GROSJEAN [1977, 1978, in press] in connection with an experiment on rate in American Sign Language, was employed to obtain five different reading rates from the subjects seated in an audiometric room: 'A long time ago a little girl decided to take a walk in the woods. In the woods she saw a house and went in. She was very hungry, so she sat down. She saw a big bowl and began to eat. She didn't like it because it was too cold. She went to the next bowl. This one was too hot and she really didn't like it. Then she went to the smallest bowl and ate and ate. It was good, really good and so she ate it all up. Then she saw three different chairs and sat on each of them. One was too hard, one was too soft and one was just right.'

The speaker's breathing was measured by monitoring rib-cage contraction and expansion with a pneumograph. An expandable rubber tube was fitted across the thoracic cavity of the subject; it was linked to a pressure transducer (Sanborn 268B) which changed pressure variations into electrical energy. This signal was amplified (Sanborn Transducer Converter, 592) and read on an oscillograph (Minneapolis Honeywell Visicorder, paper speed 2 in/sec); the subject's speech was detected by a microphone (AKG D 707E) and recorded on a second track of the oscillograph; it was also tape-recorded (Crown SS800)[1].

Procedure

The method of magnitude production was used to obtain the readings. Each subject was asked to read the passage at a normal rate. To the apparent rate of this reading, E assigned the numerical value 10. A series of values (2.5, 5, 10, 20, 30) was then named in irregular order, twice in all, and the speaker responded to each value by reading the passage with a proportionate apparent rate.

Data Analysis

The oscillograph tracings of the 60 reading productions were measured with dividers to an accuracy of $\pm$ 0.02 sec. These measures yielded, for each passage, the number and dura-

[1] Since the writing of this paper, the first author has received a lengthy letter from Dr. T. Hixon concerning the technique used to monitor breathing. Dr. Hixon very correctly states that abdominal displacements were not measured in the study and that what we call a breathing pause in this study is only a rib cage pause and not necessarily a lung volume pause. As Dr. Hixon writes, "The problem is a clear one. The rib cage wall's contribution to changes in lung volume is not sufficient to specify what is happening to lung volume. It is likely that lung volume is also changing substantially through abdominal wall displacements". We are of course quite aware that our method of measuring breathing in speech was imperfect but nevertheless we feel that the main conclusions we arrive at in this study bring some light to the role of breathing in speech production. Whether we would find very different results when using a body plethysmograph remains an empirical question of considerable interest.

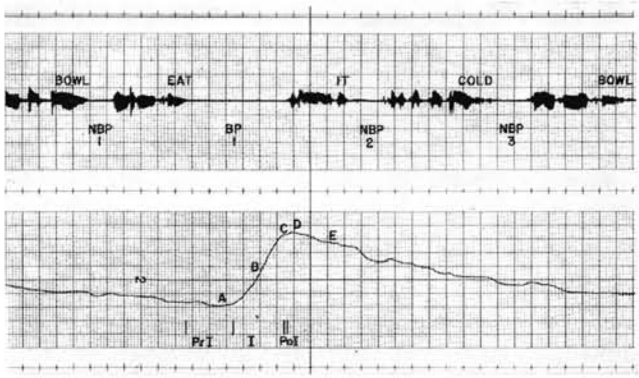

Fig. 1. A sample of the oscillographic recording of a subject's speech and breathing patterns. Three NBPs and one BP occur. The latter has been subdivided into its three components: preinspiration (PrI), inspiration (I), and postinspiration (PoI). The section of the passage that is of interest here is: '...saw a big bowl [NBP1] and began to eat [BP1]. She didn't like it [NBP2] because it was too cold [NBP3]. She went to the next bowl...'.

tion of the pauses and the runs (the stretches of speech between the pauses), with a pause defined as an interruption of the soundwave lasting 200 msec or more. The following parameters were then calculated: global rate (WPM), number and mean length of the pauses.

Our definition of a pause corresponds to the unfilled pause encountered in numerous studies [see for example, GOLDMAN-EISLER, 1968; GROSJEAN and DESCHAMPS, 1975]; it encompasses, however, NBPs and BPs. To separate the two, we used the oscillographic tracing of the subject's breathing, displayed on the second channel of the oscillograph. As can be seen on figure 1, BPs can be differentiated quite easily from NBPs; whereas BPs are characterized by a steep ascending slope, NBPs show a relatively flat breathing slope. The pattern of BPs is as follows: at the end of vocalization, the breathing pattern is marked by a slight dip (fig. 1, A) in the oscillographic recording. This takes place either immediately after the end of vocalization or, if the subject wants to put in a longer pause, some time later, as in figure 1. Inspiration then takes place; it is characterized by a long ascending slope (fig. 1, B) which corresponds to the steady and rapid expansion of the thoracic cavity; this is followed by a slight break in the slope (fig. 1, C) which may mark the checking action of the inhalation muscles just prior to vocalization. The beginning of speech is then marked by a small convexity (fig. 1, D) which corresponds to the slight expansion of the rib cage. With the onset of vocalization, the classic gradual descending slope begins (fig. 1, E) marking the slow release of air during phonation.

The BPs were thus separated into the following three components: preinspiration, measured from the end of vocalization to the beginning of the ascending inspiration slope; inspiration, and postinspiration, measured from the end of the inspiration slope (where the slight break in the slope occurs) to the beginning of vocalization. The duration of each component was averaged across readings and subjects, to give a grand mean duration at each rate.

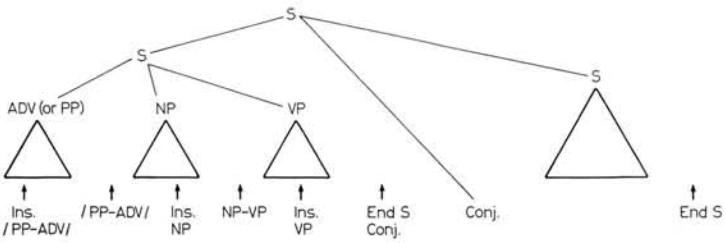

Fig. 2. Illustration of the seven linguistic categories used in the data analysis of pause duration and frequency.

In the linguistic analysis of the pause locations (NBPs and BPs) seven linguistic boundaries were used: the sentence boundary (End S), e.g. *She saw a big bowl and began to eat/She didn't like it...;* the break between two conjoined sentences (End S Conj.), e.g. *She saw a big bowl/and began to eat;* the break between an adverbial or prepositional phrase and the preceding or following NP or VP (/PP-Adv/), e.g. *A long time ago/a little girl...* or *In the woods/ she saw a house...;* the NP-VP breaks (NP-VP), e.g. *...a little girl/decided to...;* the breaks inside the NP subject or object (Ins. NP), e.g. *...a/little/girl...* or *...to take a/walk...;* the breaks inside the VP (Ins. VP), e.g. *...she really/didn't/like it.* And finally, the breaks within the adverbial or prepositional phrases (Ins. PP-Adv.) e.g. *A/long/time/ago...* or *...take a walk in/the/woods.* These seven linguistic categories are signaled by an arrow in figure 2.
For each linguistic category, all pauses, BPs and NBPs were counted and their durations were averaged across readings and subjects.

Results and Discussion

Breathing Patterns and Change of Rate

Figure 3 presents a sample of the oscillographic recordings of speech and breathing at three different rates for one subject. Each sample covers approximately the same time span, 13.08, 12.92 and 12.76 sec, respectively. At the slowest rate (124 words/min; WPM), 26 words are uttered in the 13-sec time span; two BPs occur: one after the first sentence *(A long time ago a little girl decided to take a walk in the woods)* and

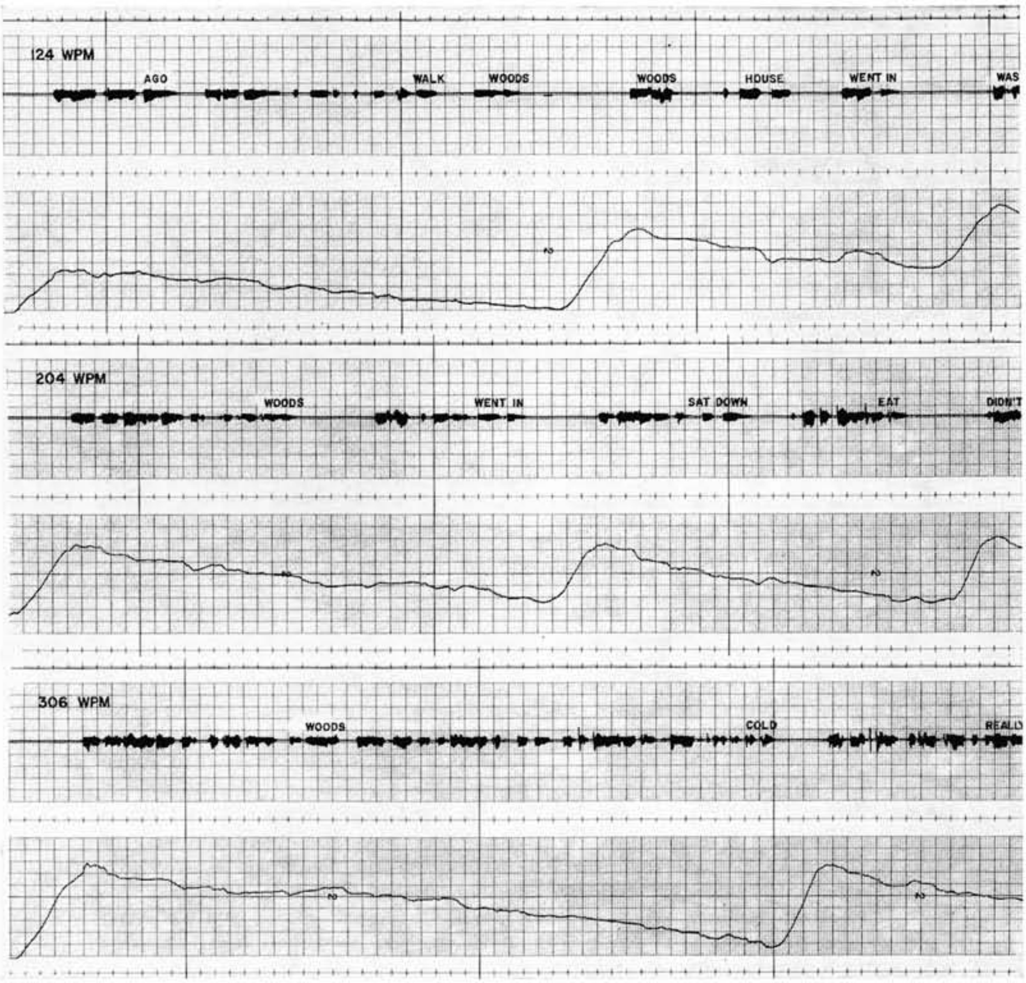

Fig. 3. Samples of the speech and breathing oscillographic recordings of one subject reading the *Goldilocks* passage at three different rates. The section of the passage that is of interest here is the following (each pause location and the rate, in WPM, at which it occurred are indicated): 'A long time ago [124] a little girl decided to take a walk [124] in the woods [124, 204, 306]. In the woods [124] she saw a house [124] and went in [124, 204]. She was very hungry so she sat down [204]. She saw a big bowl and began to eat [204]. She didn't like it because it was too cold [306]. She went to the next bowl. This one was too hot and she really didn't like it.' As the rate increases, pauses diminish in number and in length and NBP disappear almost completely.

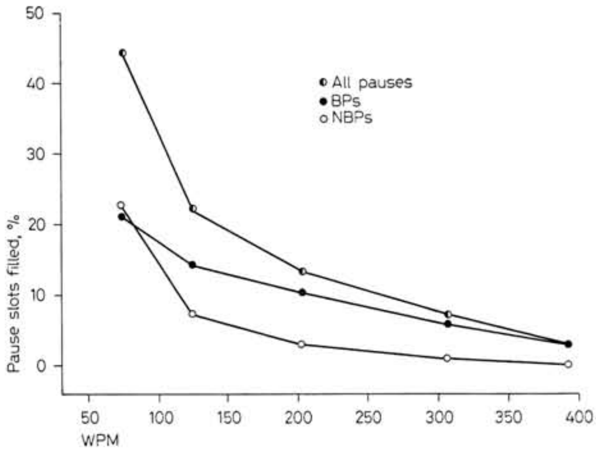

Fig. 4. Number of pauses in the passage (all pauses, BPs and NBPs) as a function of WPM. The ordinate is expressed as the percentage of the pause slots in the passage that are filled. Each point is the mean of twelve values, two by each of six subjects.

one after the second conjoined sentence *(In the woods she saw a house and went in)*. Four NBPs are also inserted, two in the first sentence and two in the second. At normal rate (204 WPM), again two BPs occur but the number of words spoken has almost doubled (44). The subject thus inserts less BPs per words uttered but still puts in a few NBPs (note that he no longer breathes after the first sentence although he maintains a pause). All pauses now occur at major constituent breaks. Finally, at the fastest rate (306 WPM), 65 words are uttered in the time span, all but one NBP have disappeared and only one BP is inserted. Both these pauses are now much shorter than the pauses that occur at 124 and 204 WPM. This small sample of a subject's speech and breathing is quite characteristic of the general results obtained across all subjects and gives a general picture of the breathing and pausing patterns which follow.

Figure 4 presents the percentage of pause slots (or word boundaries) filled by a pause as a function of reading rate (as the passage contains 116 words, the maximum number of slots is 115). The function for all the pauses (BPs and NBPs), is similar to that found by GROSJEAN [1972] and LANE and GROSJEAN [1973]. As rate increases, the number of pauses decreases rapidly, from one pause every 2.26 words at the slowest rate

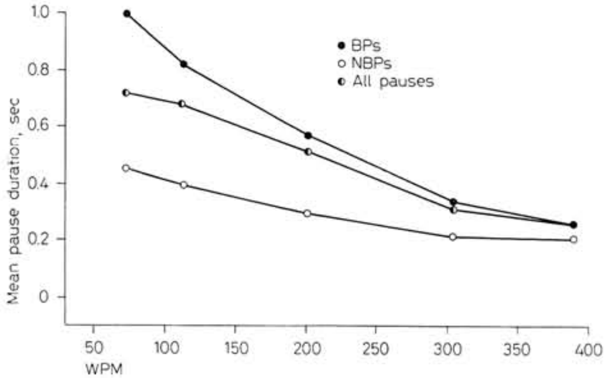

Fig. 5. Pause length for all the pauses, BPs and NBPs as a function of WPM. Each point is the mean of twelve values, two by each of six subjects.

(75 WPM) to one pause every 32.9 words at the highest rate (391 WPM). Both the BP and NBP functions follow the same trend, but at somewhat different rates. The steepest of the two functions is that of the NBPs; at the slowest rate, there are slightly more NBPs than BPs (23 as opposed to 21%) but then NBPs fall off rapidly so that at normal rate (201 WPM) they account for only 22% of all pauses (3% of the slots) and at the fastest rate they have practically disappeared. The function for the BPs falls off more slowly and merges into the function for the pauses at the highest rate, signifying that at fast rates, all the pauses inserted into one's speech are in fact BPs. This is not surprising: when asked to read or speak at very fast rates, the subjects attempt to delete all pauses (these slow down the overall rate and interfere with the smoothness of the articulation) but are stopped from doing so by the need to breathe; they will therefore pause only when their air reserve has been spent and will then inhale as quickly as possible. It is interesting to note that in Sign Language, where breathing and signing are unrelated, fast signing rates are completely devoid of pauses [GROSJEAN, 1978]; were breathing not linked to speech production in such an absolute way, one would expect speakers to adopt similar tactics when asked to increase their rate of speaking: i.e. articulate quickly and continuously.

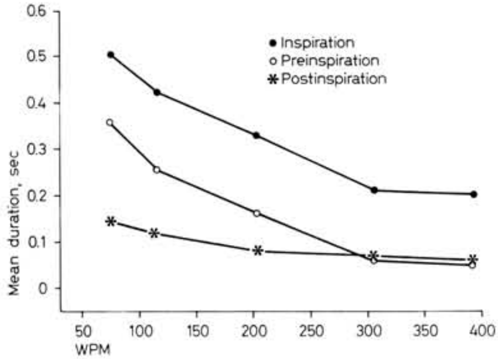

Fig. 6. Mean duration of the three components of a BP (preinspiration, inspiration and postinspiration) as a function of WPM. Each point is the mean of twelve values, two by each of six subjects.

These results, then, are a first indication that fluent pausing is not directly determined by the need to breathe: at slow rate there are just as many NBPs as BPs and at normal rate, one-fifth or all pauses are NBPs. It is only at rates faster than normal that the physiological need to breathe takes over and controls the occurrence of pauses.

Figure 5 presents the mean duration of pauses, BPs and NBPs as a function of rate of speaking. As rate increases, the duration of all three pause types decreases. The BPs have the longest durations across all rates; they remain practically twice as long as NBPs in four of the five reading rates. The function for the pauses is naturally situated between the BP and NBP slopes, but closer to the former slope, as BPs are longer and more numerous than NBPs. As was observed in the pause frequency graph (fig. 4), the pause function merges with the BP function at the highest reading rate, indicating again that almost no NBPs are left at rates ≥ 300 WPM.

There are two possible explanations for the fact that BPs are longer than NBPs. The first is that the action of inhaling (in BPs) requires more time than only stopping phonation (NBPs); this seems reasonable considering the complex physiological operations demanded of the inspiratory and expiratory muscles when a breath is taken. The second explanation is that BPs may occur only at important syntactic breaks and subjects naturally pause for a longer time at these breaks (e.g. End S) than at minor constituent breaks (e.g. Ins. NP), quite independently of whether or not they will breathe during the break. As will be seen in our linguistic analysis of BP and NBP locations, the first explanation would seem to be appropriate.

Thus, BPs, like NBPs, become shorter as rate is increased; but how are the preinspiration, inspiration and postinspiration components of BPs affected by change of rate? In figure 6, the mean duration of the three components of the BP are plotted as a function of WPM. The component that takes up the most time during the BP is the actual inspiration; but a great deal of the BP (especially at slower rates) is *not* taken up by actual breathing, as one might have expected had breathing constraints been controlling pause duration. About 36% of the BP at slow rate is made up of preinspiration time during which the subjects either maintain a constant subglottal air pressure or continue exhaling and 14% of the BP is made up of postinspiration time. As the rate is increased, the mean durations of preinspiration, inspiration and postinspiration decrease, but at unequal rates. From a mean duration of 0.37 sec at 75 WPM, preinspiration duration falls to 0.051 sec at 301 WPM (a seven fold decrease in duration) whereas inspiration and postinspiration times decrease only about two fold. This means that the subjects will shorten their BPs by mainly decreasing the preinspiration component. From this we can conclude that when the subjects are faced with a forthcoming pause of a given duration, in which they have decided to take a breath, they will fill as much of that total time with postinspiration and inspiration time (the latter can be stretched to quite an extent) and what remains will be allocated to preinspiration. As rate increases, inspiration and postinspiration times can fill up an increasing percentage of the planned pause time (at the fastest rate, the two account for 84% of the total BP time) and the preinspiration time is no longer required to play such an important role (at fast rates, mean pre- and postinspiration durations are practically identical).

It is interesting to note that mean postinspiration durations remain very stable across rates; this is due to the fact that inspirations only occur at the end of BPs, irrespective of the rate of speaking. The reason for this is that the subjects do not want to sustain the high subglottal pressure that follows inspiration for any length of time; it is much easier to maintain a subglottal pressure which is close to atmospheric pressure at the end of vocalization (during the preinspiration time)

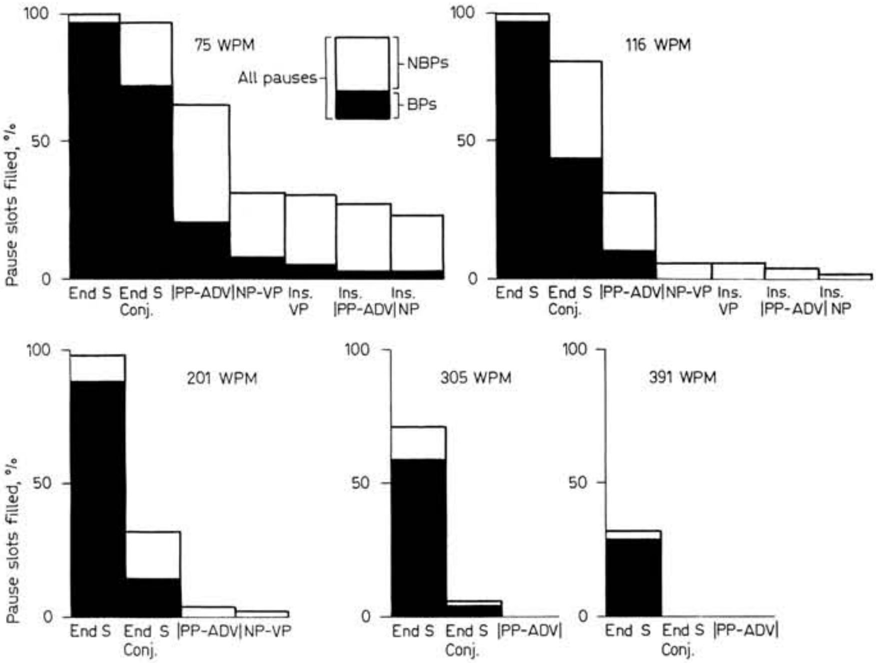

Fig. 7. Percentage of pause slots filled by BPs and NBPs at each of seven linguistic locations at five different rates. The abbreviations are explained in 'Data Analysis'.

than to inhale straight away and have to block the air for the remaining duration of the pause.

We have thus far seen that both BPs and NBPs are reduced in number and in length when reading rate is increased. In addition, almost all pauses at fast rate are made up of BPs; NBPs are always shorter than BPs and the amount of BP time allocated to preinspiration, inspiration and postinspiration varies with rate. In addition, two indications lead us to believe that the need to breathe (at least at slow and normal rates) is not in control of pausing but that on the contrary, breathing adjusts itself to pause patterns: on the one hand, not all pauses are NBPs and on the other, not all of the BP time is allocated to inspiration: 28% of the BP at normal rate and 36% at slow rate is taken up by preinspiration time.

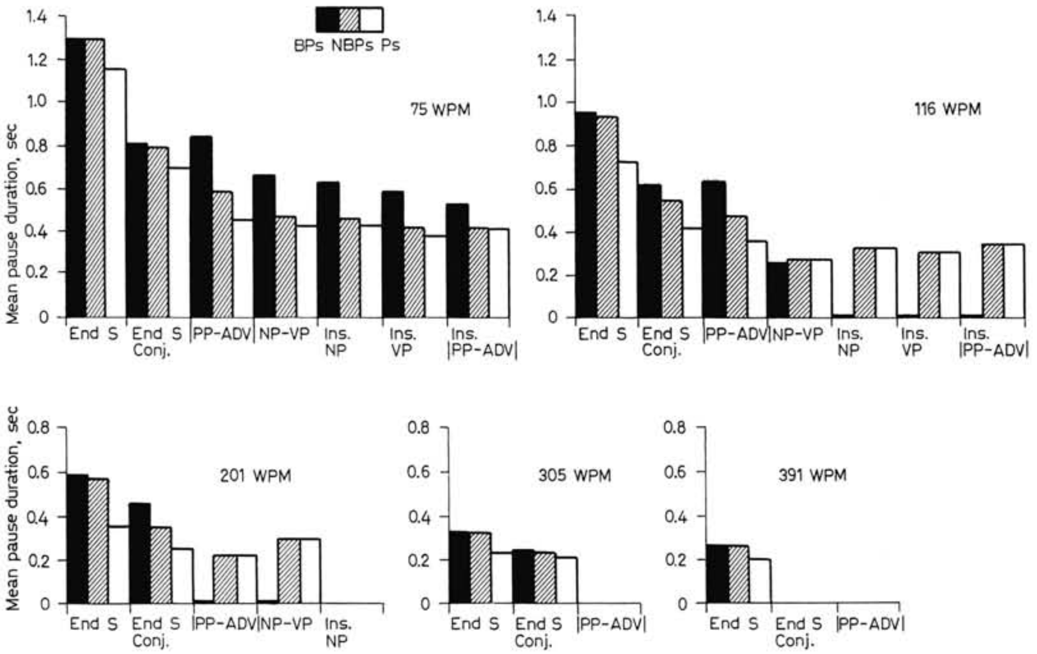

Fig. 8. The mean duration of BPs, NBPs and all pauses (Ps) at each of seven linguistic locations at five different rates. The abbreviations are explained in 'Data Analysis'.

Linguistic Distribution of BPs

Figure 7 presents the percentage of pause slots filled by BPs and NBPs at each of seven linguistic locations at five reading rates. As can be seen from the five histograms, the number of BPs at a particular pause slot is not only a function of the rate of reading of the passage but also of the linguistic status of that pause location. BPs occur mainly at major constituent breaks (for example, 78% of all BPs at 75 WPM are placed either at the End S or End S conj. breaks) but can also occur at minor breaks (inside VPs, NPs, prepositional phrases, etc.). However, as rate is increased, BPs very quickly disappear from these minor constituent breaks and at higher than normal and normal rates, they are confined to the two major breaks and finally only to the End S location. It is also at these very high rates that the subjects no longer take a breath at every sentence break (End S): only 58% of the pause slots at 305 WPM and 29% at 391 WPM are filled by BPs.

The frequency of NBPs at a particular pause slot is also determined by rate and the linguistic status of the pause location. However, very few NBPs ever occur at the End S break (this location is utilized mainly by BPs) and most are inserted at less important breaks. As was seen in figure 4, the absolute number of NBPs diminishes considerably as rate is increased and at rates faster than normal (305 and 391 WPM), the few NBPs that remain occur mainly at the End S break.

Thus speakers will prefer to take a breath at major linguistic breaks (although they can also occur at less important breaks when the rate is quite slow) and prefer to pause without breathing at minor breaks. When the rate is increased, the minor breaks no longer receive a pause and consequently, NBPs are the first to disappear.

Figure 8 presents the mean pause duration of BPs, pauses and NBPs at each of the seven linguistic locations at five rates. As for pause frequency, the mean duration of BPs and NBPs is not only a function of speaking rate but also of syntax. Both types of pauses are longer at the End S location than at any other location and as the linguistic importance of the breaks diminishes, so does the duration of BPs and NBPs. BPs are systematically longer than NBPs at every linguistic location. This eliminates the location explanation when accounting for the difference in duration of BPs and NBPs and leaves a physiological justification: stopping to take a breath is a very complex physiological operation and therefore takes more time than simply stopping phonation as in an NBP.

From this we can conclude that both the duration and frequency of occurrence of BPs are dependent on the rate of speaking *and* on the syntactic nature of the pause location. The more important a linguistic break (End S, End S Conj.), the longer and more frequent will the BPs be. But the absolute frequency and duration of BPs, at any linguistic location, will also depend on the speaking rate: as the rate is increased, BPs will become shorter and fewer. NBPs follow the same pattern but are always shorter than BPs and tend to occur primarily at minor constituent breaks.

Finally, the data counter the very strong claim that speakers only pause to inhale: many pauses in the readings were NBPs and not all of the BP time is allocated to actual inspiration. A third piece of evidence emanates from research in American Sign Language [GROSJEAN and LANE, 1977; GROSJEAN, 1978, in press]. In this manual-visual language, where breathing is not related to signing, signers also pause at important syntactic locations. In addition, when they slow down, they increase the number of pauses (following the syntactic hierarchy of the sentence) and lengthen these pauses. In fact, increasing and decreasing rate in sign and speech follows identical patterns except that at very fast rates, signers eliminate all the pauses whereas speakers must maintain a minimum number of BPs.

To conclude, it would appear that breathing in speech depends to a large extent on the speaker's preplanned pause patterns. Pauses, in turn, are controlled by such variables as rate of speaking, the syntactic importance of the boundaries and to a lesser extent by emphatic stress, sentence length and the tendency to bisect segments [GROSJEAN *et al.*, 1978]. If a pause in an utterance is supposed to be long (as determined by the above factors), and the speaker needs to take a breath, then inhalation will take place during the pause; but if the pause is supposed to be short, then no breathing will occur within that pause and the speaker will have to wait for the next important pause. This subservience of breathing to pausing is reversed only in the case of fast rates; then, the physiological need to breathe forces the speaker to stop in order to inhale – but he does so as rarely and as quickly as possible.

Acknowledgements

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Zusammenfassung

Atmen, Pausieren und Lesen

Eine Analyse der Atmungsmuster von Sprechern in einem Lesetest mit variabler Geschwindigkeit zeigt, daß Dauer und Häufigkeit von Atmungspausen sowohl vom Sprechtempo als auch von der syntaktischen Funktion der Pausenlokalisierung abhängen. Pausen, die nicht mit dem Atmen zusammenhängen, weisen dieselben Regularitäten wie Atmungspausen auf, sind aber immer kürzer und haben die Tendenz, primär an Grenzen niedriger Konstituenten vorzukommen. Bei langsamer und bei normaler Geschwindigkeit passen die Sprecher ihr Atembedürfnis an die vorweg geplanten Pausenmuster an. Bei schnellem Tempo ist jedoch die physiologische Notwendigkeit zum Atmen der einzige für die Pausensetzung bestimmende Faktor.

Résumé

Respiration, pause et lecture

Une analyse du mode respiratoire de locuteurs durant un test de lecture avec variation du débit montre que la durée et la fréquence des inspirations dépendent à la fois du débit et de la place de la pause inspiratoire par rapport à la syntaxe du texte. Les pauses non respiratoires obéissent aux mêmes règles que les pauses respiratoires, mais sont toujours moins longues et ont tendance à se produire principalement à la limite de constituants mineurs. Lorsque le débit est lent ou normal, les locuteurs insèrent leurs respirations aux endroits préalablement établis pour recevoir une pause. Lorsque le débit est accéléré, la nécessité de reprendre de l'air est le seul facteur déterminant des pauses.

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