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Development of Temporal Patterning and Vocal Hesitations in Spontaneous Narratives

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Narratives were told aloud by 12 boys and 12 girls at each of seven age levels in response to nine cartoon pictures. Speech rate increased with age, due to corresponding decreases in both legnth and frequency of unfilled pauses (UPs), although the two measures were themselves uncorrelated. Parenthetical remarks (PRs) increased with age, while repeats (Rs) decreased. Location of UPs (81% before function words) was stable over age levels. Comparisons with other experiments are made. Interrelationships of speaking and thinking are discussed in terms of the cognitive and linguistic functions of length and frequency of UPs, respectively. Theories that neglect multiple psychological determinants of speech behavior and/or concentrate on only one level or unit of encoding are rejected as inadequate.

INTRODUCTION

Temporal patterning and vocal hesitation in various types of speech have been studied by a number of researchers. Studies on the significance of unfilled pauses (UPs) and filled pauses (FPs) in spontaneous speech (speech produced in the absence of a verbal model) have been reviewed recently (Rochester, 1973). Although there is a lack of a general theory, all studies seem to have in common the basic assumption that UPs and FPs are functional for the speaker and can be related to emotional states and/or cognitive processes underlying his production of speech.

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A cognitive emphasis is adopted in the present research, which originated in the work of Goldman-Eisler (1968) and Maclay and Osgood (1959). The main goal of this approach is to investigate the dynamic interaction of language and thought at the very moment of speech production. Speech production is considered to be a process that involves planning, formulating, and executing successive speech events in real time. With respect to silent and vocal hesitations, the basic assumption is that "hesitation is to be taken as behavior which is synchronous with, and indicative of, encoding processes responsible for the generation of information" (Goldman-Eisler, 1968, p. 51). Analyses of speech are in terms of frequency, length, and location of UPs, FPs, repeats (Rs) and false starts (FSs), as suggested by Maclay and Osgood (1959).

Temporal patterning and vocal hesitation in the speech of children have been largely neglected in developmental psycholinguistics, although their investigation may well provide a partial answer to the puzzling question, "How does the child come to *improve* upon his language, moving steadily in the direction of the adult model?" (Brown, 1973, p. 104). Only a few studies have investigated temporal patterning from the viewpoint of language development. O'Connell and Kowal (1972) found an effect of age on the number of UPs in a reading task: both German and English adolescents produced more UPs than their adult counterparts.

Various types of proficiency, as reflected in the time pattern of speech, have been studied by Kowal *et al.* (1975). In experiment I, adult American *S*s of four levels of proficiency in a second language (German), including *S*s with no, intermediate, and good knowledge of German, and native speakers of German, were asked to read a paragraph (in German) and to retell it (in English). With increasing levels of proficiency, reading rate increased due to a significant decrease in the number of UPs.

In experiment II, second and fourth graders were again asked to read aloud a paragraph and to retell the story. Speech rate (syl/sec) for both reading and story retelling was higher for the older *S*s. Also, girls read at a faster rate than boys for both age levels. In reading, rate variations were due to frequency of UPs; in story telling, length of UPs determined speech rate.

In experiment III, *S*s of various educational levels (ranging from second graders to college professors) were asked to read a prose passage and three poems. Length and number of UPs increased at both ends of the educational continuum, indicating undeveloped skill in the youngest and rhetorical interpretation in the well educated. The results from all three experiments were thought to reflect both cognitive and linguistic functions of UPs.

One of the limitations of these experiments was the restriction to

particular types of speech, namely reading and story retelling. Speech production in both instances was largely determined by typewritten stimulus material, although only through memory in the latter case. Story retelling, then, can be considered only as a first step in the direction of spontaneous speech, i.e., unrehearsed speech, the content of which is organized at the moment of production. In such speech, "one may expect the relationship between speaking and thinking to reveal itself most naturally" (Goldman-Eisler, 1968, p. 9). A further limitation consisted of the small age range of the younger *S*s included in these studies.

The main purpose of the present experiment, therefore, was to study developmental trends in temporal patterning and vocal hesitation of more spontaneous speech by children at various age levels in order to provide normative data on language development. Due to the exploratory rather than hypothesis-testing nature of the experiment, hypotheses were stated in a rather general manner. Older children should produce speech at a faster rate due to shorter and less frequent UPs. An interaction of age and sex should occur for temporal aspects: with increasing age, the differential (higher) frequency of UPs found in experiment II (Kowal *et al.*, 1975) for young boys compared with girls should disappear. Vocal hestiations which reflect lack of linguistic skill (Rs and FSs) should decrease over increasing age levels.

Since research by Levin and Silverman (1965) showed that the presence of an audience did affect temporal patterning and vocal hesitation in the speech of children, social context was included as a further variable. It was hypothesized that *S*s who spoke in the presence of two unfamiliar *E*s would be less fluent than *S*s with whom a peer was also present.

METHOD

Speech was elicited by nine pictures from a "Snoopy" cartoon without verbal cues. The pictures were on 2½- by 3-inch cards covered with clear plastic and depicted a dog, a girl, and a balloon. The pictures allowed a variety of arrangements into narrative sequences.

A total of 168 *S*s, 12 boys and 12 girls at each of seven age levels (in years and months; at all levels, range $\leqslant 2.1$), were included: kindergarten (K, 5:10), grades 2 (8:0), 4 (9:11), 6 (11:11), and 8 (14:1), and high school sophomores (16:2) and seniors (18:1). No attempt was made to control for IQ, school achievement, or socioeconomic level. For each age level, however, *S*s were recruited from two schools to balance selection peculiar to any one school, residential area, or teacher. All were white with no diagnosed speech disability.

Two social contexts were used. Half of each age group (six boys and six girls) were run individually, in the presence of two *E*s, and half were run in boy-girl pairs. In all instances, both *S*s belonged to the same class, and the same two *E*s were present.

The *S*s were presented with the nine pictures spread out at random (but similarly for all *S*s) on a table. Standardized instructions could not be used because of the wide age range of *S*s. All *S*s were asked to arrange the pictures in one row (working alone, or together in the pair context) so that they would tell a good story, and then to tell the story.

Tape recordings (Telefunken Magnetophon 300 TS) were made of all stories. The microphone was placed directly in front of the *S* in order to secure recordings of high quality with as little background noise as possible, and *S*s were told that their speech would be tape-recorded. It was assumed that they would get used to the presence of the microphone while they were arranging the pictures.

For each story, a verbatim typewritten transcript was made without corrections and punctuation. The tape recordings were transferred to a Brüel and Kjaer audio frequency spectrometer (type 2112) and level recorder (type 2305), yielding a graphic record of the acoustic energy in terms of amplitude over time, from which all temporal responses could be measured directly.

The minimum length of UPs was 270 msec. They were defined by length alone and therefore included also whatever juncture pauses exceeded 270 msec. Filled pauses (FPs) were defined as *uh, ah,* and *hm.* Repeats (Rs) were defined as in Maclay and Osgood (1959). Because of the danger of arbitrary designation, false starts (FSs) were defined according to these conventions: (1) correction of a noun phrase (e.g., *then the dog then the girl*); (2) correction of a word (e.g., *now he's let leavin' home*); and (3) incomplete utterances (e.g., *Snoopy uh has a is about to leave*). Parenthetical remarks (PRs) were defined as in Levin and Silverman (1965). They included words which were considered to function as verbal fillers rather than to convey information (e.g., *well, you know,* and *sort of*).

Rate of speech was measured in syl/sec as in O'Connell *et al.* (1969), although a number of studies have used a word/sec measure. This was necessary because in many instances it was impossible to define a word with any intersubjective reliability. The FPs were included in the syllable count.

The location of UPs was analyzed in terms of their occurrence before function and content words. Function words were defined according to Miller *et al.* (1958).

Table I. Total Number of Vocal Hesitations of All Types and of Subordinate Conjunctions for Age Levels

Age	FPs	FSs	Rs	PRs	Subordinate conjunctions
Kindergarten	32	60	48	3	14
Grade 2	51	50	34	24	24
Grade 4	43	85	41	42	37
Grade 6	41	31	18	23	42
Grade 8	33	29	25	50	73
Sophomores	46	37	18	79	63
Seniors	29	29	12	70	67

RESULTS

Speech samples were analyzed in terms of content and function words. The percentage of content words was quite stable over experimental conditions (30.9-37.3%).

To facilitate comparisons with other studies, mean number of syl/word was calculated (range across all factors 1.2-1.3 syl/word).

A number of researchers have used units larger than the word in spontaneous speech to assess encoding units in accord with linguistic concepts. But their criteria for the identification of phrases, clauses, or sentences either have been unstated (e.g., Hawkins, 1971; Goldman-Eisler, 1972) or have excluded parts of the speech samples (e.g., Maclay and Osgood, 1959). In the present experiment, speech samples were analyzed only in terms of word units, as in Martin's (1967, 1968) research. The total frequency of various subordinate conjunctions across age levels is shown in Table I. Of these, 75.7% are *that, because, when,* or *what.*

Temporal Aspects

The statistical design was 2 X 2 X 7 (sex X social context X age) analyses of variance. For number of syllables, syl/sec, syl/UP, and UP length/syl, the main factor of age was significant: $F = 3.83$, $p < 0.005$; $F = 29.57$, $p < 0.001$; $F = 8.93$, $p < 0.001$; and $F = 13.20$, $p < 0.001$, respectively (df = 6, 140). The corresponding means and standard deviations are presented in Table II. Newman-Keuls tests indicated that successive age levels were significantly different as follows: for syl/sec, K-2 ($p < 0.01$), 2-4 ($p < 0.05$), and 6-8 ($p < 0.01$); for syl/UP, K-2 ($p < 0.05$) and 6-8 ($p < 0.05$); and for UP length/syl, K-2 ($p < 0.05$).

Table II. Means ($\bar{X}$) and Standard Deviations (SD) for Significant Main Factor of Age in Analyses of Variance

	Number of syllables		Syl/sec		Syl/UP		UP length/Syl	
Age	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD
Kindergarten	80.3	31.0	2.15	0.75	5.5	1.9	293	239
Grade 2	94.2	24.1	2.86	0.53	7.4	2.2	120	72
Grade 4	107.5	36.4	3.24	0.51	7.6	2.8	101	45
Grade 6	89.9	30.7	3.26	0.66	7.3	2.5	114	68
Grade 8	111.8	39.0	3.83	0.50	9.4	2.4	77	45
Sophomores	113.8	25.5	4.00	0.51	9.9	3.2	74	26
Seniors	116.5	43.4	3.84	0.52	10.0	3.2	89	37

For UP length/syl, the main factor of sex was also significant: $F(1, 140) = 5.10$, $p < 0.05$. Males showed a greater UP length/syl (in msec) than females ($\bar{X}$, $142 > 106$; SD, $106 > 80$). No other main factors or interactions were significant.

For the pair context, t tests for *S*s who told the story first or second did not yield significant differences.

The relationship between location and length of UPs was also determined. When the data were analyzed according to age levels, in six out of seven cases the mean length of UPs before content words was shorter than before function words ($629 < 887$ msec). The UPs preceding proper names which occurred in the stories were much longer (1029 msec) than UPs preceding other content words. The overall mean percentage of UPs prior to function words varied nonsignificantly from 70.8% to 87.8% across the three main factors. Of the function words, 53% consisted of the coordinate conjunctions *and, then,* and *so.*

The product-moment correlation coefficient was determined over *S*s for frequency and length of UPs. No systematic relationship between the two response measures was found ($r = -0.07$). In order to assess the relative effect of both length and frequency of UPs on speech rate, product-moment correlation coefficients were also calculated for UP length/syl and syl/sec ($r = -0.63$), and for number of syl/UP and syl/sec ($r = +0.68$).

Vocal Hesitations

The total numbers of vocal hesitation types across age levels are presented in Table I. The UPs (nonvocal) contributed 69.0% of all hesitations, FSs 9.0%, PRs 8.4%, FPs 7.9%, and Rs 5.7%.

A number of researchers (e.g., Maclay and Osgood, 1959) have suggested that vocal hesitations to a large extent reflect individual differences in speech style. In the present research, such is not the case. The percentage of *Ss* who use each type of hesitation at least once is in every instance more than half of the group; for FPs, 60.7%; for Rs, 57.8%; for FSs, 73.8%; for PRs, 62.5%.

The location of FPs before content and function words was determined. Of all FPs, 39.3% occurred before content words.

The Rs were analyzed in terms of the size of the repeated unit. When divided into the categories of one syllable, one word, and more than one word, it was found that 47.4% of all Rs included one word, most often a function word; in 28.6% of the cases, more than one word was repeated. The Rs of one syllable only were restricted to kindergarteners and second and fourth graders.

Concurrence of UPs with various types of vocal hesitation was peculiar to each type and was divided into four mutually exclusive categories: UP precedes and follows (e.g., UP-R-UP), UP precedes only (e.g., UP-FS), UP follows only (e.g., FP-UP), and UP does not concur at all. Of all FPs, 47.9% were in the FP-UP category; the Rs were typically in the UP-R category (66.1%), never in the R-UP category; of all PRs, 56.6% did not concur at all with UPs; and FSs occurred almost as often in the FS-UP category (31.9%) as in the nonconcurrence category (33.6%).

DISCUSSION

Effect of Age

The hypothesis regarding age was manifestly confirmed. Speech rate increased steadily with age up to high school sophomores, and the acceleration was due to both frequency and length of UPs. Younger *Ss* produced fewer syllables between UPs and needed more time to plan these shorter speech segments. This result is noteworthy because frequency and length of UPs were found to be uncorrelated. It is also remarkable because Kowal *et al.* (1975) reported that rate variations in reading due to age were accounted for by an increase in frequency but not length of UPs. They found that differences in rate of story retelling, on the other hand, were accounted for by differences in length only (not frequency) of UPs. Apparently the present study deals with a type of speech different from both reading and retelling a story. Both of the strategies available to facilitate speech generation reflect age trends: a shortening of the units produced (between UPs) and a lengthening of the time period (UP) during which speech output is withheld.

Significant changes in speech rate over successive age levels were restricted to three transition points, and so four age clusters could be distinguished (see Table II): (1) kindergarten, (2) second graders, (3) fourth and sixth graders, and (4) eighth graders, sophomores, and seniors. Phrase length (syl/UP) has consistently proven to be a considerably less reliable measure than syl/sec. Only two transition points occurred for phrase length: between kindergarten and second grade and between sixth and eighth grade. Only one significant transition point was found for UP length/syl (which in turn has been less reliable in previous research). It occurred between kindergarten and second grade.

Developmental changes of verbal skills at specific age levels have also been reported by O'Donnell *et al.* (1967), where they occurred between kindergarten and first grade and between fifth grade and seventh grade. These data are in agreement with Piaget's (1970) periods of cognitive development, and they suggest a close relationship between linguistic and cognitive development (Palermo and Molfese, 1972; Slovin, 1971).

Effect of Sex

The expected interaction between age and sex for temporal patterning was not found. Instead, sex had a main effect on only one response measure, length of UPs: boys produced longer UPs than girls at all age levels except eighth grade. This result indicates that sex differences in fluency of speech production are established early in life and are maintained throughout further speech development.

Effect of Social Context

No effect on any response measure was observed for the factor of social context. Apparently the emotional state of *S*s was not altered by the presence of a peer in a way that would be reflected in temporal aspects of speech. In view of the "cognitive hypothesis" about the function of UPs, the absence of any social-context effect reflects the fact that the verbal models given to the second speaker by the first speaker were not used facilitatively in any group by the second speaker. Such facilitation might have reduced both length and frequency of UPs, as occurred in the study of Goldman-Eisler (1968).

Vocal Hesitations

Although the hypothesized decrease in FSs over increasing age levels was not found, age-dependent frequency variations were observed for PRs and Rs

(an increase and decrease, respectively, with age level). The PRs seem to be inserted into ongoing speech to avoid (silent) interruptions and allow continuous speech at points where the speaker does not know how to start or to continue an utterance. The use of such a rhetorical device is part of the acquisition of verbal skills. The Rs, on the other hand, which practically disappear in older speakers, seem rather to indicate a lack of verbal skills. They signal that a speaker has started an utterance before adequately planning it.

The frequency of vocal hesitations was generally very low. This result does not seem to be due to the size of the speech sample. Stories in the present experiment averaged 102 syl (85 words), long enough to yield a stable index of UPs (Goldman-Eisler, 1954). Levin and Silverman (1965) also analyzed speech samples of the same type, but with 500 words on the average, and reported a low overall occurrence of vocal hesitations. A similar result was found by Levin *et al.* (1967).

Hence the results seem to indicate characterisitcs of the cognitive processes accompanying narrative speech production, but not the irrelevance of such hesitations for speech production in general. A study of dialogue, in particular, would seem a more promising way to investigate vocal hesitation, much as Jaffe and Feldstein (1970) have done already, but with the methodology of the present research for purposes of comparison. A speech situation which emphasizes accuracy of expression and/or allows for verbal interaction between interlocutors might well increase the monitoring effort required for speech production and consequently increase vocal hesitations.

These results also indicate that narrative speech which is generated spontaneously can be far less erratic and ungrammatical than has often been assumed. The "myth of the ungrammaticality of spoken language" (Labov, 1970, p. 42), according to which spontaneous speech is "a kind of hodge-podge of false starts, incomplete sentences, and so on," may well be a "gross exaggeration" by linguists rather than psychological reality (Brown, 1973, p. 99).

Location of UPs

None of the main factors in the experiment had any effect on location of UPs. About 81% of all UPs occurred before function words, a result in close agreement with the finding of Kowal *et al.* (1975) that 83% of the UPs in story retelling of second and fourth graders preceded function words. German adults in the study of O'Connell *et al.* (1969) also paused more often before function words (63%) than content words. Maclay and Osgood's

(1959) observation that only 35.6% of all UPs preceded function words may be only an artifact due to their methods of selection and analysis of speech samples (see O'Connell *et al.*, 1969, p. 65).

The fact that even for the youngest children phrases between UPs averaged 5.5 syl or 4.6 words (see Table II) and the fact that frequency of UPs before content words was low both suggest that the process of selecting individual words separately (as a process distinct from planning an entire utterance) was of minor importance in the present sample. It is evident that a model of the speaker which emphasizes encoding processes on a word-to-word level as *the* important process in transforming ideas into overt speech behavior is inadequate.

In fact, it seems more difficult to stop ongoing speech in order to select individual words and then continue an utterance than it is to produce contents which are embedded in syntactic structures. Some implications of these empirical findings are reflected in a statement by Slobin (1971). Due to restricted memory capacities and the sequential processing and production of speech in real time, there must be in the child "a pressure to preserve the internal or underlying structure of linguistic units in their surface manifestations" (p. 352).

A difference between encoding processes for planning utterances and searching for individual lexical items is suggested by the interaction of length and location of UPs. The longest UPs occurred before proper names; UPs were shorter when preceding function words and even shorter when preceding content words other than names, a result which confirms Hawkins' (1971) data. Apparently it is more time consuming to select one specific word (such as a proper name) than it is to choose among optional semantic alternatives. Or, in other words, a speaker's tolerance for his own silence is higher when he is preoccupied with the search for a specific lexical item.

It should be evident from the preceding discussion of location of UPs that the findings of this study are not in accord with theories that neglect multiple determination of location of UPs and/or concentrate on either a word-to-word level of analysis or any one unit of encoding. Both Goldman-Eisler's (1968, p. 125) insistence on semantic and lexical determinants to the exclusion of syntactic determinants and Boomer's (1965, p. 157) insistence on the phonemic clause to the exclusion of the word as "the molar encoding unit of speech" are therefore equally unacceptable.

Comparisons

Since speech rate has been found to be a quite reliable response measure in the research of O'Connell and his associates, some comparisons are

warranted. For three different types of speech–retelling a story just read, reading (Kowal *et al.*, 1975), and spontaneous narrative in response to pictures in the present experiment–for second graders the syl/sec rates were $1.59 < 2.16 < 2.86$ and for fourth graders $2.37 < 2.97 < 3.24$, respectively. For older *S*s, the relative order of magnitude was different. The speech rate of adolescents, with a mean age of 14:9 and 16:1 in the study of O'Connell and Kowal (1972) and the present study, respectively, was fastest when they read (4.99), slower when they told a narrative in response to pictures (3.89), and even slower when they retold a story after a verbal model (3.22). The same ordering occurred for adults, although both reading rate (4.47) and speech rate for retelling (2.62) were reduced.

CONCLUSIONS

The psycholinguistic approach adopted in the present research should be regarded as only part of a more general theoretical approach to speech behavior. The authors consider the study of spontaneous speech production both important in itself and to date a seriously neglected approach to psycholinguistic research. The methodology based on temporal aspects of speech production engages psychological processes without undue dependence on linguistic theories. It clearly reflects the multiple psychological determinants of speech behavior with considerable reliability. Of these determinants, those concerned with acquisition processes have been primarily engaged in the present research.

Developmental changes in temporal patterning and vocal hesitations are interpreted so as to reflect both their cognitive and linguistic functions in narrative speech. The task in the present experiment, it is hypothesized, entailed at least two processes. The content of the pictures had first to be recognized and have some meaning attributed to it. Then the product of this thought process had to be realized acoustically through the verbal skills of a given age level. The general *cognitive* ability to derive meaning from the pictures, especially the ease with which some logical action sequence between successive pictures could be established, is assumed to be reflected inversely in *length* of UPs, i.e., in the time needed to focus on central rather than peripheral activity. *Linguistic* skills related to the use of more or less complex structural verbal patterns are assumed to be reflected in the *frequency* of UPs. In general, a younger child needs more time to recognize the meaningful context and has to stop overt speech activity to think, because he cannot manage both simultaneously. The limitations of both his linguistic skills and

memory preclude longer sequences of uninterrupted speech and are correspondingly reflected in a higher frequency of UPs.

The distinction of linguistic and cognitive processes, of course, does not imply that the two processes do not overlap. In fact, the finding that the respective response measures change significantly at the same age periods suggests that cognitive and linguistic skills develop concurrently in children.

In summary, the interaction between language and thought in narratives produced by the adult speaker can be characterized as follows. The adult has at his disposal both overlearned linguistic skills and the ability to establish a meaningful overall context. Consequently, he will not have to think as much about how to put his thoughts into words. He will be able to think ahead while he is acoustically realizing what he thought out before. Thinking and speaking will most typically occur simultaneously but with a content-related time lag. Such a speaker will not need as many and as long UPs devoted to central processes as a speaker whose linguistic skills are more limited, and who is therefore not able (as yet) to think and speak concurrently about varied contents.

One important aspect of language development therefore seems to consist of learning to produce overt speech without the necessity of deliberate control, so that thinking and speaking can be carried out simultaneously and without interference, although always with a content-related time lag.

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