

MULTI-DISCIPLINE ANALYSIS OF SUBVOCALIZATION EFFECTS ON COMPREHENSION

JAMES L. LAFHEY
James Madison University
DONNA KELLY
Rockingham County Schools

Subvocalization is an activity which cuts across disciplines. It occurs while students read in science, social studies, and English materials. It is pervasive, yet not understood. Furthermore, it is a language behavior which has been a subject of controversy in the discipline of reading for many years. Some educators' views reflect Huey's thinking (1908):

There can be little doubt that the main meaning comes to consciousness only with the beginning of the sentence utterance, and the reader does not feel he has the complete sense until he has spoken it. He is almost sure to deliberately say the passage over to himself if it is difficult and persons who do not read very much must usually use an actual whisper, even in easy reading, if the meaning is to be obtained. (p. 147)

The opposite viewpoint, that subvocalism is detrimental to the reading process, can be traced to proponents of the silent reading method which emanated from the discovery that silent reading was faster than oral reading (Buswell 1945).

Currently, most authorities agree that subvocalism does occur among readers of all ages. In addition, it is widely regarded as a negative phenomenon (Bond and Tinker 1973, Ekwall 1970, Spache 1976, Smith 1978) in spite of a growing body of evidence to the contrary.

In a recent search of the literature, covering the years from 1966-1981, relating subvocalization to reading and language comprehension, there were approximately one hundred fifty studies reported. Generally, these studies can be broadly classified into the following four areas: 1) subvocalism and its incidence in early childhood language behavior, 2) the relationship of subvocalism to rate of reading, 3) the effect of feedback and suppression of subvocalism on related language behaviors, and 4) verbal mediation and its impact on cognitive behaviors.

While the literature search clearly indicates that there has been a great deal of research conducted on subvocalism during reading and other related language behaviors, there has been no definitive attempt to summarize and synthesize the research in this area. The purpose of this paper is to examine a select group of reports which were prominent in the four areas mentioned in order to: 1) identify the current state of knowledge about subvocalism, 2) clearly delineate what implications there are for teaching in developmental programs, remedial programs, and in content reading, and 3) suggest what future directions research in this area should take.

CURRENT STATE OF KNOWLEDGE

Subvocalism and Language Development

There have been a number of investigations which have reported on the incidence of subvocalization among young children performing different language tasks. Amodeo (1975) investigated one aspect of developmental progress in language acquisition, "private speech" (a form of subvocalization), especially as it relates to monolingual and bilingual children. All the children exhibited private speech. There were differences in the quantity of subvocalization and the differences indicated that bilingual children exhibit less private speech than monolingual children. Dickie (1973), in an earlier study which focused on private speech reported that 1) more private and social speech occurred when peers were in the room than when parents

were there, and 2) more private speech occurred during free play than during a structured task.

Garrity (1973) investigated the relationship of subvocalization to recall on short term memory tasks. She found that 1) subvocalization and short term memory were significantly correlated, 2) the correlation between subvocalization and short term memory was higher for boys than for girls, and 3) finally, subjects who subvocalized most had significantly higher recall scores than subjects who subvocalized the least. In a subsequent study (1975) involving the levels of subvocalization as related to picture presentation and verbal tasks she found that the amount of subvocalization is significantly related to the amount of recall. She also found that younger, slower children subvocalized less than older, brighter children. Furthermore, Garrity (1977) while conducting research on subvocalization and short term memory, noted that preschoolers as young as age four engaged in spontaneous subvocalization.

Ringwald (1978) conducted an investigation which focused on the role of subvocalization in short term memory as it relates to beginning reading instruction. She found that the high correlation between memory tests, reading test scores, and subvocalization is a significant predictor of reading ability at the beginning stage. She reported also that the combination of mental age and subvocalization was a significant predictor of reading at the beginning stage. Uchida-Nobuko (1955), while working with a group of five year olds, found that both internal (subvocalization) and external verbalization facilitated learning and sentence comprehension. Locke and Fehr's investigation (1970) of speech code and recall among four and five year olds led them to conclude that the nature of an individual's short term memory is shaped to some extent by the phonetic characteristics of the implicit response to the material. They suggested that a critical function of the speech code is that of mediating the environment.

Subvocalism and Rate of Reading

A major thrust of subvocalization research over the years has centered on gathering empirical data on the effect of techniques designed to reduce or eliminate subvocalization. Researchers who considered subvocalization detrimental to the reading process because it was viewed as a deterrent to rate of reading used delayed auditory feedback (DAF) and biofeedback training to decrease subvocalism. A major issue that appears to have been overlooked by the critics of subvocal activity is the differences in the various levels of the activity itself as identified by Edfeldt (1960):

- 1) Saying or loud whispering of almost every word.
- 2) Faint whispering of many words.
- 3) Pronounced lip movements but no sound.
- 4) Faint or no lip movements, no sound, but sufficient movements of the tongue to be felt by the fingers under the lower jaw.
- 5) No sound, no movements of lips or tongue, but movements in the throat perceptible to the fingers if placed on the throat.
- 6) No sound, no movements of lips or tongue or in the throat directly perceptible to an observer, but movements which can be registered by means of electromyography.

Oviously, the first two levels which actually involve production of speech would limit rate of reading to an oral reading rate. The next two levels involve lip movement, but no sound could presumably occur at a somewhat faster rate. The last two levels involve little motor activity. Therefore, it seems reasonable to assume that rate would be faster.

Verification of this theory appears to have been provided from research by Laffey (1966) which showed that rate of subvocalization increased parallel to rate of presentation by machine until a saturation point was reached. In addition, Feldman's research (1974) showed that rate of subvocalization increased as rate of silent reading increased. In fact, silent readers produced the most speech muscle activity. This nullifies

Smith's contention (1978), which, incidentally, was not supported by empirical data, that silent reading is too fast for subvocalization to occur. Riley and Lowe (1981) also concluded that subvocalization is not related to rate of reading after unsuccessfully attempting to reduce or eliminate it through biofeedback training.

It would appear that both the rate of reading and the rate of subvocalization adjust according to the difficulty of the material, decreasing as the material becomes more difficult to understand and increasing as less difficult material is read. In other words, difficulty of the material is the apparent determinant of rate of reading as well as rate of subvocalization.

Suppression and Feedback

An important aspect of the suppression research, which is critical in terms of understanding the role of subvocalization in reading and language comprehension, deals with its effect on short term memory. The researchers who used delayed auditory feedback or had subjects count aloud during reading have reported that either 1) the suppression of vocalization did not have a detrimental effect on comprehension (Bergering 1975, Colle 1973, Ferrara 1977) or 2) that the suppression of subvocalization did in fact interfere with comprehension (Donovan 1977, McGuigan 1973, Cole and Young 1975, and Wells 1976).

While the argument can be made that having subjects count aloud while reading would cause direct interference in comprehending the printed message, other research which contends with a related issue, that of determining what happens when subvocalization is permitted to occur naturally without any attempt to suppress it in any manner, clearly suggests that it aids in short term memory and reading comprehension. McGuigan (1974) indicated that subvocalization facilitated the reading proficiency of college students. Izzo (1975) found that an increase of subvocalization in his subjects increased comprehension. Keeny et. al. (1967) utilized verbal rehearsal training with six and seven year olds which resulted in improved recall scores.

Verbal Mediation—The Integrative Factor

While subvocalism has frequently been considered as a kind of undesirable behavior which either inhibits effective reading or has a serious detrimental effect on such cognitive behaviors as reading comprehension, some writers view subvocalization as an essential mediation strategy which connects print and language. According to Laffey (1966), one indication of the significance of oral reading to successful silent reading is the role that vocalism or covert language plays in the silent reading process. It is well known among reading educators that when a person encounters difficult material and wants to understand that material, he/she will often read the material so that some voice mechanisms can be heard or observed by others viewing the person reading silently. In any attempt to retain information, an individual, at whatever level of reading, will often read the material both silently and orally, so that the material is processed consciously and overtly through the language center of the brain, in both the auditory and visual channels. Furthermore, it is not only a matter of retention when considering vocalism during silent reading, but also a matter of basic understanding. When a person wants to be sure that he is understanding an idea or concept, he will attempt to process the language through both channels again, thus, enabling him to understand the concept as he is reading silently.

Aarons (1971) conducted an experiment with a group of

mature readers who were classified as high or low subvocalizers and concluded that theoretically subvocalization "may amplify meaning in the externally directed thinking of reading." Hardyck and Petrinovich (1970) concluded that subvocal speech is a useful stimulus to mediate cognitive responses. Levy (1975) while investigating the question as to whether phonemic or auditory processing is beneficial during reading worked with over 150 high school and college students in three experiments and found that 1) speech-motor activity during reading plays a useful information-processing role, 2) suppressing subvocalization by asking students to count while reading dramatically depresses retention, and 3) that the auditory channel was superior to the visual channel in processing information. This author viewed these findings as indicating that the suppression procedure is one in which the speech activity usually associated with the comprehension process is prevented from operating naturally as it does when a reader subvocalizes while reading silently. Essentially, then, subvocalization as viewed and described in these studies is the mediational bridge that connects printed symbols to the cognitive processing of language. This view, of course, is different from that of the psycholinguists who contend that reading is a matter of going from print to meaning without any mediational step.

Tarver et al (1977) provides further enlightenment on the role of subvocalization as a mediational strategy. These researchers conducted an experiment which supported the hypothesis that selective attention deficits in children with learning disabilities, as well as inadequate verbal rehearsal strategies, as compared to the strategies employed by typical children, represent a developmental lag rather than a more permanent defect in learning and/or information processing. This is consistent with Hagen's (1975) viewpoint that selective attention develops with age and is particularly relevant to the notion that verbal mediation strategies facilitate the development of short term memory (Belmont and Butterfield 1971, Bristow 1976, Ellis 1970) and selective attention (Hagen and Kail 1970). Furthermore, since these two aspects of information processing are thought to be basic psychological processes upon which all higher levels of cognitive processing are dependent, there is a resultant developmental delay of higher levels of cognitive functioning among learning disabled children. It is important to note that subvocalization is viewed as a key verbal rehearsal strategy reported in this study. Flavell et al (1966), who also viewed spontaneous verbal rehearsal in memory tasks as a function of age, suggested that verbal rehearsal requires certain intellectual competencies and a demonstration of sustained attention. He noted a continued increase in verbalization from 2nd to 5th grade.

According to McGuigan and Winstead (1970), the phonetic code facilitates semantic processing and subvocalization aids efficient processing by serving as the mechanism for retaining information from long term memory. This is particularly enlightening when considered with Perfetti and Goldman's contention (1976) that short term memory capacity is not as important as the efficiency with which it's used. Subvocalism would appear then to develop the capacity of short term memory, as indicated in research discussed earlier, and promote efficiency of its use as well, by facilitating the retrieval process.

Oral reading, the overt form of subvocalization, serves as verbal mediation with reading disabled students. The use of oral reading techniques on a regular basis resulted in statistically significant gain scores in a number of studies (Laffey, Kelly, Perry 1980, Laffey and Kelly 1981, Negin and Rios 1980, Title I

Report 1981—in preparation). Perhaps the effectiveness of this verbal mediation strategy can be explained when one considers Farnham-Diggory and Gregg's (1975) research which showed that poor readers have an asynchrony between the auditory and visual channels. Obviously, verbal mediation would tend to have a synchronizing effect. The researchers concluded that the attentional control mechanisms for the reading process were vested in the auditory channel.

Lassen (1978), while investigating brain blood flow activity during silent and oral reading, observed that "it is now apparent that during a (neurological) test involving a specific type of function (i.e., speaking, thinking, listening) there is a local change in nerve-cell activity and hence in metabolic rate that gives rise to an increase in blood flow in the active (brain) region." Furthermore, he states later in his paper "the resting pattern of blood flow in the brain of a normal subject is highly characteristic and reproducible and it serves as a point of departure for the interpretation of the functional patterns recorded during different types of sensory, motor, and purely mental activity. With this information as the logical and empirical bases of his investigations he noted that reading silently and reading aloud involved different blood flow patterns of activity in the cortex. Reading silently activated four cerebral cortex areas: 1) visual association area 2) the frontal eye field 3) the supplementary motor area and 4) Broca's speech center in the lower part of the frontal lobe. Reading aloud, on the other hand, activates these four regions plus three more centers: 5) the mouth area 6) the auditory cortex and 7) the primary visual cortex. What appears to be exceptionally significant about this neurological data is that subvocalization has been noted as a technique that individuals use to provide auditory feedback as a rehearsal strategy. Also important to note is the reality of Broca's speech center functioning during silent reading. This phenomena would seem to lay to rest the notion that it is possible, while reading, to go from print to meaning. Since Broca's speech center is functioning during silent reading, this clearly suggests that reading is a matter of going from print to oral language (speech) to meaning. Further arguments to support this point of view come from the work of Aarons (1971) who notes that speech is a complex skill with auditory and kinesthetic components. In reading vision, speech and its auditory, kinesthetic and sensory motor components coordinate intermodally and intramodally all of these complex elements. It seems reasonable then to suggest that subvocalization is an unconscious and sometimes conscious technique readers use to not only integrate these complex elements but also use it as a verbal rehearsal strategy. This latter activity appears to fit within Osgood's mediational hypothesis which describes the visual, auditory, and motor sensory integration as a basis for verbal learning or "mediating reaction" which seems to be a psychological construct that can be used to describe subvocalization. A final bit of evidence that offers enlightenment on both the neurological processes and their integration during reading has been offered by Brown (1979). He noted the existence of neurological activity in the speech center of the brain during CAT scans of the brain during silent reading when no recordable subvocalization was taking place. Again, this seems to highlight a continuum of activity during the process of relating print to oral language to meaning.

CONCLUSIONS AND IMPLICATIONS FOR TEACHING

The authors of this paper have synthesized the results of a wide variety of investigations of subvocalization as it relates to

language behaviors. The importance of the synthesization lies in the patterns suggested by the results of the investigations, the tentative conclusions which can be drawn based on those patterns, and the implications of the conclusions for instructional programs:

1) Subvocalization is a natural speech related adjunct to reading which is part of the process of internalizing the phonetic code. The internalization of the code provides for automatic processing of phoneme/grapheme correspondences, thus, freeing attention for comprehension.

2) When the reading task requires some type of recall activity, subvocalism should be encouraged as a type of verbal rehearsal, particularly with remedial students.

3) Efforts to suppress subvocalism should be discontinued especially among disabled readers since research clearly indicates that it enhances comprehension.

4) In content classrooms, greater emphasis should be placed on encouraging students to vocalize or verbalize the technical language of the subject matter. Content teachers need to be informed of the role of subvocalization in the reading process as indicated by the wide body of research reviewed for this paper.

RESEARCH DIRECTIONS

An analysis of the recurrent patterns of results in the investigations suggests that future research in a number of areas would lend further clarity to the role of subvocalization in the reading process:

1) Student populations with various types of deficits should be investigated including those who have demonstrated: (a) developmental lag, (b) asynchronous modalities, and those that give (c) evidence of a lack of internalization of the code.

2) Investigations of brain function during reading should be an area of emphasis in subvocalization research, particularly with the following procedures: (a) blood flow monitoring and (b) CAT scanning.

3) Longitudinal research focusing on different strategies for helping students to internalize the code, particularly those which include subvocalization as an overt method, should be conducted. At least these three techniques should be used: (a) verbal rehearsal strategies, (b) listen and read techniques, (c) repeated readings.

4) Research that deals with clarifying how phonemic encoding acts as the bridge between short-term memory and long-term memory is especially needed.

REFERENCES

- Amodeo, H. B. The Functional Significance of Private Speech During Problem Solving in Monolingual and Bilingual Two to Five Year Old Preschoolers. *Dissertation Abstracts International*, 1977, p. 2657-A.
- Aarons, H. "Subvocalization: Aural and EMG Feedback in Reading," *Perceptual and Motor Skills*, Vol. 33, 1971, pp. 271-306.
- Belmont, J. M. and Butterfield, E. C. What the Development of Short-Term Memory Is. *Human Development*, 1971, 14, pp. 236-248.
- Bergering, A. J. An Investigation of Laryngeal EMG Activity and its Relation to Reading. *Dissertation Abstracts International*, 1976, Feb., Vol. 36, (8-B), p. 4192.
- Bond, G. H. and Tinker, M. A. *Reading Difficulties: Their Diagnosis and Correction*, (3rd ed.), New York: Prentice-Hall, 1973.
- Bristow, P. S. The Relationship of Reading Ability, Freedom From Distractibility, Verbal Knowledge and Ability, and Sex to Amount of Subvocalization in Reading. *Doctoral Dissertation*, University of Georgia, 1978.
- Brown, E. R. A Theory of Reading. New York University, 1978.
- Brown, E. R. The Relevance of Neurological Factors in the Reading Process, paper presented at 1979 National Reading Conferences, San Antonio, Texas.
- Buswell, G. T. Non-Oral Reading—A Study of its Use in the Chicago Public Schools. *Supplementary Educational Monographs*, No. 60, 1945.
- Cole, R. A. and Young, M. "Effect of Subvocalization on Memory for Speech Sounds," *Journal for Experimental Psychology: Human Hearing and Memory*, 1975, Nov., Vol. 104 (1), (6), pp. 772-779.
- Colle, H. A. Rehearsal in Inner Speech Resources In Education, E.R.I.C. Document 70521, Apr., 1973, Chicago University, Illinois.
- Dickie, J. R. Private Speech: The Effect of Presence of Others, Task and Intrapersonal Variables. *Dissertation Abstracts International*, 1973, Sept., Vol. 34 (3-B), p. 1292.
- Donovan, K. M. Comprehension and Subvocalization in Normal and Speed Readers. *Dissertation Abstracts International*, 1979, May, Vol. 39, 11B, p. 5609.
- Edfeldt, A. As quoted in *Silent Speech and Reading*, Chicago: University of Chicago Press, 1960, pp. 77-78.
- Ekwall, E. E. *Locating and Correcting Reading Difficulties*, (Vol. 2), Columbus: Charles E. Merrill Pub. Co., 1977.
- Ellis, N. R. "Memory Processes in Retardates and Normals," in N. R. Ellis (ed.), *International Review of Research in Mental Retardation*, (Vol. 4), New York Academic Press, 1970.
- Farnham-Diggory, S. and Gregg, L. W. "Short-Term Memory Function in Young Readers." *Journal of Experimental Child Psychology*, Vol. 19 (1975), pp. 279-298.
- Feldman, J. M. Little Voices Inside: The Influence of Articulation on Oral and Silent Reading Rate, *Doctoral Dissertation*, University of Michigan, 1975.
- Ferrara, P. The Relationship of Subvocal Speech Activity to Encoding Processes and Recall in Short-Term Memory, *Dissertation Abstracts International*, Vol. 38, No. 5-B, 1977, p. 2396.
- Flavell, J. H., Beach, D. R., and Chinsky, J. M., "Spontaneous Verbal Rehearsal in a Memory Task as a Function of Age." *Child Development*, 1966, Vol. 37, pp. 283-299.
- Garrity, L. I. The Role of Subvocal Speech in Memory: An EMG Study of Pre-School Children, *Doctoral Dissertation*, University of Houston, 1973, pp. 1-175.
- Garrity, L. I. "An Electromyographical Study of Subvocal Speech and Recall in Pre-School Children." *Developmental Psychology*, May, 1975, Vol. 11, No. 3, pp. 274-281.
- Hagen, J. W. "Some Thoughts on How Children Learn to Remember." *Human Development*, 1971, Vol. 14, pp. 262-271.
- Hagen, J. W. and Kail, R. V. The Role of Attention in Perceptual and Cognitive Development. In W. M. Cruickshank and D. P. Hollahan (Eds.) *Perceptual and Learning Disabilities in Children*, Vol. 2., Syracuse: Syracuse University Press, 1975.
- Hardyck, C. C. and Petrinovich, L. F. "Subvocal Speech and Comprehension Level as a Function of the Difficulty Level of Reading Material," *Journal of Verbal Learning and Verbal Behavior*, 1970, Vol. 9, pp. 647-652.
- Huey, E. B. *The Psychology and Pedagogy of Reading*. New York: The Macmillan Co., 1908.
- Izzo, R. A. Reading Comprehension in Fourth Grade Children as a Function of Biofeedback Training to Increase Subvocalization. *Doctoral Dissertation*, University of Pennsylvania, 1975. *Dissertation Abstracts International*, 1976, 36, 6357 B.
- Keeney, T. J., and Flavell, J. H. "Spontaneous and Induced Verbal Rehearsal in a Recall Task," *Child Development*, 1967, Vol. 38, pp. 953-966.
- Laffey, J. L. The Effect of Different Modes of Presentation of Reading Materials on Vocalism in Silent Reading, *Doctoral Dissertation*, University of Pittsburgh, 1967, pp. 1-100.
- Laffey, J. L., Kelly, D., and Perry, B. "The Effect of Repeated Reading of Taped Literature on Reading Achievement." *Perspective in Reading and Reading Instruction*. (Edited by Michael L. Kamil and Alden Moe) Twenty-Ninth Yearbook of the National Reading Conference, San Antonio, Texas: The National Reading Conference, 1980, pp. 189-193.
- Laffey, J. L. and Kelly, D. "Repeated Reading of Taped Literature: Does It Make a Difference?" *Comprehension: Process and Product*, First Yearbook of the American Reading Forum (George McNinch, ed.), University of Southern Mississippi Press, Hattiesburg, Mississippi, 1981, pp. 80-83.
- Lassen, W. A., Ingvar, D. H. and Shinj, E. "Brain Function and Blood Flow." *Scientific American*, (September, 1978), pp. 62-71.
- Levy, B. A. "Vocalization and Suppression Effects in Sentence Memory," *Journal of Verbal Learning and Verbal Behavior*, Vol. 14, 1975, pp. 304-316.
- Locke, J. H. and Fehr, F. S. Young Children's Use of the Speech Code in Learning. *Journal of Experimental Psychology*, 1970, Vol. 10, pp. 701-733.
- McGuigan, F. J. Silent Speech During Silent Reading, ERIC Document 003312 U.S. Office of Education, 1964.

- McGuigan, F. J. and Winstead, C. H., Jr. "Discrimination Relationship Between Covert Oral Behavior and the Phonemic System In Internal Information Processing." *Journal of Experimental Psychology*, 1974, Vol. 103, No. 5., pp. 885-890.
- Negin, G. A. and Rios, J. H. "Read It With Meaning: Aloud." *Reading Horizons*, Vol. 21, No. 1 (Fall, 1980), pp. 7-11.
- Osgood, C. "A Behavioristic Analysis of Perception and Language as Cognitive Phenomena." *Contemporary Approaches to Cognition*. Cambridge: Howard University Press, 1957.
- Perfetti, C. A. and Goldman, S. R. "Discourse Memory and Reading Comprehension Skill." *Journal of Verbal Learning and Verbal Behavior*, Vol. 14 (1976), pp. 33-42.
- Riley, J. A. and Lowe, J. D., Jr. "A Study of Enhancing Vs. Reducing Subvocal Speech During Reading." *Journal of Reading*, Vol. 25, No. 1, October, 1981, pp. 7-13.
- Ringwald, L. O. Covert Speech In the Beginning Reading Process. *Dissertation Abstracts International*, 1978, Apr., Vol. 38 (10-A), p. 5914.
- Smith, F. *Understanding Reading* (2nd ed.) New York: Holt, Rinehart and Winston, 1978.
- Spache, George B. *Diagnosing and Correcting Reading Disabilities*. Boston: Allyn and Bacon, Inc., 1976.
- Tarver, S. C., Hallahan, D. P., Cohen, S. B., and Kauffman, J. M. The Development of Visual Selective Attention and Verbal Rehearsal in Learning Disabled Boys. *Journal of Learning Disabilities*, 1977, Vol. 10, pp. 491-500.
- Uchida-Nobuko. The Effects of External and Internal Verbalization on Memory and Comprehension of a Story in Pre-School Children. *Japanese Journal of Educational Psychology*, June, 1975, Vol. 23, No. 2, pp. 87-96.
- Wells, J. L. "An Investigation of Subvocalization During the Silent Reading Process." *Dissertation Abstracts International*, Vol. 38, No. 6, p. 3392.