PRODUCTION AND RECEPTION OF SPEECH BY HEARING-IMPAIRED CHILDREN

by

© Tina Novelli-Olmstead

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ABSTRACT

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M.Sc. Research Degree

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The relationship between speech production and speech reception was studied in seven matched pairs of profoundly deaf children between the ages of five and seven years. The pairs were matched as closely as possible on the basis of age, sex, hearing loss, and the results of three pre-test measures. Subjects were then randomly assigned to one of two groups; active or passive. Active subjects orally produced and rehearsed selected materials while passive subjects made discriminations using the same materials. All subjects were trained twice daily for fifteen minutes until thirty sessions were completed. Results showed that active subjects made significant gains in production and auditory discrimination of speech whereas passive subjects showed gains in production but not in auditory discrimination. Implications for speech teaching are discussed.

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La relation entre la production et la réception de la parole fut étudiée avec sept paires d'enfants sourds entre les âges de cinq et sept ans. Ces groupes furent sélectionnés le plus précisément possible selon leur âge, sexe, perte auditive, et les résultats de trois tests préliminaires. Par la suite, les sujets furent placés au hasard dans un des deux groupes soit: actif ou passif. Les sujets du groupe actif produisirent et répétèrent oralement des sujets pré-sélectionnés, tandis que les sujets du groupe passif produisirent des discernements sur ces mêmes sujets pré-sélectionnés. Tous les membres furent entraînés deux fois par jour pendant quinze minutes, et ce, jusqu'à ce qu'il y ait trente sessions de complétées. Les résultats ont démontré que les sujets du groupe actif ont fait des gains significatifs en production et en discrimination auditive de la parole tandis que les sujets du groupe passif ont démontré des gains en production, mais

non en discrimination auditive. Les implications dans l'enseignement de la parole seront discutées.

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INTRODUCTION

Congenital deafness is often regarded as an insurmountable barrier to the development of normal speech and language. Although some hearing-impaired children attain high levels of proficiency in their verbal skills, others struggle to produce even a few intelligible words or phrases. The subject of speech production is one of great concern to educators and researchers in the field and has received much attention in the literature (Jensema, Karchmer, and Trybus, 1978; Monsen and Shaughnessy, 1978; Parkhurst and Levitt, 1978). Descriptions of the characteristics of deaf speech are abundant and yet few offer suggestions as to how to remedy or prevent the errors common to most of the hearing-impaired population--errors described by Hudgins and Numbers (1942); Levitt, Smith, and Stromberg (1974); Monsen (1974); and Bernstein, Rollins, and Stevens (1978). Thus, faults in speech persist as the hearing-impaired person attempts to verbally interact with his community.

Effective teaching of speech to hearing-impaired children requires a highly skilled teacher willing to meet the daily challenges the task imposes. Ling (1976) concluded, after an extensive review of the literature, that teachers either do not have or are not using current knowledge in the areas of acoustic phonetics, speech science, and hearing aid technology to devise appropriate classroom speech programs. Careful assessment, planning and record keeping is needed to ensure that the child is making adequate and rapid speech progress.

While the task of teaching speech may be time consuming and at times, frustrating, the final result of a child verbally communicating with society at large is a most satisfying reward, both for himself and his teacher and parents. The importance of effective verbal communication skills and its implications for the hearing-impaired were discussed by Ling, Ling, and Pflaster (1977).

Most educators would agree that auditory training is an essential and beneficial component of the hearing-impaired child's education. However, the process of auditory training is not well defined in the literature. Some researchers recommend that auditory training will improve perception thus leading to improved production (Asp, 1975; Winitz, 1975; Bennett and Ling, 1977). Others suggest that speech training provides the framework for accurate perception of speech (Ling, 1976; Lieberth and Subtelny, 1978). The primary purpose of the present study was to investigate the role of speech training and its relationship to auditory discrimination among a group of young hearing-impaired children.

REVIEW OF THE LITERATURE

Speech Teaching Methods

Methods, approaches and philosophies for teaching speech to the hearing-impaired have been reported over several centuries (DiCarlo, 1964; Giangreco and Giangreco, 1970). However, it has been in the present century that educators have made concentrated efforts to make speech a more viable tool for communication among the hearing-impaired population. Bell (1906) presented his father's visible speech system as an educational instrument for teaching speech to the deaf. A system of characters were drawn in a series of eight charts to represent the physiological formations of the sounds of English. The deaf child was then trained to recognize the symbols as parts of the speech mechanism and to adjust his own articulators in order to match the written symbols. In this way, it was thought the deaf child could learn to speak.

Dissatisfied with Bell's Visible Speech System, Worcester (1915) of Clarke School for the Deaf devised a system of charts using the conventional alphabet as a basis of instruction rather than unique characters as suggested by Bell's system. Eventually, Worcester's charts were reorganized by Yale (1938) into the charts known today as the Northampton Vowel and Consonant Charts. Like Bell, Yale used written representations to be associated with the production of English sounds. The Clarke speech curriculum continued to be revised. In its

present form it not only contains the Northampton Charts but also offers many teaching techniques (Clarke School for the Deaf, 1971).

Haycock (1933) introduced a detailed program designed to promote speech in deaf speakers. His text suggested both methods and an extensive curriculum for the development and remediation of suprasegmental as well as the segmental aspects of production. Haycock gave special attention to the development of speech sounds, the common faults of their production and suggestions for correcting typical errors. There were no audiometers and personal hearing aids in 1933. Haycock was therefore unaware that some deaf children had residual audition. Hence, he did not expect them to use it in developing natural speech. Many of the visual and tactile strategies described by Haycock are still in use today (Calvert and Silverman, 1975; Ling, 1976).

As personal hearing aids became more readily available, teachers of the hearing-impaired began to emphasize appropriate selection of aids and maximum use of residual hearing in teaching speech. Ewing and Ewing (1964), stressing the importance of hearing aids and early training, described the foundations of developing spoken language in hearing-impaired children. Speech readiness was one of the major principles underlying the Ewings' program. Formal speech training was begun only after the child had abundant experience of listening to and watching the speech of others, and after the child had begun to use his own voice purposively. At this point, the child was considered

ready for specific articulation training and the Ewings suggested speech periods that were carefully planned. Within their text, many strategies and activities were described which facilitate the production of suprasegmentals, vowels, diphthongs, and consonants. The principles of motor and acoustic phonetics formed much of the basis for the Ewings' approach to teaching speech to the hearing-impaired.

Vorce (1974) presented a set of guidelines for developing and remediating speech skills. No prescribed order of development was outlined and most instructional work was carried out at a phonological level. Written symbols were associated with the sounds once the child had rehearsed them in many vocabulary contexts.

Recently, Calvert and Silverman (1975) explored the physical aspects of speech, its production, and the development of speech in hearing-impaired children. The authors integrated current technical knowledge into the task of teaching speech. For each phoneme, several orthographic representations were given along with the production classification. The authors listed information on sensory feedback as well as some visual, tactile and auditory strategies. Rather than adhere to one method of teaching speech the authors described three common approaches: the Auditory Global, primarily an auditory approach emphasizing the use of connected speech; the Multisensory Syllable Unit, a syllable based system using all senses as needed to transmit production information; and the

Association Phoneme Unit in which phonemes are taught in isolation and associated with the written representation of the sound.

Ling (1976) proposed a systematic model for developing speech skills in hearing-impaired children based on principles derived from acoustic phonetics, hearing aid technology, and practical teaching experiences with children. Seven sequential stages, each containing several targets, provided a foundation for the overall teaching system. Within each stage, Ling suggested that targets be taught concurrently, rather than sequentially, in order to compare and contrast features of the targets grouped together. The model consisted of two levels of teaching; phonetic and phonologic. The phonetic level involved the teaching of a number of target speech behaviors which were further delineated into very specific subskill behaviors. He suggested that phonetic level skills should be transferred into phonology using common everyday words and phrases. Ling presented three assessment tools to serve as the cornerstone for teaching; an oral-peripheral exam, a phonetic level assessment, and a phonological assessment. Also included in the program were many strategies for developing each of the subskill behaviors.

Evaluation Studies of Speech Teaching Methods

Few evaluative studies are reported in the literature to substantiate or validate the effectiveness of speech teaching

methods. One such study was reported by Shaffer (1942) in which he evaluated a teaching method he termed the "Kinesthetic Method". Shaffer's system incorporated speech babbling drills and speechreading skills into one system. In Shaffer's study, one group was instructed in the Kinesthetic Method (a phonetic-to-phonologic system) and the other group continued in the speech program traditionally used by the school (the incidental teaching of sounds in conversation). At the end, Shaffer reported the raw scores and means for both groups on the pre- and post-tests which consisted of a vowel-consonant test and a word production test. The mean of the group in the Kinesthetic Method was at least twice the mean for the other group but no statistical analysis was performed on the data. Shaffer concluded that the Kinesthetic Method was superior to incidental teaching of speech.

Another attempt to evaluate a speech training program was made more recently (Osberger, Johnstone, Swarts, and Levitt, 1978). The authors adapted the system described by Ling (1976) and employed it with a group of twenty hearing-impaired children ranging in age from seven to ten years. All subjects were trained in fifteen minute sessions, four times a week, over a period of thirty-nine weeks, by their classroom teachers. Only suprasegmental patterns were trained using primarily an auditory-oral approach. At the conclusion, subjects were divided on a post hoc basis into three groups according to their rate of progress: rapid, slow but steady, and inordinately slow.

Although the authors reported the system to be effective, one must question the length of training for suprasegmental patterns. After one school year, only one third of the subjects had mastered the suprasegmental aspects, which are but the basis of speech production. Since Ling (1976) reported a two or three year period to be sufficient to master most aspects of speech production, it seems that even those subjects categorized by Osberger et al as rapid learners actually made inordinately slow progress. A closer look at the study revealed that the authors' adaptations seriously violated Ling's system. The authors developed the suprasegmentals sequentially rather than concurrently. Ling's system required that skills be taught concurrently in order to make optimal use of contrasts and comparisons between sounds. Furthermore, embedded into the teaching of segmentals were provisions for rehearsing suprasegmentals. A more rigorous implementation of Ling's system is indicated in order to determine the effectiveness of his suggested hierarchy of development.

Speech Production

Extensive reviews of the literature on the subject of speech production in hearing-impaired children have been provided by Nickerson (1975) and by Ling (1976). Both covered research related to suprasegmental and segmental patterns of production.

Most research in speech production of hearing-impaired children has been primarily concerned with describing the errors

commonly found in the speech of the deaf (Hudgins and Numbers, 1942; Nober, 1967; Smith, 1972; and Levitt, 1977). The authors believed that once the errors were identified, effective intervention and remediation programs could be devised. Although the typical characteristics have now been described for many years and remediation programs might have been expected to effect change, overall poor speech intelligibility continues to be reported (Angelocci, 1962; Jensema, Trybus, and Karchmer, 1978). Research, as of yet, has had little effect on improving speech teaching methods used in schools today.

Little of the research was directly concerned with devising and implementing strategies to remediate or prevent the errors already defined in the literature. Only Ling (1976) accepted the challenge to develop techniques for improving speech production. Since the reviews of Nickerson (1975) and Ling (1976), more research has been reported with most emphasis, again, placed on descriptions of speech errors, rather than on the evaluation of remediation techniques or prevention strategies.

Suprasegmentals

Deviant suprasegmental characteristics continue to be described (Boothroyd, Nickerson, and Stevens, 1974) even though the problems were identified in many earlier studies (e.g., Hudgins, 1937, 1946). Recent work on such deviancy is reviewed below.

Parkhurst and Levitt (1978) studied the effect of select-

ed prosodic errors on the intelligibility of deaf speech. Forty hearing-impaired children ranging in age from eight to fifteen years, each read a series of fifteen sentences. Afterwards, a trained speech pathologist listened to the recordings and classified the errors into one of four categories: adventitious or interjected errors, excessive duration, pitch breaks, and pauses. Adventitious sounds had the greatest negative effect on intelligibility followed by excessive duration and pitch breaks.

McGarr and Osberger (1978) analyzed the speech production of fifty-seven young hearing-impaired adolescents in the following areas: pitch, prosodic features, segmental features, and overall intelligibility. Although errors of prosodic feature production and phonemic production were highly correlated with intelligibility, there was no evidence that deviancy in pitch affected overall intelligibility.

Word and syllable concatenation of fifty-one deaf students was assessed using spontaneous and read materials (Bernstein, Rollins and Stevens, 1978). The authors reported that while normal hearing speakers produce very few gaps between syllables in single utterances and that there is usually a smooth rhythmic contour, hearing-impaired subjects produce many pauses and glottalizations. Furthermore, the authors concluded that undue emphasis on speech teaching at the phonetic and single word levels may result in phrasing problems.

All of the above studies substantiated the earlier find-

ings that the deviant production of suprasegmental aspects of speech results in lower intelligibility.

Vowels and Diphthongs

The most frequently reported errors in vowel production are substitution, neutralization, diphthongization and nasalization (Hudgins and Numbers, 1942; Angelocci, Kopp and Holbrook, 1964; and Smith, 1972). These findings have received further support from present day research.

Monsen (1974) compared durational aspects of vowel production in deaf and normally hearing adolescents using the contexts of the stressed /i/ and its lax counterpart /I/ in fifty-six words. Normal hearing subjects reduced the duration of vowels preceding voiceless stops as compared to those vowels followed by voiced stops. Deaf subjects failed to vary the duration of the vowel, thus reducing intelligibility.

Another study by Monsen (1976a) investigated the production of the diphthong /aI/ in deaf and normal subjects. Two sentences containing the word "ice cream" were spoken and recorded for computer analysis. Of the thirty-seven hearing-impaired adolescents, only twelve produced the target /aI/ normally. The remainder of the group made errors characterized by three types: large change in F_1 and stationary F_2, both formants relatively immobile, or a downward movement of F_2 instead of the rapid and extreme changes in both formants as would normally be the case. Monsen suggested that teachers

should supplement the auditory information with visible articulatory movements and direct the deaf child's attention to the closing movement of the mouth associated with the production of /aI/ in common words.

Finally, Monsen (1978) assessed the improvement in vowel articulation in three, eleven-year-old deaf speakers before and after five months of training. Each subject received individual instruction twice weekly for half hour sessions. Based on acoustic measures prior to the study, five vowels were selected for training (i, I, æ, ɔ, u). Before and after training, a list of six words for each vowel were produced by each subject and recorded for spectrographic analysis. Training strategies included comparing and contrasting vowels in words as described by Calvert and Silverman (1975). In addition, an adjustable model of the mouth and cross-sectional diagrams of the vocal tract were used to visually display the target vowels. At the end, acoustic measurements revealed improvement in the frequency range of the second formant for all three subjects. However, only two of the subjects produced the second formant within the normal frequency range. In summary, the author felt that the training methods resulted in improvement in vowel articulation in a relatively short amount of time.

Consonants

Ling (1976) discussed the results of some major studies on consonant production reported over the years (e.g., Hudgins

and Numbers, 1942; Nober, 1967; Markides, 1970; Heidinger, 1972; and Smith, 1972). He noted that the misarticulations first categorized by Hudgins and Numbers (1942) were later confirmed by the others. No changes or improvements were identified even though modern technology had led to significant advances, particularly in the development of hearing aids.

Recently, Monsen (1976b) also confirmed the findings of Hudgins and Numbers (1942) and Smith (1972), namely that voiced-voiceless confusions were frequent errors in the speech of the deaf. However, Monsen's data were based on acoustical measurements whereas previous research was based on listeners' judgements. Monsen's study investigated the production of word initial stop consonants (p, t, k) and (b, d, g) using spectrographic measurements. Thirty-seven hearing-impaired and six normal hearing adolescents read word lists containing 24 monosyllabic words preceded by the word "the". Monsen found that those subjects who could adequately produce the voiced-voiceless distinction tended to be more intelligible than those who could not. Also, he reported that children with average hearing levels better than 93 dB tended to produce all stop consonants correctly. Again, these findings were in agreement with previous research.

Speech Reception

The hearing-impaired child has three principal avenues for speech reception available to him; the auditory, the visual

and the tactile channels. The extent to which a child maximizes the use of any single channel or combination of channels is often a reflection of the emphasis of his educational program (Ling, 1979, in press). Traditionally, teachers of the hearing-impaired have employed each of these modes of reception to some degree as a means for transmitting information (Calvert and Silverman, 1975; Ling, 1976).

Although some educators advocate training audition, suppressing vision and touch altogether (e.g., Pollack, 1970), few, if any, advocate training the visual and tactile senses to the exclusion of audition. The exception to this would be in the case of a totally deaf child who must rely solely on sense modalities other than hearing for speech reception.

Since all three channels were, at times, used in the present study, a review of recent literature related to auditory speech reception and multisensory speech reception was conducted to identify the cues available to the hearing-impaired child.

Auditory Speech Reception

Residual hearing has long been recognized as a useful channel for developing communication skills in hearing-impaired children (Wedenberg, 1951; Pollack, 1970; and Ross and Giolas, 1978). Since few children are totally deaf (Ling, 1964; Elliott, 1967; and Boothroyd, 1970), it is imperative that the auditory management of hearing-impaired children is given serious

attention (Ross and Giolas, 1978). A comprehensive program of auditory management includes careful assessment of auditory skills, appropriate selection and fitting of hearing aids, systematic training, and ongoing evaluation of progress (Ling and Ling, 1978). In this section, recent studies related to the training component of auditory management will be reviewed.

The suprasegmental aspects of speech such as duration, pitch and intensity can be auditorily perceived by most hearing-impaired children, if they are appropriately fitted with hearing aids, since these dimensions contain low frequency information (Ling, 1976; Stoker, 1978). Gengel (1969) demonstrated that, given practice, hearing-impaired children improved in discriminating changes in the first and second formant frequencies of vowels and also learned to discriminate changes in vocal pitch.

Correct identification of all vowels and diphthongs is dependent upon reception of the first and second formants which lie between 270 - 3,000 Hz (Delattre, Liberman, Cooper, and Gerstman, 1952). The child with no hearing beyond 1,000 Hz will receive only partial acoustic information since all first formants of vowels lie below 1,000 Hz. In such cases, other sense modalities may be needed to complement the limited acoustic message.

One study attempted to improve vowel discrimination in severely hearing-impaired children through programmed instruction (Doehring and Ling, 1971). Two groups of subjects, each

containing eight children between the ages of seven and eleven, were matched into pairs as closely as possible. The experimental group was trained in vowel discrimination using sets of three words which differed only in the vowel. Fifteen minute training sessions were carried out three to five times weekly over a two month period. Subjects made continual improvement during the training period but did not show any significant improvement between pre- and post-tests in which sets of thirteen words were used; nor was there a significant difference between the experimental and control groups on pre- and post-tests. Baldwin and Houchins (1976) reported similar problems of generalization in vowel discrimination in their group of hearing-impaired subjects.

In order to adequately perceive all consonants, a frequency range of 250 - 4,000 Hz is required (Ling, 1976). Within this broad frequency spectrum, a variety of cues are available signalling manner, place, and voicing features. For those children with limited ranges of hearing, manner and voicing cues may be available while cues on place of production are often unavailable (Walden, 1971; Erber, 1972; Binnie, Montgomery, and Jackson, 1974).

A few studies investigating the effects of training on consonant perception have been reported. Ling and Maretic (1971), examining the use of frequency transposition in teaching speech to eighteen severely hearing-impaired children aged seven to eleven years, reported marked gains in auditory-vocal

skills as a result of articulation training regardless of the type of amplification system used. The training consisted of imitating and identifying sixty-four syllables presented by a teacher of the hearing-impaired. Consonant errors were lowest for the nasal/oral distinction. Aston (1972) further supported the results of Ling and Maretic. After discrimination training on twelve minimal-pair distinctions, her ten severely hearing-impaired subjects, aged nine to fourteen, improved in the discrimination of consonants differing in manner and nasality but were unable to learn place of articulation. This was similar to the finding reported for hearing-impaired adults by Walden and Montgomery (1975).

Bennett (1977) trained six severely hearing-impaired children to discriminate the voiced-voiceless distinction of cognate pairs. Initially, a tactile cue was provided to signal the presence or absence of voicing. Gradually, the cue was withdrawn. All subjects, trained with consonant-vowel syllables containing /a/, were able to generalize to syllables containing /u/ and /i/. Some subjects were able to generalize further from the syllable context into words.

The above research on auditory speech reception indicates that given training some improvement in speech reception can be achieved. Presently, there are no auditory training curriculums reported which make reference to the science of acoustic phonetics as the underlying premise for their development. Only Ling (1976) has outlined the acoustic cues available

to children with various degrees of hearing loss in order that appropriate auditory training programs could be individually devised by the teacher. He has further stressed the need for maximizing the child's chances for auditory reception through the fitting of appropriate hearing aids.

Multisensory Speech Reception

The more restricted the child's ability to derive information from the acoustic signal, the more he must use the channels of vision and direct touch for speech reception. Until educators began exploring the use of residual hearing, vision and touch were the primary avenues used for teaching speech (Haycock, 1933).

Lipreading or the ability to receive information from the movements of the face, tongue, lips, jaw and throat, is one of the most common tools for speech reception among hearing-impaired listeners (Berger, 1972). Since vision has played such an important role, much research has been designed to define the limitations and perceptual confusions of visual stimuli (Heider and Heider, 1940; Woodward and Barber, 1960). The cues available through vision will be discussed below.

Direct touch is another mode available to the child for speech reception. However, it can only provide supplementary information on the production of sounds. The use of touch in the teaching of speech has been reported for several centuries (de l'Epee, 1784; Haycock, 1933; Alcorn, 1938) and continues

to be reported as an effective teaching tool today (Calvert and Silverman, 1975; Ling, 1976). These cues will also be briefly discussed below.

Little research has been directed towards the visibility of suprasegmentals. Fisher's (1969) normally hearing adult subjects were able to visually identify terminal pitch contour in a set of sentence materials. Hearing-impaired subjects, between the ages of seventeen and twenty-six, studied by Risberg and Agelfors (1978) showed considerable improvement in speechreading scores only with the addition of acoustic information on prosody. Gains were made with familiar materials as well as with open set questions.

Durational aspects of production and partial information on intensity can also be transmitted by direct touch, either alone or as a supplement to auditory and visual information (Calvert and Silverman, 1975; Ling, 1976).

The visual aspects of vowel production are primarily characterized by the degree of mouth opening, shape of the mouth, and movement of the mouth (Jackson, Montgomery, and Binnie, 1976). This information coupled with the acoustic information of the first formant will be sufficient for partial vowel identification (Ling and Bennett, 1974-1975). Confusions will most likely occur with adjacent vowels (Berger, 1970).

Degree of constriction and height of the tongue can be satisfactorily relayed through direct touch. Ling and Bennett (1974-1975) demonstrated the efficacy of touch in

teaching vowels to two profoundly deaf children aged four years. The addition of tactile cues resulted in superior performance over two children with similar backgrounds who were trained using only audition plus vision. Maintenance of vowel production was observed after tactile cues were eliminated indicating that the children generalized from the audition, vision, plus touch situation to an auditory-visual setting.

Cues on place of articulation for consonant phonemes are readily available through speechreading (Erber, 1972; Binnie, Montgomery, and Jackson, 1974). Since information on place of articulation is often unavailable auditorily, it is important for the profoundly hearing-impaired listener to supplement audition with vision for correct identification of consonant phonemes. The auditory cues on manner and voicing coupled with the visual cues on place lead to greater scores on consonant recognition than by lipreading alone (Ewing, 1944).

Direct touch is particularly useful in distinguishing manners of production such as nasal vs. oral, the onset of plosives and the breath of fricatives (Ling, 1976). Partial information is also available through direct touch on place and voicing and can, therefore, be used as a teaching tool supplemental to audition and vision.

The Relationship between Perception and Production

Motor Theory of Speech Perception

The Motor Theory, first introduced by Liberman (1957),

suggested that speech is perceived by reference to articulatory movements. Ling (1976) suggested that the theory may be relevant in the development of speech among hearing-impaired children. Ling's system emphasizes the need to ensure accurate and automatic production of the speech sounds. He considers (see Ling and Maretic, 1971) that knowledge of the motor speech patterns of English may, at least in part, provide the necessary foundations for correct perception. The Motor Theory has not been adequately tested. Therefore, further research is needed to support the premise that speech production will aid speech perception in the hearing-impaired.

A study by Denes (1967) attempted to determine whether or not listening and associating sound with articulatory movements facilitates learning to recognize speech. Ten normally hearing subjects were divided into one of two groups: listeners and speakers. Both groups were presented a list of 150 words that had been processed through a vocoder, which rendered them quite unlike normally sounding English words. During a twenty minute training session, the listeners were instructed simply to audit the processed speech. The speakers orally repeated the words which were then processed and played back so that they could monitor the accuracy of their productions. After training, a five minute test was administered. It was comprised of a different list of words also processed through the vocoder. All subjects wrote their responses. Since both groups improved their word recognition scores from 40% to 70%, the motor theory

was apparently not supported. However, Denes did not consider his experiment to be an adequate test of the theory. He suggested that his results could not be interpreted for the following reasons: speaker variability, subject age (adults instead of children), and failure to use an appropriate vocoder. A formant vocoder should have been used so that place of articulation cues could have been maintained. Without a formant vocoder, place information was unavailable and correct identification was made too difficult a task.

There is a need to test the motor theory using a more adequate design than that devised by Denes. Hearing-impaired children, who have to learn both to speak and to hear, would appear to be ideal subjects for such experimental work. It would be of both basic and applied interest to determine whether teaching them to make correct articulatory movements would help them to develop consistent, useful perceptual skills.

Normal Hearing Children

The intricate relationship between speech perception and speech production is a very special one and may be observed most readily in young children. Schvachkin (1973) concluded, after an extensive study of young normal hearing Russian children, that the mastery of certain sounds facilitates their perception. This was further supported by Garnica (1973). However, her results for English speaking children were not as consistent as those of Schvachkin.

Several workers have studied the relationships between perception and production through training children with misarticulations. Williams and McReynolds (1975) examined the relationship between discrimination and articulation in four children with misarticulations. Two of the subjects received production training followed by a test of discrimination ability. For the other two subjects, discrimination training preceded the test of productive ability. Finally, the conditions were reversed. Results indicated that production training changed articulation and discrimination while discrimination training was only effective in changing discrimination. The authors pointed out that, within the production training, opportunity existed for discrimination practice because the child received sensory information from his articulators as he practiced the sound. The results of this could not, therefore, define the relationship between perception and production.

Hearing-Impaired Children

Studying hearing-impaired children, Holman (1974) divided his 42 subjects, ranging in age from eight to thirteen years, into three equal groups: listeners, speakers, and a control group. All had hearing losses in excess of 70 dB. The listeners received auditory receptive practice only on words and sentences while the speakers had combined practice of listening and producing sets of words and sentences. Speech

correction was not included as part of the training program for the speakers. At the end of the seven-week program, no significant differences were obtained on word recognition scores between any of the groups. However, the speakers' scores were significantly better than the others on the sentence recognition materials. Holman suggested that this was due to the addition of prosodic information. Since speech correction was not an integral part of the program, speakers were permitted to rehearse errors in articulation, poor stress, poor rhythm, and poor phrasing. A training program which leads to more accurately produced speech would be more likely to promote the development of adequate perceptual skills.

Recently, Lieberth and Subtelny (1978) investigated the relationship between perception and production in young hearing-impaired adults. Two groups of twenty-nine subjects were matched in pairs on the basis of hearing loss. In the experimental group the mean pure tone average hearing loss was 90 dB and in the control group, the mean was 91 dB. The experimental group received twenty weeks of intensive speech training while the control group received no training. The hierarchy of speech training developed at the National Technical Institute for the Deaf includes the production of vowels, syllables, phrases, simple sentences, and question and answer sequences. Targets were selected based on individual assessment. At the conclusion, auditory perception tests were readministered to both groups. Only the experimental group

showed marked gains in auditory phoneme identification. Even though the authors concluded that it was the speech training which effected the change, it may have been the discrimination training embedded within the production activities that led to the improved speech recognition scores. Since the control group did not receive auditory training, the improvement of the experimental group cannot be attributed to speech training alone.

Implications of the above work are that a study of the relationship between perception and production requires a design which controls for the contribution of discrimination within production training. Such a design was employed in the present study. It utilized the yoking procedure described by Held and Hein (1963).

Held's work was primarily concerned with defining the role of motor activity in providing sensory feedback. One such study by Held (1972) demonstrated the importance of motor sensory feedback in perceptual adaptation. All subjects, matched in pairs, wore prism goggles for several hours which completely rearranged their visual perception of the environment. One member of the pair was designated as the active learner while the other was assigned to a passive role. Active subjects, who walked freely and voluntarily in the situation, were able to achieve full adaptation. No adaptation was observed for those subjects whose movements were passive; that is, without self-produced movements. Passive subjects were transported

by wheelchair through the environment. Other similar experiments were conducted by Held using kittens. Again, those permitted to make voluntary movements exhibited normal behavior in visually guided tasks such as blinking at an approaching object, and avoiding the deep side of a visual cliff. Passive kittens failed all of these tasks. Held concluded that physical motor activity was imperative to the development of the sensory feedback loop in visual perception.

The Present Study

In view of the above literature, it is apparent that the relationship between production and perception has not been satisfactorily defined. As of yet, there is no reported research design which satisfactorily taps the intricate relationship of perception and production. Therefore, the present study attempted to fill some of the gaps by employing a hearing-impaired population which needed to learn to produce and to perceive. Also, by utilizing the active-passive procedure described by Held (1972), the role of speech training and its relationship to auditory discrimination could be investigated through the comparisons of scores on pre- and post-test measures.

Secondly, the study attempted to evaluate the effectiveness of the speech model proposed by Ling (1976) for developing speech skills in hearing-impaired children. Since the introduction of the speech system, teachers throughout the

world have incorporated aspects of the program into their classrooms or clinics. As indicated by the review of the literature, there are no studies that have rigorously implemented the speech system in an educational setting to confirm its value and effectiveness. Data is needed to support Ling's conviction that classroom teachers can acquire the necessary skills to carry out the organized, structured program.

The goal of every speech training program is to have the student generalize from training sessions into his spontaneous everyday speech. The final aim of the present study was to determine to what extent, if any, the subjects generalized the skills they acquired during training into their phonology outside of the training environment.

METHOD

Subjects

Two groups of seven hearing-impaired subjects, matched in pairs as closely as possible in age, sex, hearing loss, and scores on three pre-test measures were selected from classes in the Montreal Oral School for the Deaf. All subjects were originally selected on the basis of the following criteria: congenital deafness, chronological age from five to seven years and teachers' judgements that all were free from other major disabilities. All were at the beginning stages of speech development. An eighth pair, who could not be sufficiently matched, was excluded from the study.

After preliminary matches were established, the teachers were instructed to rate academic performance of each pair as compatible or incompatible. All were academically equivalent. The members of each pair were then randomly assigned to one of two groups. The first group (Group A), consisting of three boys and four girls, was designated as the active group. The second group (Group P), also consisting of three boys and four girls, was designated as the passive group. Both members of each pair attended every training session.

Audiograms were obtained from recent clinical evaluations and were reported as reliable. The mean pure tone averages in the better ear were 98 dB in the active group and 102 dB in the passive group. All subjects wore binaural hearing aids

at school and were encouraged to do the same at home. Oral communication, the method of instruction at the school, was used by every subject for at least three years prior to the study. Details of sex, age, hearing loss, and etiology appear in Table 3.1.

Apparatus

Pre- and post-test measures, requiring a spoken response, were recorded on a Uher 4200 Report Stereo IC taperecorder in conjunction with a Uher M517 microphone. Responses were tape-recorded with 1.5 mil mylar tape played at 7.5 ips in order to achieve superior tonal quality.

A Danish Interacoustics DU5 Auditory Amplifier with a MD611 dynamic microphone was used for the testing and training. A juncture box attached to the auditory amplifier permitted simultaneous use of two pairs of Sharpe HA-10 headphones.

Materials

Materials Used in Testing

The Phonological Level Speech Evaluation constructed by Ling (1976) was designed to ascertain the number of spontaneous sound patterns produced in a child's spoken language sample and to determine whether or not a child incorporates newly acquired sounds into his spoken language. Using language sampling techniques (Lee, 1974; Tyack and Gottsleben, 1974), a taperecorded sample of at least fifty utterances is collected.

TABLE 3.1

Chronological age, sex, pure-tone average in dB (ISO) at 500, 1,000, and 2,000, and etiology of hearing loss. Subjects are grouped in pairs with A designating active subjects and P designating passive subjects

SUBJECT	AGE	SEX	PTA		ETIOLOGY
A_1	7:3	M	R.110	L.117*	Birth Injury
P_1	7:3	M	R.105	L.111	Unknown
A_2	7:2	F	R.108	L.106	Unknown
P_2	6:9	F	R.105	L.110	Unknown
A_3	6:7	F	R.105	L.103	Unknown
P_3	6:6	F	R.105	L.106	Unknown
A_4	7:6	M	R. 98	L. 92	Rubella
P_4	6:11	M	R.103	L.100	Rubella
A_5	6:9	F	R. 92	L. 78	Unknown
P_5	6:10	F	R.115	L.103	Unknown
A_6	6:7	M	R.103	R.106	Rubella
P_6	7:1	M	R.113	L.111	Unknown
A_7	5:5	F	R. 92	R. 93	Unknown
P_7	6:4	F	R. 95	L. 93	Unknown

* No response at 2,000 Hz - 125 dB used for averaging

Nonsegmental and segmental aspects are analyzed and recorded by the tester on Phonological Speech Evaluation forms (Ling, 1976). Nonsegmental features include breath control, intensity, pitch, intonation, duration, phrasing and stress. They are analyzed to determine whether the production was normal or faulty. The segmental aspects, vowels and diphthongs, consonants and blends, are scored as being produced consistently (✓), inconsistently (+), or not at all (-).

The Phonetic Level Speech Evaluation also constructed by Ling (1976) was primarily designed to determine a child's ability to imitate the sound patterns of English in a variety of contexts. Areas covered in the evaluation include supra-segmentals, vowels and diphthongs, consonants and consonant blends. Using auditory and visual cues, the tester presents a model to the child who is then asked to reproduce the pattern through imitation. Again, the child's production is scored as to whether the sound was produced consistently (✓), inconsistently (+), or not at all (-), in single, repeated, and alternated syllables, at loud, quiet and whispered levels, over a range of at least eight semitones. All vowels are presented in the context of a consonant-vowel syllable, using a consistently produced consonant from the child's repertoire. All consonants and word initial blends are presented in the context of three vowels, [u], [a] and [i]. Word final blends are tested in one vowel context.

A 70-item Auditory Discrimination Test was specially

constructed for this study to determine the subjects' ability to discriminate among various pairs of vowels and consonants in a syllable context. A pilot test, designed to evaluate the subjects' ability to discriminate among three items such as [ba - ma - wa], revealed that the subjects could not retain a three item sequence in memory. Therefore, the test was reduced to a two item discrimination task. All subjects could perform at this level.

The test consisted of four lists: the first contained 23 pairs of consonants varying in manner, the second, 14 varying in place, the third, 16 varying with respect to voicing and the fourth containing seventeen different pairs of vowels and diphthongs initiated by [b]. One item from each pair was circled on the record form to identify it as the test item (See Appendix A).

Syllable pairs were randomly selected from any of the four lists and presented to the subject. Each consonant was presented in the vowel context [a]. Every pair of sounds was visually represented by pegs, blocks, or marbles. Allowing the child to watch and listen, the tester presented the items twice in a series of three repetitions, e.g., [bababa, wawawa], [bababa, wawawa]. Visual cues were then eliminated and one item was repeated in a sequence of three syllables, e.g., [bababa]. The subject then pointed to the peg, block, or marble he considered to correspond to the auditory stimulus. The tester then recorded the subjects' selection by marking off the selected syllable on the record sheet (see Procedure).

Materials Used in Training

Single syllables, repeated syllables, and syllables alternated with other syllable combinations comprised the earliest practice materials. The syllables were selected on the basis of the phonetic level evaluation in order to meet the needs of individual pairs of subjects. A typical rehearsal pattern was [wa], followed by [wawawawa], and finally [wabawa bawaba]. Written representations of the syllables were not introduced to the subjects during training.

Sets of words, incorporating the syllables, were devised for phonological level training. The following consonants were used in combination with every possible vowel to create an easily illustrated word: /b/, /p/, /w/, /f/, /v/, /θ/, /ð/, /h/, /m/, /d/, /t/, /ʃ/, /ʒ/, /s/, /z/, /n/, /j/, /l/, /g/, /k/, /tʃ/, /dʒ/, and /r/. Black and white illustrations, measuring 2" X 2", were drawn by a professional artist and were mounted and laminated onto 3" X 5" pieces of poster board to maximize durability. The picture cards were filed and cross referenced according to the initial and final consonants. The drawings used are presented as Appendix B.

Phrases containing several target phonemes were constructed to encourage further transfer of training from syllable and word levels of production. An attempt was made to devise phrases which reflected different levels of phoneme acquisition. For example, the phrase "That's mine" contains the diphthong /aɪ/, the vowel /æ/ plus the consonants /ð/ and /m/ which are all early targets of instruction. The list of

phrases from which the training materials were drawn is presented in Appendix C.

Procedure

The study was conducted in one room of a two room Tracoustics suite in the audiology clinic of the Montreal Oral School for the Deaf. During the pre- and post-test sessions, the experimenter sat on the floor of the suite facing the subject. Subjects wore headphones driven by the auditory amplifier. Output levels for each child were determined by having subjects adjust volume controls to their most comfortable levels. All were able to detect three vowels, [a], [u], [i] and most were able to detect the consonant [ʃ].

Pre- and Post-Training Tests

The following tests were administered by the experimenter to each of the subjects prior to and after the training sessions: The Phonological Level Speech Evaluation, The Phonetic Level Speech Evaluation, and the Auditory Discrimination Test (see Materials). All subjects were tested individually. Each speech test was given in one session. The auditory discrimination test, which contained 70 items, had to be administered over several brief session (approximately ten minutes) in order to ensure the children's consistent attention to the task.

Phonetic Level Speech Evaluation. For this task, the subjects were required to imitate a model presented by the experimenter. The following instructions were given:

"First, it is my turn to talk."

"Then you will say the same thing."

"Do the best you can."

The entire test was taperecorded for later analysis. Testing was terminated at the end of the section in which the subject made at least six successive errors. All subjects were given social reinforcement throughout the testing, and a tangible reinforcer upon completion of the task.

Responses were independently recorded by the experimenter and the independent judge on Phonetic Level Speech Evaluation record forms (Ling, 1976) while listening to the taperecorded testing sessions. The judges' transcriptions were compared during the analysis. In the small number of instances where the judges disagreed, the tape was replayed until agreement was reached. To facilitate statistical analysis, a numerical system was devised. Phonemes that were correctly and consistently produced (√) received two points, and phonemes that were inconsistently produced (+) received one point. Phonemes not produced (-) were disregarded. An overall score was then calculated by summing all points obtained.

Auditory Discrimination Test. For this task, only a pointing response was required. Two pegs, marbles or blocks were placed in front of the child and the following instructions

were given:

> "Today, you are just going to listen. You will do no talking. I am going to do all of the talking. Please listen and watch very carefully."

While pointing to one peg:

> "This one is wawawa."

While pointing to the other peg:

> "This one is bababa."

Both stimuli were then repeated without the carrier phrase but with the pointing gesture:

> "wawawa"
>
> "bababa"

The experimenter then eliminated visual cues by covering her mouth with a large sheet of colored construction paper and proceeded to repeat one of the items. The child responded by pointing to the peg which he decided corresponded to the auditory stimulus. Practice sessions were carried out with randomly selected items until the experimenter was confident that the subject understood the task.

Responses were recorded on a scoring sheet by the examiner. The total number of correct responses were counted.

At the completion of all pre-testing, the subjects were matched in pairs and assigned to one of two groups: active or passive.

The Training Procedure

A schedule for convenient training times was organized

and discussed with the classroom teachers, but they were not told whether or not a subject was to serve as an active or passive member of the pair. However, the teachers were asked to continue expecting and reinforcing accurate speech productions at the phonological level while the subjects were in their classroom settings. Teachers were told what phonemes were being taught from time to time as the study proceeded.

Both subjects in the pair attended each of the thirty training sessions. All were trained for fifteen minute periods, twice daily by the experimenter. During training, the active learner verbally produced the phonetic and the phonologic level targets. The passive learner made discriminations within the practice material and responded by pointing to a symbol or a picture. Errors made by either subject were corrected immediately. Post-testing was begun after the completion of the thirtieth session. Since all pairs were seen an equal number of times, absenteeism resulted in a slightly staggered time line for the onset of post-testing.

For training, the subjects were seated next to one another on the floor facing the experimenter. They put on the headphones and adjusted the output of the auditory amplifier. Optimal listening levels were established by having the subjects respond to the five sound test (Ling and Ling, 1978). After the initial visit, the subjects controlled the output of the auditory amplifier. However, the five sound test was a daily routine check to ensure optimal listen-

ing conditions at all times. The microphone was placed equidistant between subjects and experimenter which permitted the subjects to receive the same acoustic information.

Instructions prior to initial training were given to both subjects:

To the active learner: "You are going to be our talker. You will say lots of things."

To the passive learner: "You are going to be our listener. You must listen very carefully."

Occasionally, the subjects needed to be reminded of the instructions.

Subskills, targets, training strategies, and the order of phoneme development described by Ling (1976) were strictly followed. Ling's Teacher/Clinician Planbook (1978) and the pre-test measures were used to create the initial individual lesson plans for each pair. Subsequent plans were written as subskills and targets were achieved. After a particular target sound was satisfactorily attained (i.e., mastery of nearly all subskills), common words containing the target were introduced. When these had been learned, they were introduced in common everyday phrases. Games and activities were devised, incorporating specific words and phrases, to encourage the transfer of learning from the syllable level to the word and phrase level.

Reinforcement varied each day and included games, stickers, and candy. The active learner was reinforced for correct productions and the passive learner was reinforced

for correct discriminations. Social praise from the experimenter served as a major form of reinforcement for all subjects throughout the study.

Additional Measures

Classroom Observation

At the end of all post-testing, seven one-hour observations were made in the classrooms of the subjects. The purpose of the observation sessions was to note the number of times each subject spontaneously produced training targets during an academic instruction period such as reading or math. Also, notes were made as to the number of times the teacher reinforced correct production; modeled the production so that the child could imitate it; reminded the child to use his new target; and accepted production without notice. See Appendix D for a sample of the observation record sheet.

Parent Involvement

At the end of the study, teachers were asked to rate how they perceived the general involvement of subjects' parents in the education of their child. A six-point rating scale was devised using 0 as the lowest rating and 6 as the highest possible rating. The categories were as follows:

0 -- child receives <u>minimal assistance</u> from parents,

1 -- parental cooperation and concern is <u>poor</u>,

2 -- <u>occasional</u> or sporadic involvement,

3 -- average: participates when absolutely essential,

4 -- good: parent often participates in school activities,

5 -- very good: regular and consistent communication between school and home,

6 -- excellent: the child's total well-being is a primary concern of the parent.

Teachers were instructed to circle the number corresponding to the most accurate description of parental involvement for each subject in their classroom. See Appendix E for a sample of the parent rating scales.

RESULTS

Two groups of matched pairs of hearing-impaired children were studied: a group of active subjects who orally produced specific targets and a group of passive subjects who listened and discriminated among various combinations of speech sounds without oral production.

Comparisons among and between groups on the pre- and post-tests were made using three separate analyses of variance (Biomedical computer programs, W.J. Dixon (ed.), 1970). Tests of simple effects were then applied to the results to determine the significance of the interactions (Keppel, 1973). Pearson product-moment correlations were also performed between independent and dependent variables for the separate groups. Further analyses of the results will be presented in detail.

Phonologic Level Tests

The results of the phonologic level tests are presented in Table 4.1. The scores shown were obtained from samples of spontaneous speech prior to and after the training sessions. Each phoneme appearing in the sample was given one point regardless of the number of times it occurred. Figure 4.1 illustrates the pre- and post-test gains for both groups.

For the pre-test, the range of scores for the subjects in the active group was from 11 to 30 with a mean of 22.29. The range of scores for the passive group was from 11 to 26 with a mean of 20.43. At the completion of the training program,

TABLE 4.1

Scores for each subject on the Pre- and Post-Training Phonologic Level Evaluations

SUBJECT	ACTIVE			SUBJECT	PASSIVE		
	Pre	Post	Difference		Pre	Post	Difference
A_1	11	20	+ 9	P_1	22	21	- 1
A_2	26	32	+ 6	P_2	16	19	+ 3
A_3	22	31	+ 9	P_3	22	25	+ 3
A_4	30	40	+10	P_4	22	35	+13
A_5	21	23	+ 2	P_5	11	11	+ 0
A_6	19	25	+ 6	P_6	24	25	+ 1
A_7	27	34	+ 7	P_7	26	34	+ 8
MEAN	22.28	29.29	7.14		20.43	24.29	4.00

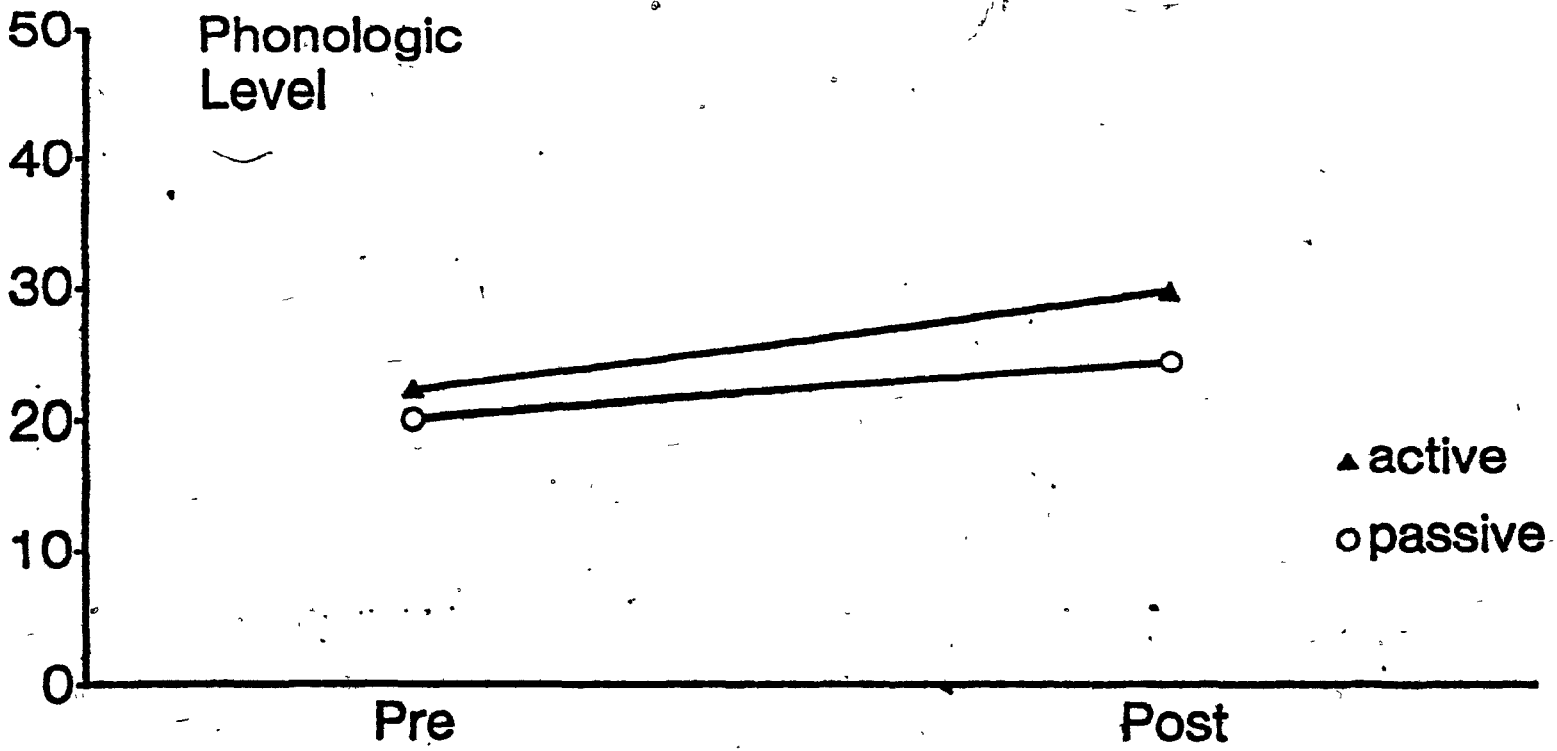

FIGURE 4.1 Pre- and post-test scores for the phonologic level speech evaluations for active and passive subjects.

post-test scores for the active group ranged from 20 to 40 with a mean of 29.29, and from 11 to 35, with a mean of 24.29 for the passive group. The analysis of variance, summarized in Table 4.2, showed a highly significant difference between pre- and post-test scores ($F = 25.67$, $df = 1,12$ $p < .01$) but no significant difference between the two groups. Both active and passive subjects scored significantly better on the post-training test than on the pre-training test.

Phonetic Level Tests

Subjects' responses were scored for the production of segmental items, i.e., vowels and consonants, in single, repeated and alternated syllables. In addition, nonsegmental items were also scored. Responses consistently produced were given two points and inconsistently produced items, one point. No points were awarded for those phonemes not produced at all.

Data for the pre- and post-test scores are presented in Table 4.3. Pre-test scores for active subjects ranged from 59 to 153 with a mean score of 105.29, and for passive subjects from 47 to 128 with a mean of 90.57. After training, all subjects demonstrated some gains in phonetic level skills. The mean score for active subjects was 162.57, with scores ranging from 116 to 251 and for passive subjects from 55 to 146 with a mean of 109.29. Pre- and post-test scores are graphically represented in Figure 4.2.

The analysis of variance, as shown in Table 4.4, revealed a highly significant main effect for tests ($F = 46.66$, $df = 1,12$

TABLE 4.2

Summary of the analysis of variance for the subjects' scores for the phonologic level tests

SOURCE OF VARIANCE	MEAN SQUARE	DEGREES OF FREEDOM	F	LEVELS OF SIGNIFICANCE
Groups (G)	82.29	1	0.97	NS
Tests (T)	206.29	1	25.67	.01
G X T	17.29	1	2.15	NS

TABLE 4.3

Scores for each subject on the Pre- and Post-Training of Phonetic Level Evaluations

SUBJECT	ACTIVE			SUBJECT	PASSIVE		
	Pre	Post	Difference		Pre	Post	Difference
A_1	59	116	+57	P_1	47	84	+37
A_2	96	148	+52	P_2	98	104	+ 6
A_3	74	146	+72	P_3	83	98	+15
A_4	153	251	+98	P_4	128	168	+40
A_5	97	166	+69	P_5	52	55	+ 3
A_6	105	135	+30	P_6	96	110	+14
A_7	153	176	+23	P_7	130	146	+16
Mean	105.23	162.57	57.43		90.57	109.43	18.86

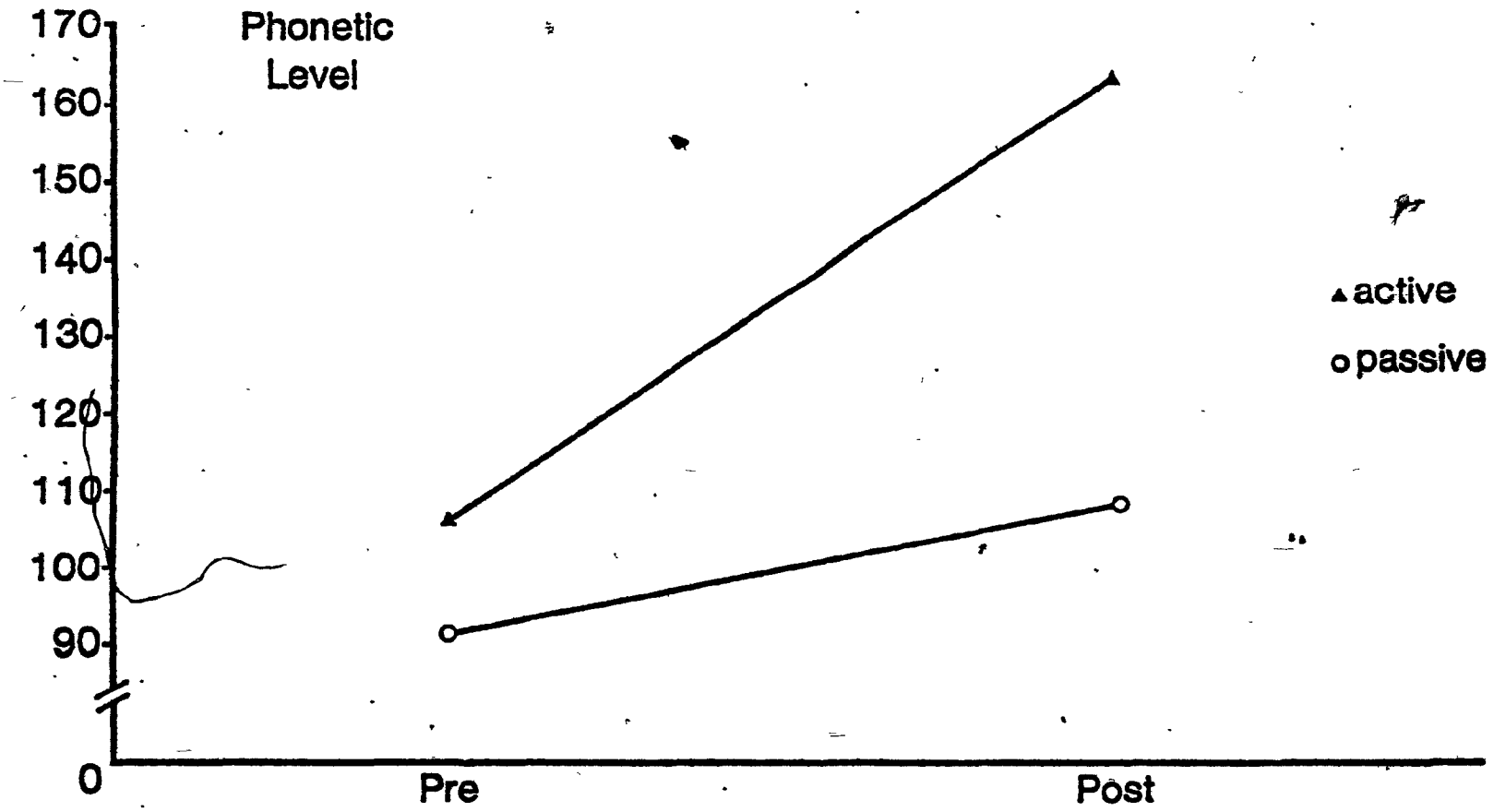

FIGURE 4.2 Pre- and post-test scores for the phonetic level speech evaluations for active and passive subjects.

TABLE 4.4

Summary of the analysis of variance for the subjects' scores for the phonologic level tests

SOURCE OF VARIANCE	MEAN SQUARE	DEGREES OF FREEDOM	F	LEVELS OF SIGNIFICANCE
Groups (G)	8092.00	1	3.07	NS
Tests (T)	10108.00	1	46.66	.01
G X T	2603.57	1	12.02	.01

$p < .01$) and a significant interaction between tests and groups ($F = 12.02$, $df = 1,12$ $p < .01$). A test of simple effects indicated that there was no significant difference between the two groups on the phonetic level evaluation pre-test ($t = .73$). However, the difference between active and passive subjects on the post-test was significant ($t = 2.64$ $p < .02$). This finding demonstrated that the active participation in speech production was more effective than passive listening in teaching phonetic level targets. Tests of simple effects showed that active learners made significant gains after training ($t = 7.28$ $p < .01$), as did passive learners ($t = 2.38$ $p < .05$).

Auditory Discrimination Tests

The final test administered to both groups, before and after training, was a measure of auditory discrimination ability. The test was specially constructed for this study and was scored according to the number of correct items out of a possible seventy. The subjects' task was to identify, through audition alone, one syllable from a given pair. Pre- and post-test scores are set forth in Table 4.5.

Auditory discrimination pre-test scores for both groups were essentially the same. Scores for active learners ranged from 33 to 54 with a mean score of 41.00, while the scores for passive learners ranged from 33 to 53 with a mean of 40.86. Figure 4.3 shows the differences between groups on pre- and post-tests.

TABLE 4.5

Scores for each subject on the Pre- and Post-Training of the Auditory Discrimination Test

SUBJECT	ACTIVE			SUBJECT	PASSIVE		
	Pre	Post	Difference		Pre	Post	Difference
A_1	39	49	+10	P_1	33	40	+ 7
A_2	51	54	+ 3	P_2	45	43	- 2
A_3	37	55	+18	P_3	42	39	- 3
A_4	54	54	+ 0	P_4	53	54	+ 1
A_5	33	54	+21	P_5	33	41	+ 8
A_6	33	48	+15	P_6	42	46	+ 4
A_7	40	56	+16	P_7	38	44	+ 6
MEAN	41.00	52.86	12.0		40.85	43.86	3.14

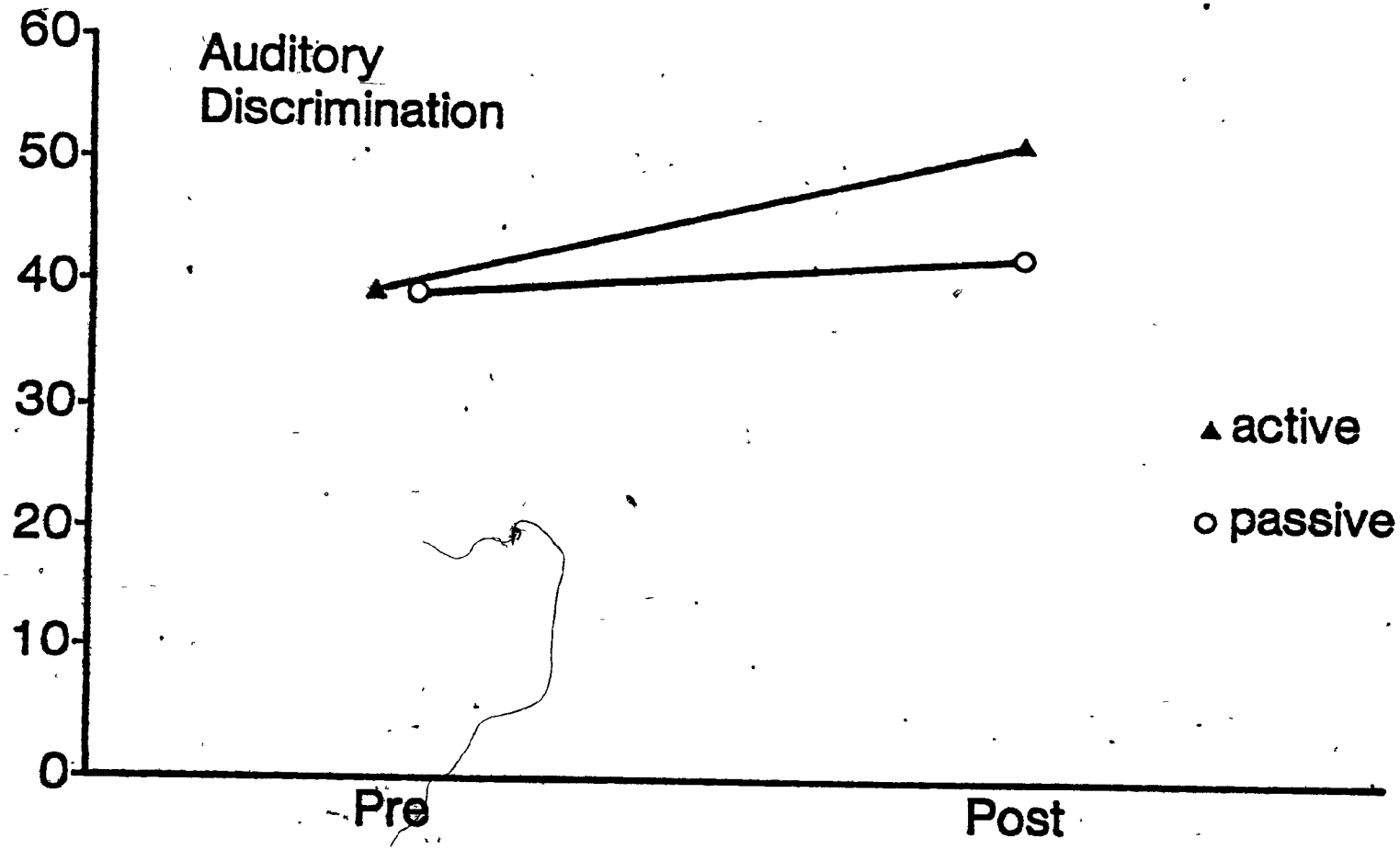

FIGURE 4.3 Pre- and post-test scores for the auditory discrimination tests for active and passive subjects.

The third analysis of variance, summarized in Table 4.6, revealed a significant main effect for tests ($F = 19.04$, $df = 1,12$ $p < .01$) and a significant interaction between groups and tests ($F = 6.77$, $df = 1,12$ $p < .05$). Tests of simple effects were, therefore, performed. No significant difference was found between groups prior to the training ($t = .04$). After completing the speech training sessions, the active learners were significantly superior to the passive learners in auditory discrimination ability ($t = 2.71$ $p < .02$). While the active learners had made significant gains over the course of training ($t = 4.92$ $p < .01$), the passive learners had not ($t = 1.24$).

Pearson Product-Moment Correlations

Correlation coefficients were calculated between independent and dependent variables as shown in Tables 4.7 and 4.8 . No significant relationship was obtained between scores on any of the measures and hearing loss for either group.

Significant relationships between scores were noted for both active and passive subjects on the following measures:

1. pre- and post-phonetic level test scores
2. pre- and post-phonologic level test scores
3. pre-phonetic and post-phonologic level test scores
4. post-phonetic and post-phonologic level test scores

In addition, the following significant relationships were obtained for the active group:

TABLE 4.6

Summary of the analysis of variance for the subjects' scores for the auditory discrimination tests

SOURCE OF VARIANCE	MEAN SQUARE	DEGREES OF FREEDOM	F	LEVELS OF SIGNIFICANCE
Groups (G)	146.29	1	2.56	NS
Tests (T)	386.29	1	19.04	.01
G X T	137.29	1	6.77	.05

TABLE 4.7

Values of the correlation coefficients between independent and dependent variables for active subjects. One asterik indicates significance beyond the .05 level; two, beyond the .01 level.

	Pre Phonetic	Pre Phonologic	Pre Discrimination	Post Phonetic	Post Phonologic	Post Discrimination	H.L.	Age
Pre Phonetic		.81*	.42	.81*	.76*	.45	-.50	-.51
Pre Phonologic			.62	.80*	.92**	.74	-.42	-.42
Pre Discrimination				.61	.74	.34	.15	-.41
Post Phonetic					.81*	.51	-.55	-.75*
Post Phonologic						.65	-.15	-.31
Post Discrimination							-.49	-.37
Hearing Loss								.73

TABLE 4.8

Values of the correlation coefficients between independent and dependent variables for passive subjects. One asterik indicates significance beyond the .05 level; two, beyond the .01 level.

	Pre Phonetic	Pre Phonologic	Pre Discrimination	Post Phonetic	Post Phonologic	Post Discrimination	H.L.	Age
Pre Phonetic		.54	.73	.93**	.84*	.70	-.49	-.01
Pre Phonologic			.24	.67	.84*	.26	-.22	.79*
Pre Discrimination				.75*	.60	.78*	-.03	-.32
Post Phonetic					.95**	.80*	-.48	.11
Post Phonologic						.64	-.51	.41
Post Discrimination							-.14	
Hearing Loss								-.12

1. pre-phonetic and pre-phonologic level test scores
2. pre-phonologic and post-phonetic level test scores

Age was negatively correlated with scores on the phonetic level post-test for active subjects.

For the passive learners, additional significant correlations were observed between the scores on:

1. pre- and post- auditory discrimination test scores
2. pre-auditory discrimination and post-phonetic level test scores
3. post-phonetic and post-auditory discrimination test scores

There was a significant positive correlation between age and the scores on the phonologic level pre-tests.

DISCUSSION

The main purpose of the present study was to investigate the effectiveness of articulation training and its relationship to auditory discrimination among young hearing-impaired children. Analysis of the pre- and post-tests indicates that the active subjects, who were engaged in vocal practice, made more gains in production and discrimination than the passive subjects, who received only discrimination training. Thus, it appears that articulation training enhanced the development of auditory discrimination skills. Further discussion will examine in detail the results of the three measures: the phonologic, the phonetic, and the auditory discrimination tests.

Phonologic Level Speech Skills

The phonological analysis, as described by Ling (1976), is a useful assessment tool in determining the number of phonemes present in the child's spontaneous language. Teachers of the hearing-impaired should find the test valuable in that it can provide the necessary diagnostic information needed for planning phonologic level teaching and a record of the child's progress from year to year. Knowledge of the child's strengths and weaknesses in spoken language is vital to the development of an appropriate and individualized speech program. Without such evaluation and planned teaching, the errors common in the speech production of hearing-impaired children are likely to persist.

To encourage the transfer of skills from the phonetic context into phonology, words and phrases containing target phonemes were selected. Both groups demonstrated some gains in their use of phonemes at the phonological level. It seems that phonologic level teaching, based on the development of phonetic skills, is effective in facilitating the transfer of phonetic skills into spoken language in a relatively short amount of time. If training could have been extended beyond thirty sessions, differences between groups may have emerged or larger gains may have been made. Teachers, who work more frequently with the child over a much longer span of time, should be encouraged by this finding. During the course of an academic year, teachers should expect many gains in phonologic level speech skills. However, research is required to determine the amount of time needed to ensure phonetic-to-phonologic transfer for different groups of children in different settings.

Since the development of phonologic skills is of primary concern to educators, further study employing a more systematic method for ensuring generalization of phonetic skills into phonology should be devised. Guess, Baer, and Sailor (1978) and Ling (1979, in press) suggested that generalization can be enhanced if target sounds are rehearsed in a variety of linguistic contexts and situations with different people and in different locations other than the school or therapy room. For example, once the /s/ phoneme is acquired, it may be more worthwhile to develop it as a morpheme signifying possession, plural forms, and as a verb marker for present tense rather than in lists of

vocabulary items. Teachers, parents and others involved with the child must then be made aware of the child's new skill and reinforce it whenever possible. In this way, speech production skills can be linked to linguistic skills.

To ensure the incorporation of all of the above conditions was out of the scope of the present study. However, an attempt was made to evaluate the possible influence of teacher and parent involvement of the subjects in this study. At the end of all post-testing, seven one-hour observations were made in the classrooms of the subjects to determine to what extent the teachers reinforced or encouraged the development of phonological skills during an academic subject such as mathematics or reading. Although opportunities existed for speech correction at the phonological level in class, observations made subsequent to the training sessions revealed that none of the teachers systematically encouraged or reinforced correct speech production during lessons other than speech lessons. Nevertheless, both groups made gains at the phonologic level. Perhaps the presence of the experimenter inhibited the teachers from making speech corrections and reinforcing correct productions as they might normally have done.

A parental involvement rating scale was designed in order to evaluate the potential involvement that may be expected in a speech program from parents of subjects in this study. Teachers rated eight parents as excellent, very good or good; two were rated as average; two were rated as showing occasional interest in their child; and two were rated as poor. None

were rated as giving the child only minimal assistance in his daily care. Since the majority of parents were rated between average and excellent, it seems that this group could be successfully involved in a speech program which includes parents as prime targets of training.

Another interesting aspect related to phonological development is the principle of interference studied by Winitz and Bellerose (1978). They suggested that improper production rehearsed over long periods of time interfere with the use of newly acquired skills. Since all of the subjects were between the ages of five and seven, most had rehearsed poor speech habits such as inadequate breath control, neutralization of vowels and diphthongs and a variety of consonant errors. Interference may have been operating for these subjects especially for the passive learners who did not have an opportunity to orally rehearse the targets. The short time of training was probably not sufficient to overcome many of the errors and problems associated with interference. A longer term study is required to determine the amount of such interference as it occurs in hearing-impaired speakers and the length of time required to eliminate its effects.

Performance of Individual Children

In general, all of the active learners made substantial gains in the use of segmental patterns in spoken language. Many of the gains were often reflected in the use of fricatives.

While few of the subjects used any correctly produced fricatives initially, most of them used many of the early fricatives such as /f/ and /θ/ during the phonologic post-test. Production training at the phonologic level may have been the essential ingredient in facilitating transfer of skills from a structural situation into spontaneous speech.

Of the passive subjects, one subject's (P_4) phonologic score improved more than any of the active or passive subjects. The passive learner, who scored an additional thirteen points on the post-test, also scored highest on the other two post-test measures as compared to other passive learners. Of importance is the fact that this subject's initial auditory discrimination score (53) was higher than all other passive subjects and second highest in relation to the active learners' scores (his active partner A_4 scored 54 on the auditory discrimination pre-test). It may be that while he had the ability to make auditory discriminations, he was not initially using auditory information as an aid to production. With intensive auditory discrimination training and through listening and observing his active partner produce the targets, the passive learner became able to correctly produce several new phonemes in his spontaneous speech.

Correlations involving Phonologic Level Tests

For all subjects, pre-test scores on the phonologic analysis were closely correlated with post-test scores. In other words, those subjects who scored high on the phonologic level pre-test

also scored high on the phonologic post-test. This finding suggests that the phonologic analyses were reliable in that subjects maintained similar patterns of performance over a period time.

Post-test scores on the phonologic speech evaluation were correlated with pre- and post-test scores on the phonetic speech evaluation for both groups. Students who scored well on the phonetic level tests tended to score well on the phonologic level post-test. These results indicate that students who produce a number of phonemes in their spoken language will also correctly imitate many of the motor speech patterns at the phonetic level.

Active learners' pre- and post-phonetic scores were correlated with pre-phonologic level test scores. Again, active subjects who performed well on the imitative tasks of the phonetic evaluation produced a high number of phonemes in their spontaneous speech. Of importance is that phonetic and phonologic skills are correlated which suggests that the two forms of evaluation can be used in conjunction to accurately assess the speech abilities of hearing-impaired students.

Age of the passive group was correlated with the phonologic level pre-test scores. It appears that the older subjects in the passive group made most use of different phonemes in their phonology.

Phonetic Level Speech Skills

The administration of the Phonetic Level Speech evaluation

(Ling, 1976) permits one to assess the child's ability to imitate the motor speech patterns of the English language in single, repeated and alternated syllables, in loud, quiet, and whispered voice over a range of at least eight semitones. The phonetic level assessment assists the teacher in identifying precisely what skills the child has mastered and those he has not. In addition, the evaluation serves to pinpoint troublesome contexts of production for the child. For example, a child may be able to produce a correct /m/ in the vowel context of /a/ whereas the vowel contexts of /i/ and /u/ result in faulty production of the /m/. Thus, phonetic level speech assessment in conjunction with the phonological analysis should be beneficial to teachers in developing long and short term objectives for speech production in hearing-impaired students.

The speech program proposed by Ling (1976), consisting of a hierarchy of targets and their subskill behaviors, was rigorously implemented. The experimenter was familiar with Ling's teaching strategies and employed them routinely. No target sound was found to be particularly difficult to teach and the system was quite easily and effectively implemented. In general, a daily lesson plan contained targets which were near mastery level, others which needed more rehearsal in various contexts, and only one or two targets which were being introduced for the first time. In other words, subjects were highly successful and familiar with many of the items which gave them the confidence needed to tackle the newly introduced

items.

For the active learners, the rate of acquisition of subskills and targets was extremely rapid as compared to other similar training studies. In the study by Osberger et al (1978), one third of the subjects attained mastery of the suprasegmentals in thirty-nine weeks of training. No attempt was made to introduce new vowels or consonants. This adaptation of Ling's model may be one of the primary reasons for such slow progress. By integrating the instruction of vowel production and suprasegmental production, one can promote correct and consistent production of both. Further rehearsal of suprasegmental patterns is embedded into the subskills listed for each consonant target. The variety of contexts and continued rehearsal of previously learned targets enhances the child's chances for retaining the production information. More research is needed to determine the length of training needed for developing suprasegmental patterns over a greater age range and with a greater number of children.

Another training study by Monsen and Shaughnessy (1978) demonstrated successful acquisition of five vowels in five months in three hearing-impaired subjects. Eventhough the authors suggested that five months was a short amount of training time, the present study suggests that such gains can be achieved in an even shorter amount of time. Rapid acquisition of targets is needed if the child is going to acquire all of the necessary skills required for effective verbal communication.

Passive learners also demonstrated gains at the phonetic

level. Since many of the subjects made substantial gains, it is important to acknowledge the effectiveness of auditory discrimination practice alone. Educators, who rely heavily on an auditory approach only will be encouraged by this finding. It is equally important, however, to note that those subjects who received speech practice in addition to the auditory discrimination practice made even more gains in phonetic level skills. It may be that since all of the subjects in this study were in a remedial training program rather than developmental program, motor speech rehearsals were much more crucial for the development of accurately produced phonemes.

The possibility exists that passive learners vocally rehearsed targets outside the speech instruction periods offers another reason for improvement. Passive learners watched and listened as the active learners rehearsed their targets. It is quite likely that the passive learners employed some of the strategies they observed to teach themselves the targets. Fricatives, were often taught by having the active learner feel the breath on his hand as he produced the /f/ or /θ/. Passive learners could have employed this strategy outside the therapy sessions. Passive learners, who were just as eager to achieve as active learners, often stopped the experimenter in the hall to demonstrate their skills. Such practice was probably severely limited due to scheduling of academic work throughout the day.

Performance of Individual Subjects

The active learner, who scored one of the highest pre-test scores (A_4), scored the most additional points at the end of training (difference score of +98). He also obtained the highest score on the post-test phonologic level speech evaluation. Since he had mastered the early targets such as suprasegmental patterns, vowels, diphthongs, and many early consonants, it was quite easy for him to use his previously learned skills in building and developing higher level consonant targets.

Although the gains of passive subjects were not as great as the active learners, the results demonstrate that auditory discrimination practice alone is beneficial for some hearing-impaired children. One passive subject (P_4) gained an additional forty points between pre- and post-phonetic level tests. He was the partner of the active learner who made the most gains on phonetic and phonologic tests. Both scored very well on the pre-test and continued to make gains throughout training.

Correlations involving Phonetic Level Tests

Scores for both groups of subjects on the pre- phonetic level tests were closely correlated with scores on the post-phonetic level tests. This finding indicates that the learners, whether active or passive, who did well on the pre-phonetic evaluation also did well on the post-phonetic evaluation. This finding suggests that the Phonetic Level Speech Evaluation is

a reliable measure of a subject's ability to perform imitative tasks over repeated testing, as Young (1978) has previously reported.

Age was negatively correlated with scores on the phonetic level post-test for active learners. The younger subjects scored better on the phonetic material than the older subjects. As mentioned earlier, poor patterns of production rehearsed over a long period of time may have interfered with the older subjects' ability to produce newly learned targets. The implication here is that developmental teaching rather than remedial teaching would prevent the development of improper productions.

Auditory Discrimination Skills

The auditory discrimination test, described earlier, was reduced from a three-item task to a two-item task because subjects were unable to retain a three-item sequence in memory. A.H. Ling (1976) suggested that a motor response may be less efficient than a spoken response in tapping a child's ability to recall sequences of items. After training, her subjects showed some improvement in recall for strings of words and digits. It may be that nonsense syllables, such as those used in the present test, are more difficult to retain and retrieve from short term memory than items which have some attached meaning. However, it would have been of interest to administer the three-item test after the intensive speech and

auditory discrimination sessions were completed to determine to what extent, if any, training had affected their ability to perform on the more difficult task. Further research is required to investigate types of materials and responses best used for auditory discrimination tasks with young hearing-impaired children.

Another possible avenue of investigation would have been to examine the results of the auditory discrimination test given under several conditions such as vision only, and vision plus audition instead of the audition only condition. With the exception of specific audition tasks, visual cues as well as auditory cues were available to the subjects throughout training. Performance on the auditory discrimination test under the conditions of vision alone and audition plus vision may have generated some interesting results. Further research is required to determine whether or not production training affects one's ability to improve reception through vision and/or vision and audition. Furthermore, research is required to determine how the subjects use their perceptual skills in discourse and spoken language to function in everyday situations. Such information would have serious implications for teachers working with hearing-impaired children who have auditory competence as one of their major objectives.

Only the active subjects made significant gains in auditory discrimination. The passive learners, who had essentially the same pre-test scores as the active group and who received auditory discrimination practice, did not score significantly

better on the post-test. In this study, motor speech practice was, therefore, the component of training that most strongly influenced the development of perceptual skills in active learners. Such gains can not be attributed to the influence of any other variable. This finding, unlike Denes' (1967), lends support to the Motor Theory of Speech Perception (Liberman, 1957) which states that articulatory movements are useful in coding perceptual information. Hearing-impaired children must learn to listen as well as to speak. It appears that the Motor Theory may be more strongly relevant to them than to their normally hearing peers in that production practice affords them the opportunity more adequately to encode the incomplete perceptual information they receive. Should further studies confirm the findings reported here, then the implications of the Motor Theory should be recognized and modifications in teaching strategies made. Optimal gains in auditory discrimination may call for hearing-impaired children to be actively involved in speech production activities rather than be taught to receive speech through perceptual training alone.

The results of the auditory discrimination tests were similar to those reported by Lieberth and Subtelny (1978) for their hearing-impaired young adults. Since their control group did not receive auditory discrimination practice, they could not attribute the gains made solely to speech training. The present study, which controlled for the contributions of auditory

discrimination more effectively, identifies speech training as a major contributor to the improvement in auditory discrimination scores.

Holman's study (1974), which did not identify clear differences between listeners and speakers, pinpoints the need for accurate and consistent production. Speaking alone is not a guarantee in itself that perceptual skills will be developed. It would seem reasonable to hypothesize that for a Motor Theory to operate, the patterns of speech production to which receptive processes are related should be clear and consistent. Holman's speakers, who merely repeated the speech materials without correction, did not produce clear and consistent patterns and they did not differ significantly from his listeners nor from his control group on word recognition material.

Performance of Individual Subjects

The active subject (A_5) making the greatest gains in auditory discrimination scored an additional 21 points on the post-test. She also scored extremely well on the phonetic level post-test (difference score +68) but she did not score well on the phonologic post-test (+2). For her, rehearsal of targets in vocabulary items and phrases was not enough to ensure phonetic-to-phonologic transfer. This subject is a case in which the audiogram indicates a large amount of residual hearing. However, she functions as though she has much greater impairment. Since she did demonstrate the ability to improve

her auditory discrimination skills and phonetic level skills, further study with her should indicate what strategies would be most beneficial in facilitating transfer of phonetic level skills into phonology.

One active learner (A_4), who initially scored the highest on the auditory discrimination test, showed no improvement in his auditory discrimination skills on the post-test. As noted before, this same subject obtained the highest score on all production measures as compared to other subjects. With production training, this subject was able to utilize his discrimination skills and achieve many gains in production. On the other hand, his passive partner (P_4), who received the same auditory discrimination post-test score as the active learner, was unable to achieve the same degree of improvement in production. This finding indicates that production training results in more rapid acquisition of targets than discrimination training alone.

Correlations involving Auditory Discrimination

Passive learners' pre- and post-auditory discrimination scores and post-phonetic level test scores were correlated. Those learners who scored well on the auditory discrimination tests also scored well on the final phonetic level speech evaluation. This finding suggests that the Motor Theory describes only one aspect of speech reception and that there is, in fact, a reciprocal relationship between speech and auditory discrimination. Training in one aspect will, it

appears, enhance the effects of training in the other. Both speech teaching and auditory training are evidently complementary.

The subjects' scores in the passive group were also correlated for the pre- and post-auditory discrimination tests. Those subjects scoring well on the pre-test maintained that level of proficiency on the post-test. This finding suggests that auditory discrimination practice alone provides less than optimal treatment. It underlines the need for speech teaching and auditory training to be closely integrated activities.

CONCLUSIONS

1. Speech production training enhanced the development of perceptual skills in the active learners.
2. Speech production training effected change in production for active subjects at the phonetic and phonologic levels of speech.
3. For passive learners, auditory discrimination practice alone facilitated some improvement in production but no improvement in perception.
4. Additional studies on phonetic-to-phonologic transfer would be valuable to teachers in planning for the generalization of phonetic skills into phonology.
5. The phonetic and phonologic speech evaluation measures described by Ling (1976) adequately assessed the speech of the hearing-impaired children in this study.
6. Ling's (1976) speech teaching model was found to be a well-ordered hierarchy of skills for teaching hearing-impaired speakers.
7. The Teacher-Clinician's Planbook (Ling, 1976) was a useful guide for selecting and programming the subskill behaviors underlying the targets in the preparation of daily lesson plans.

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APPENDIX A

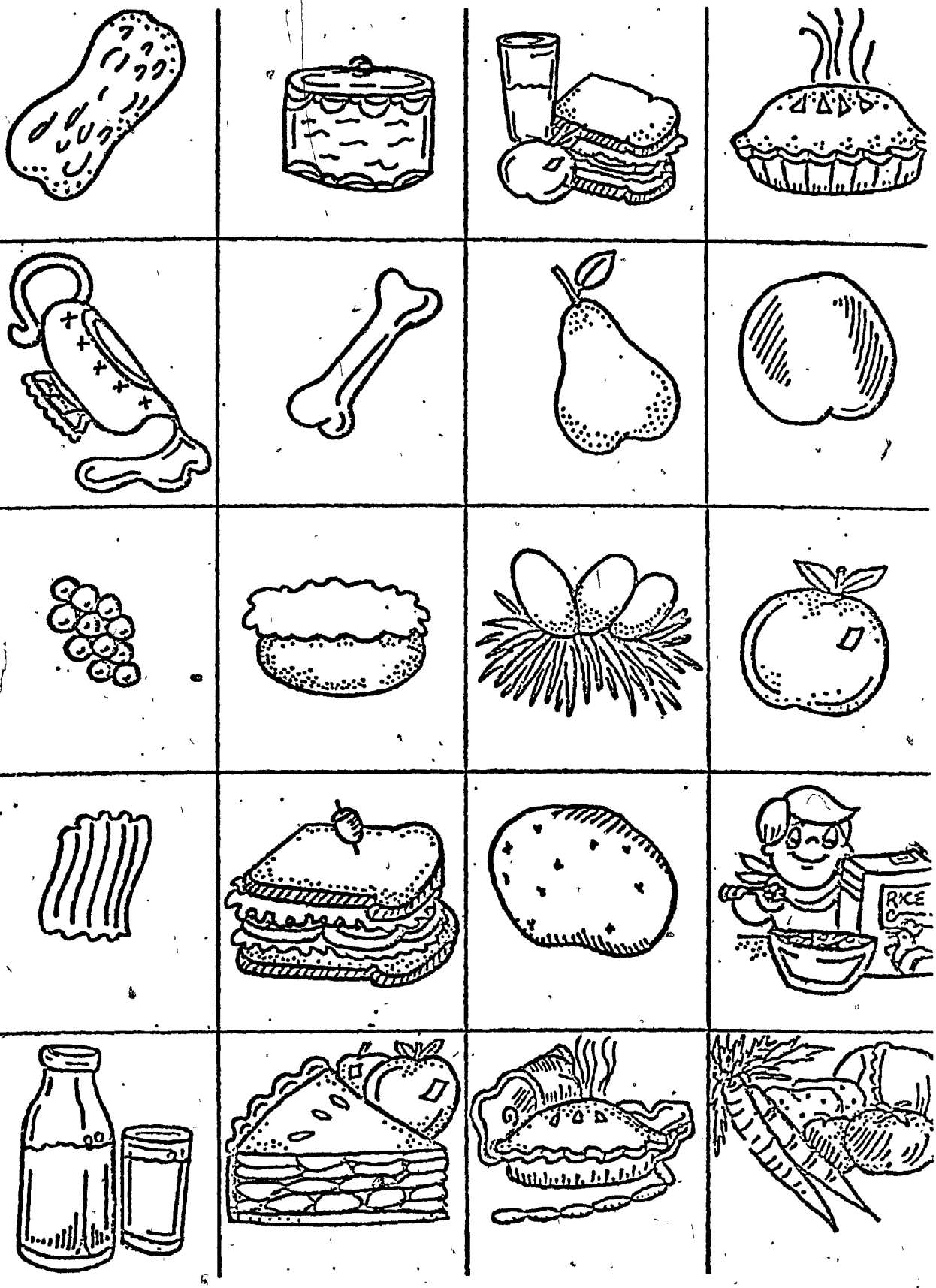
APPENDIX A

Auditory Discrimination Test

NAME _____ AGE _____

Manner		Place		Voicing		Vowels	
w	m	b	d	ʒ	ʃ	beɪ	bɛ
ʒ	d	p	t	t	d	bi	be
g	r	r	w	v	f	bɪ	bɑ
s	l	s	f	θ	ð	bɛ	beɪ
h	m	g	d	dʒ	tʃ	bɔ	bd
z	j	k	t	g	k	bʌ	bæ
g	r	d	b	p	b	bo	bav
ð	n	t	p	dʒ	tʃ	be	bi
f	t	m	n	θ	ð	bav	bo
z	j	j	r	p	b	bu	bɔ
tʃ	p	f	s	k	g	bʌ	bæ
ʃ	t	n	m	s	z	bɔɪ	baɪ
b	θ	w	r	v	f	bɑ	bɪ
v	dʒ	ʃ	f	t	d	ba[r]	bv
ð	n			s	z	baɪ	bɔɪ
f	t			ʒ	ʃ	bv	ba[r]
θ	b						
tʃ	p						
ʒ	d						
m	w						
k	s						
dʒ	v						

APPENDIX B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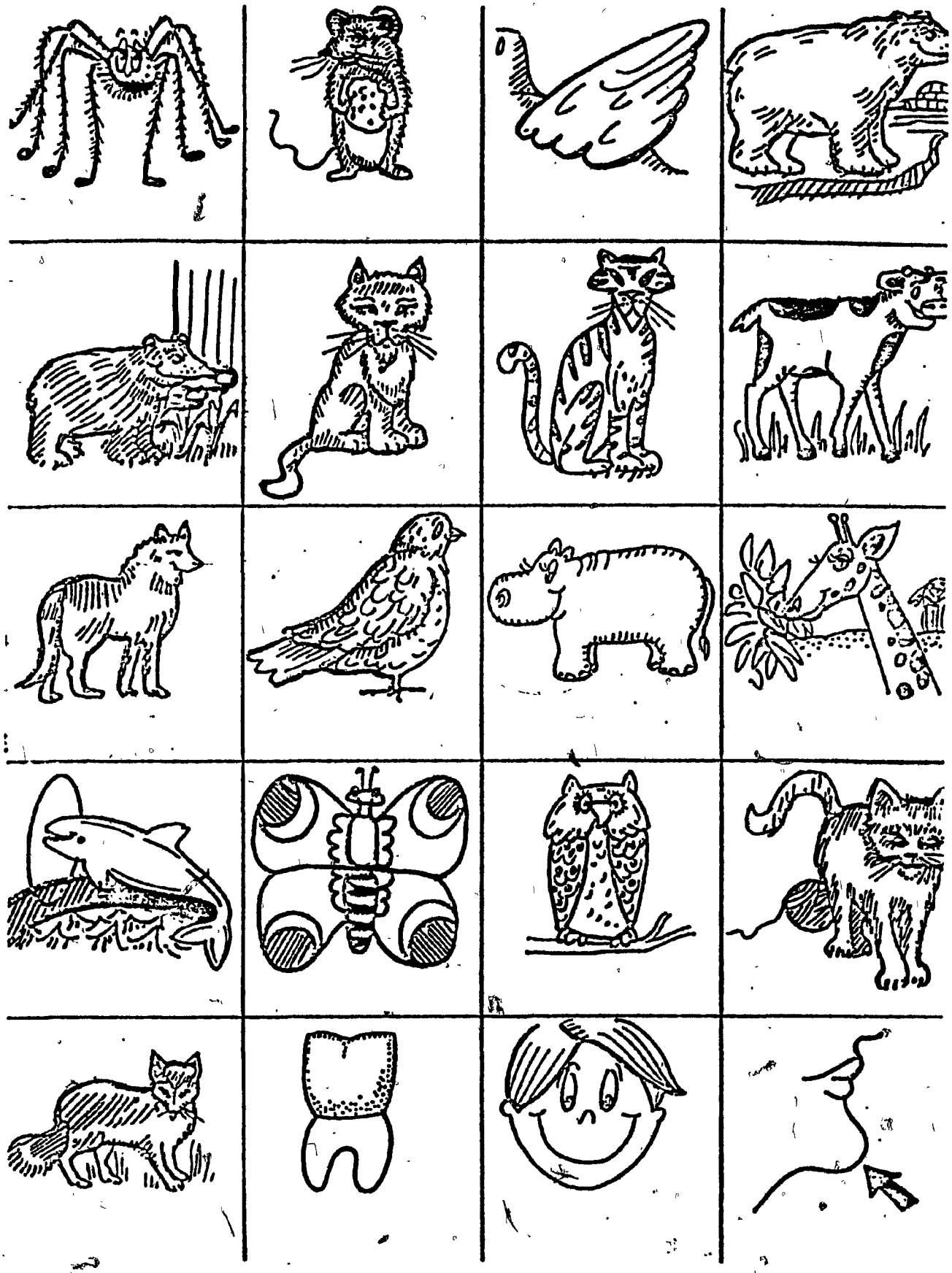
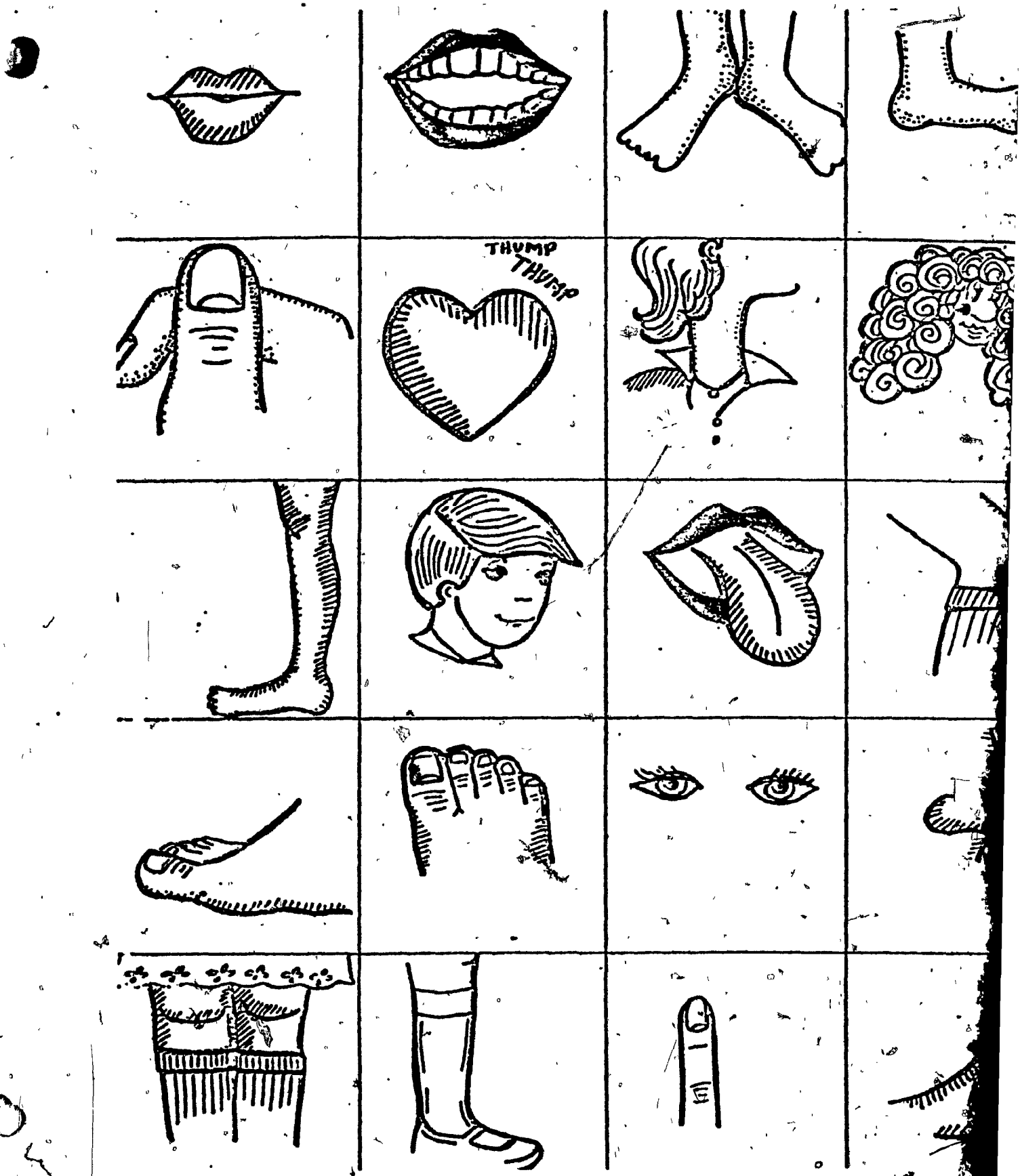
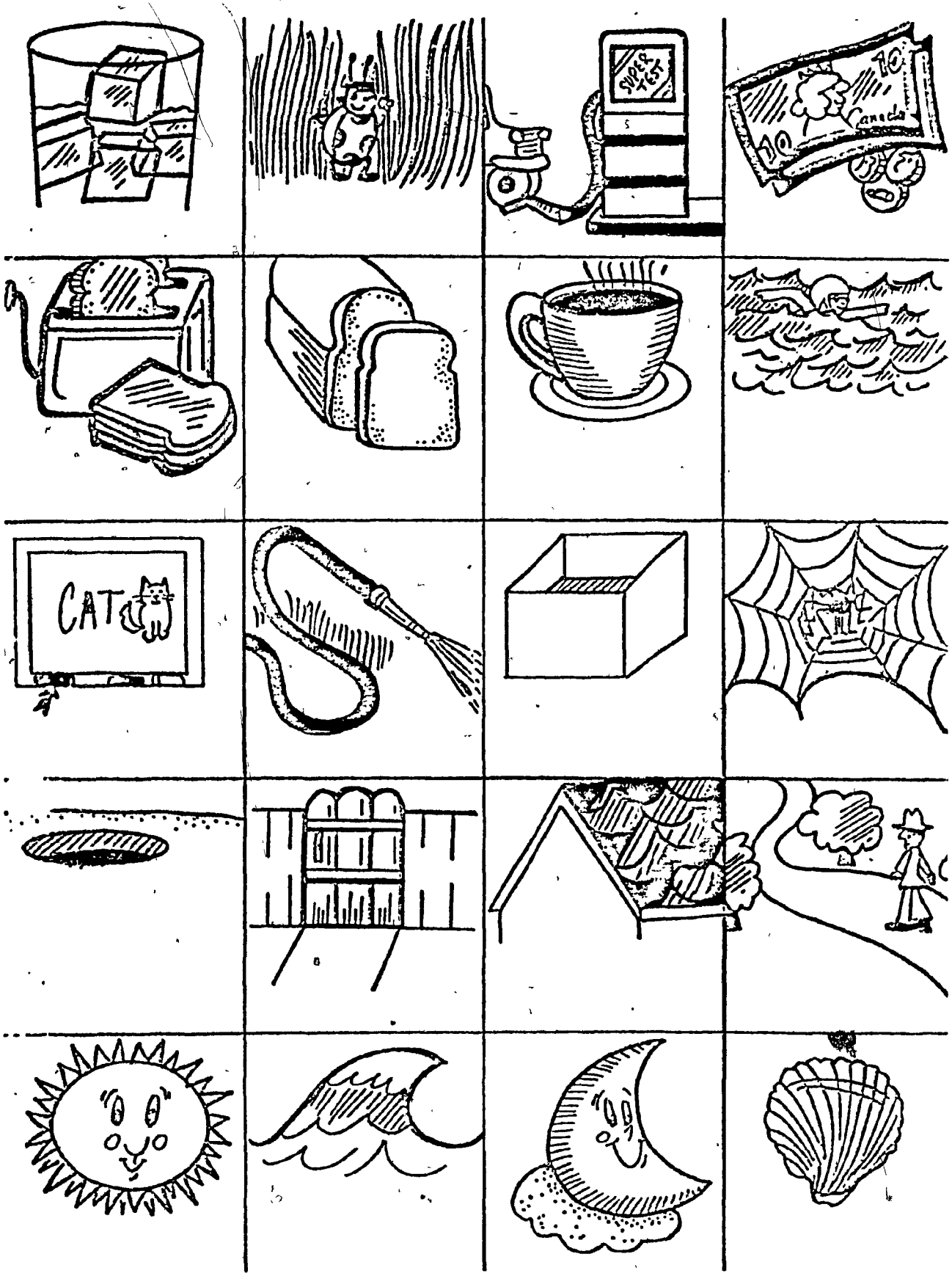
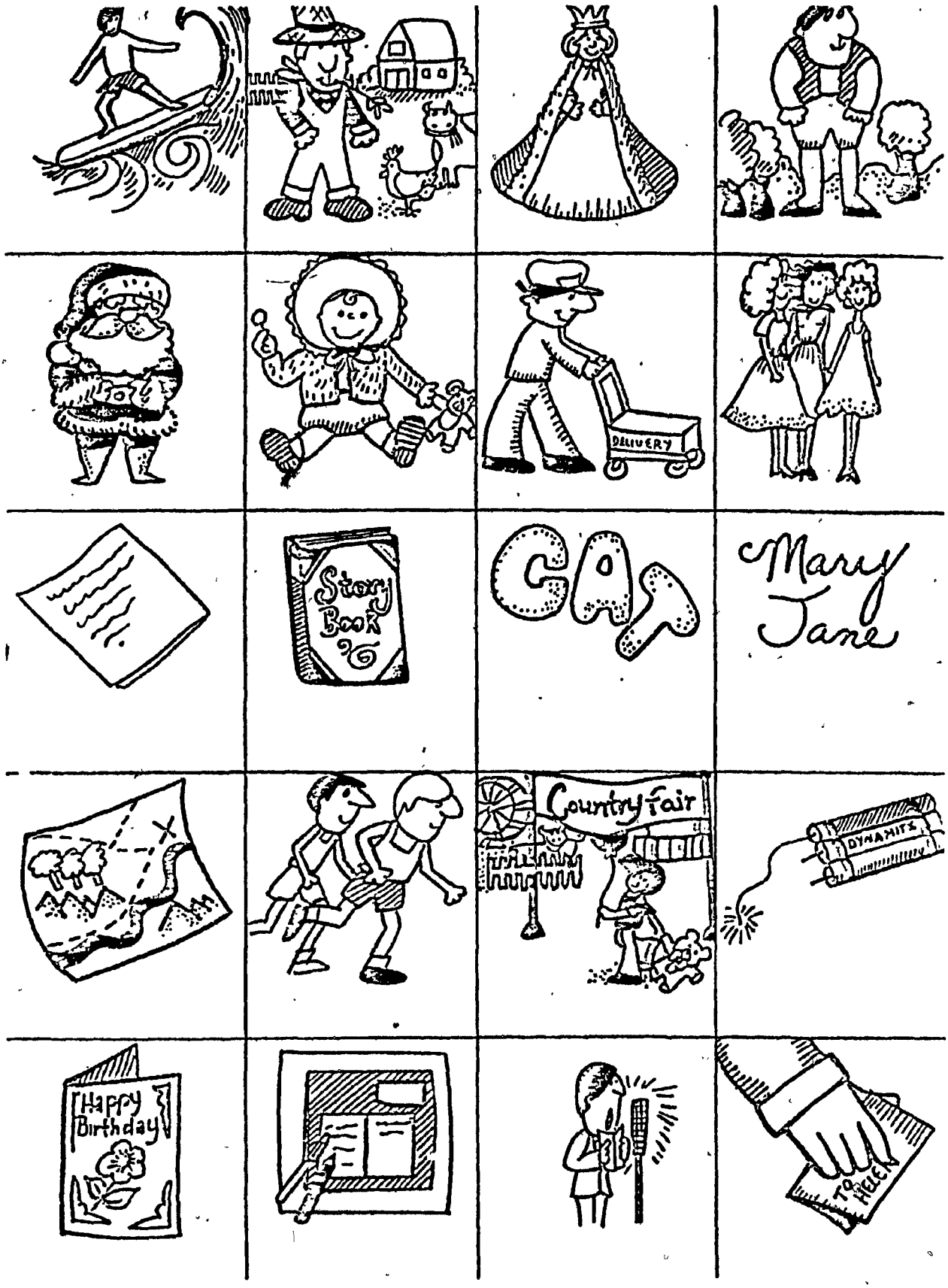
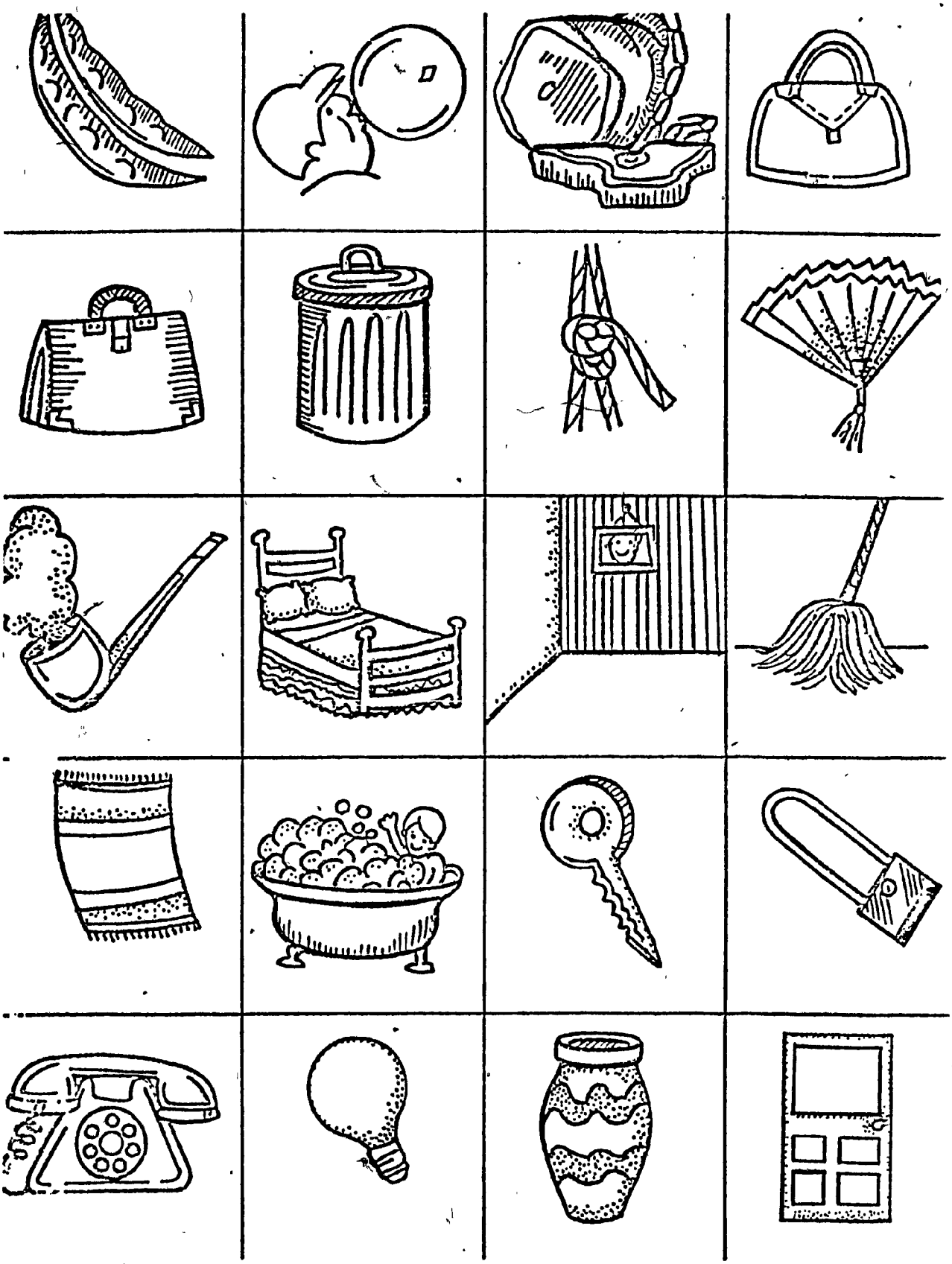
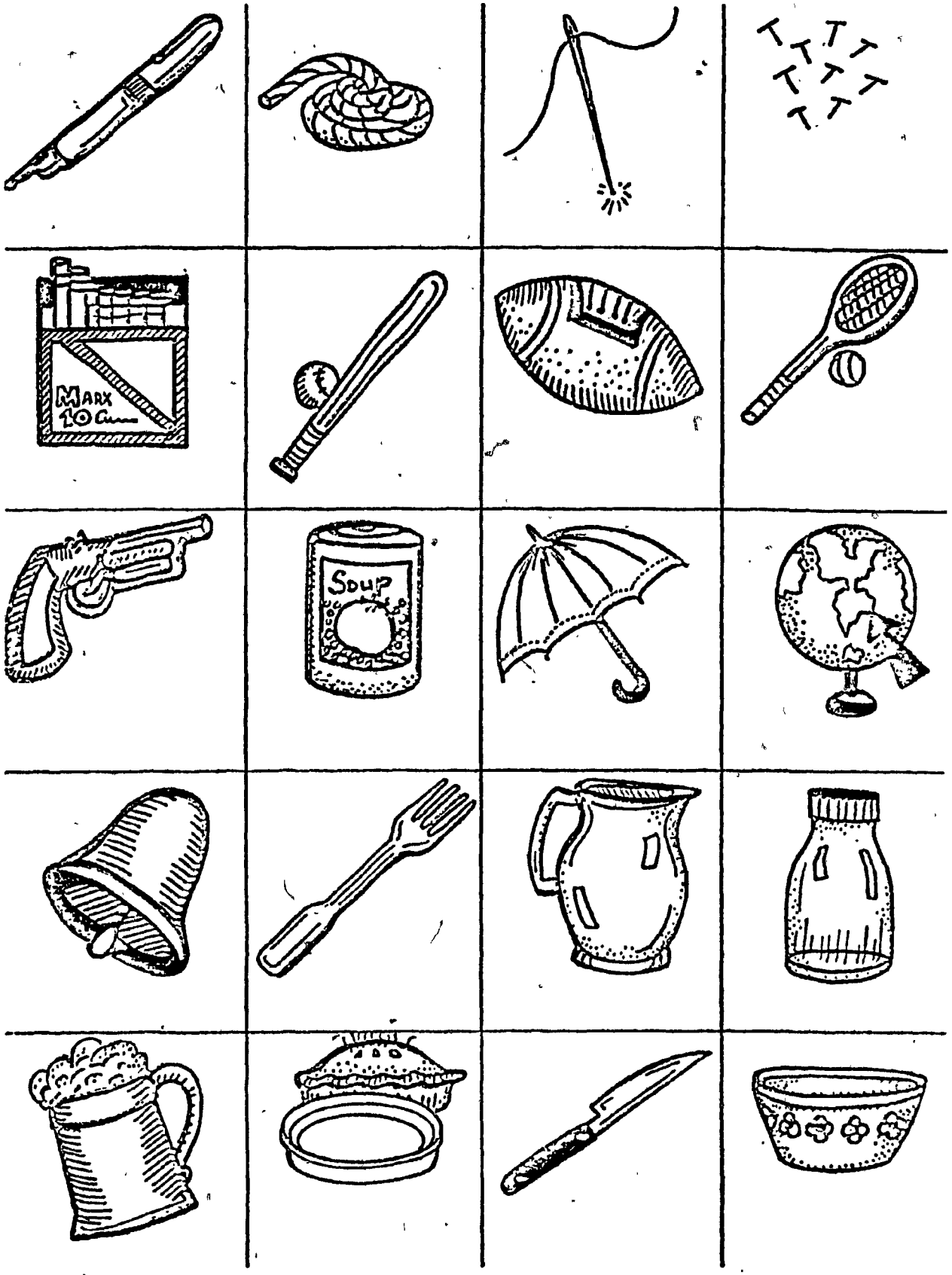


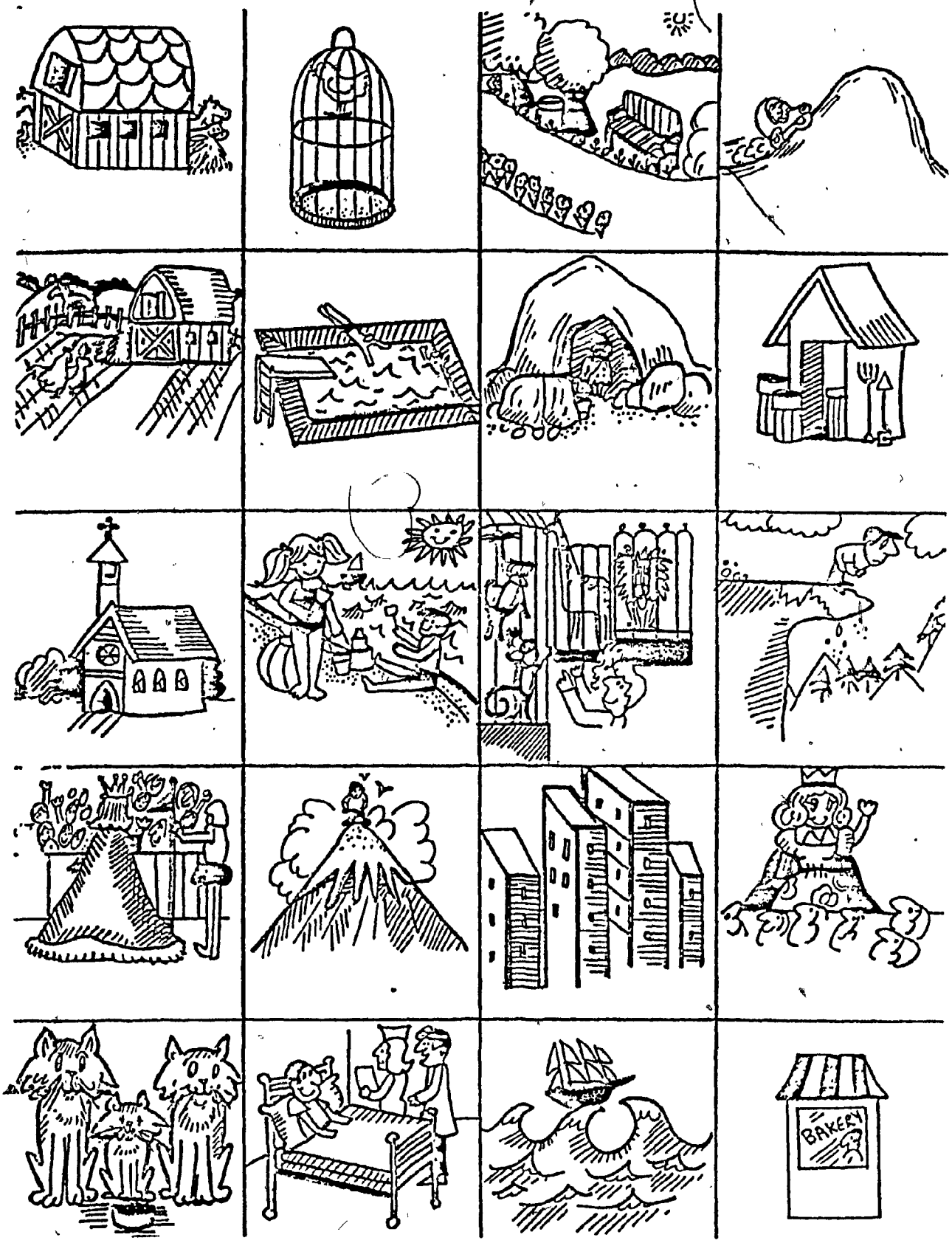

THUMP
THUMP

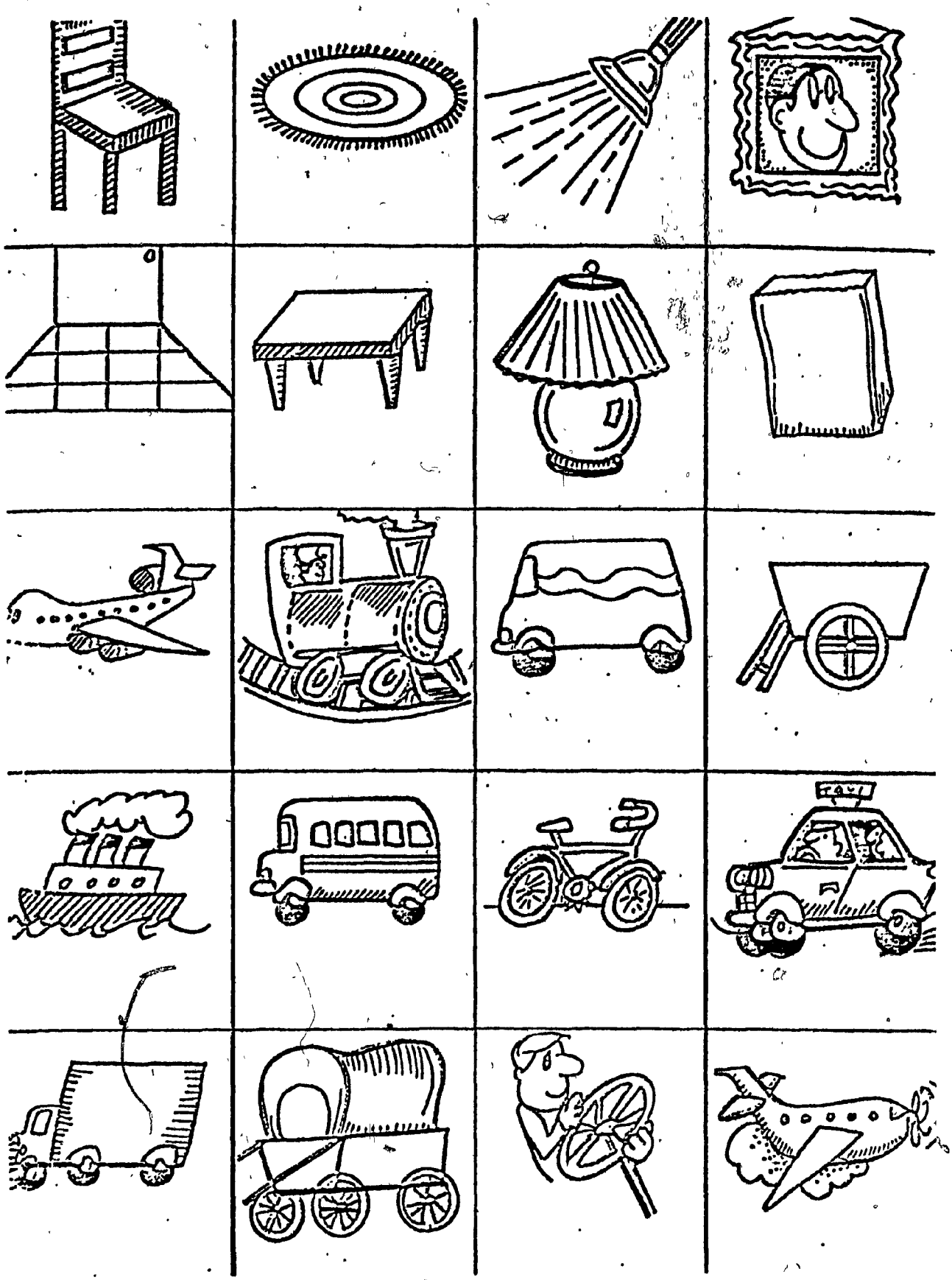

SUPER-TEST
CAT

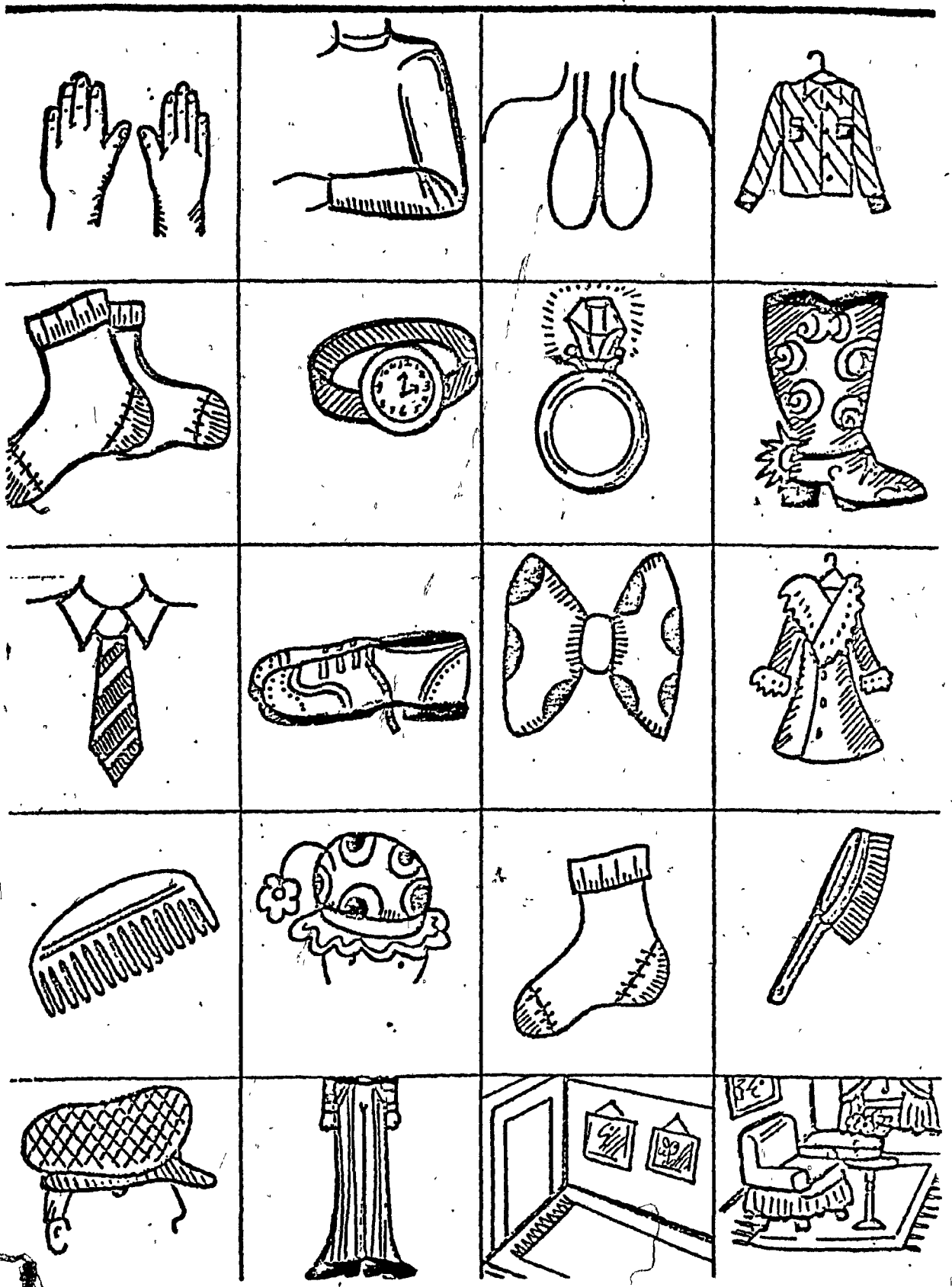

DELIVERY
Story Book
Mary Jane
Country Fair
DYNAMITE
Happy Birthday
TO HELEN

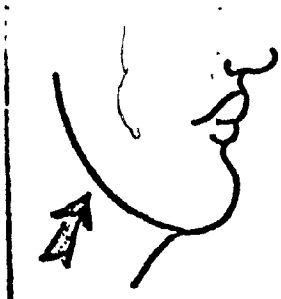


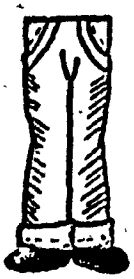

MARX
10
SOUP

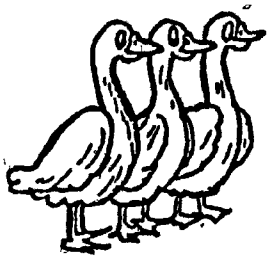

BAKERY

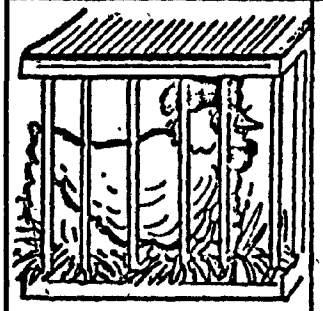


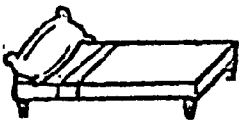


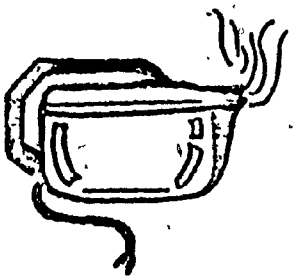


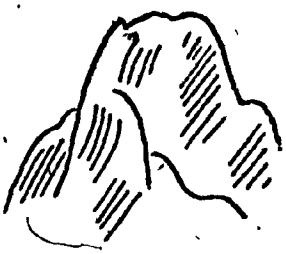


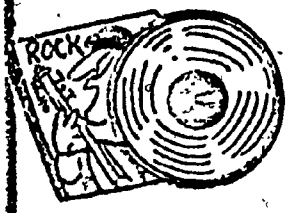


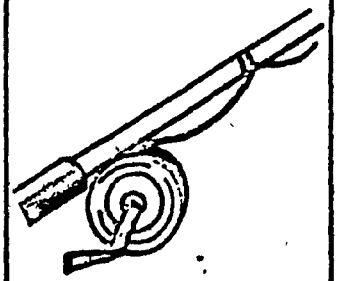




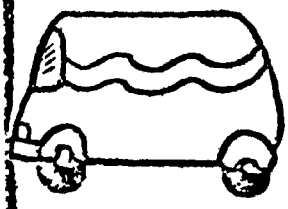


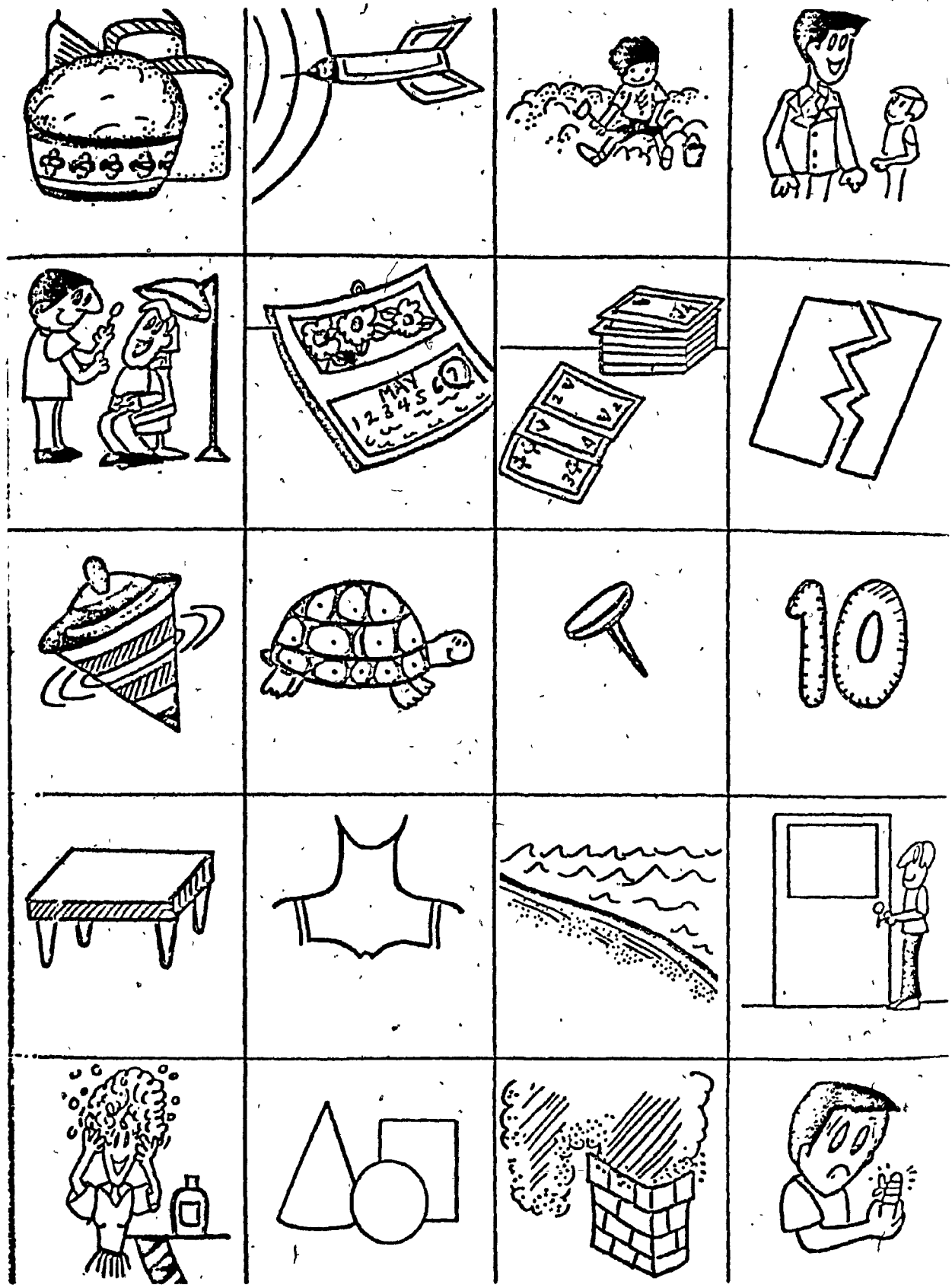


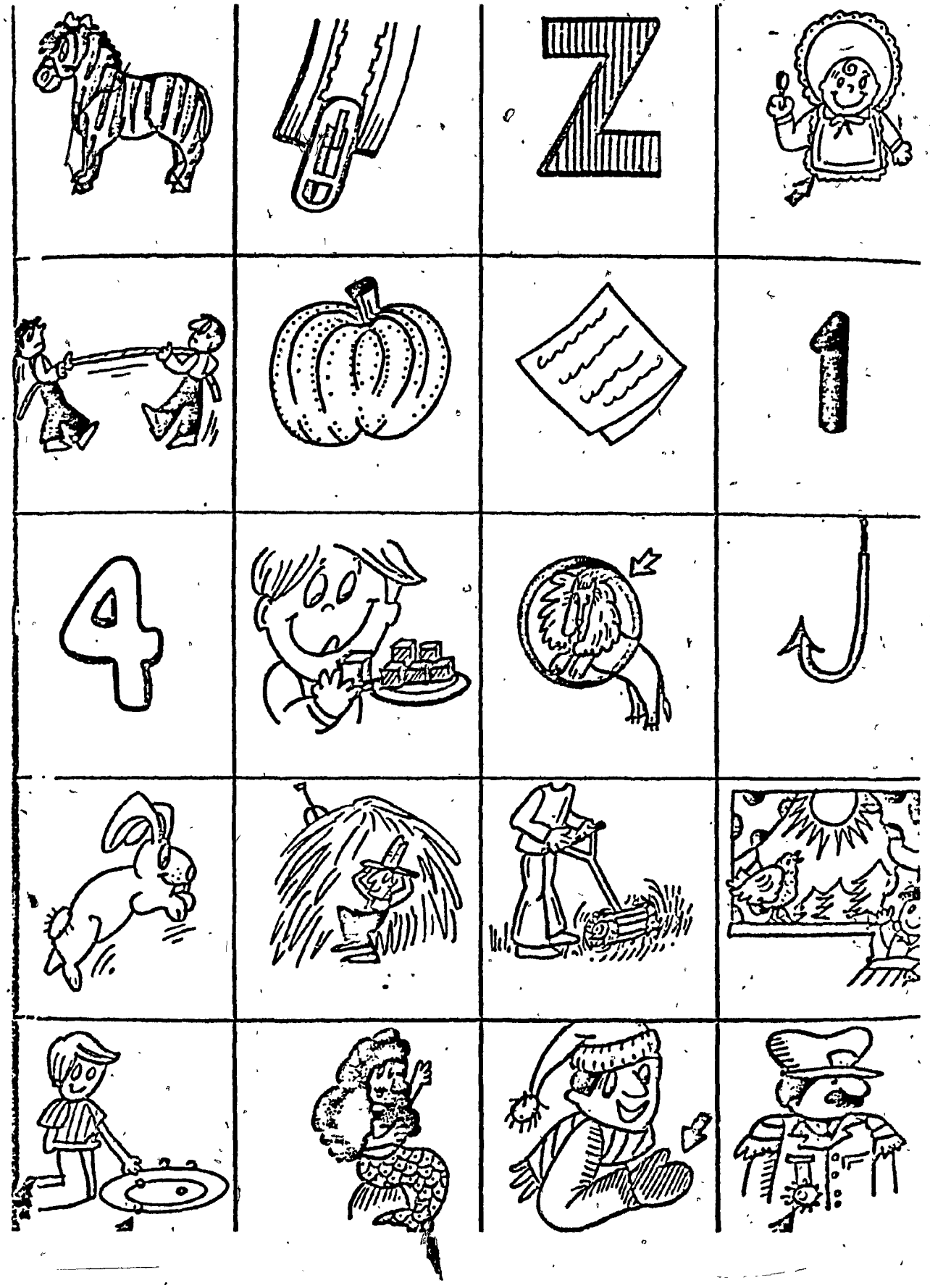


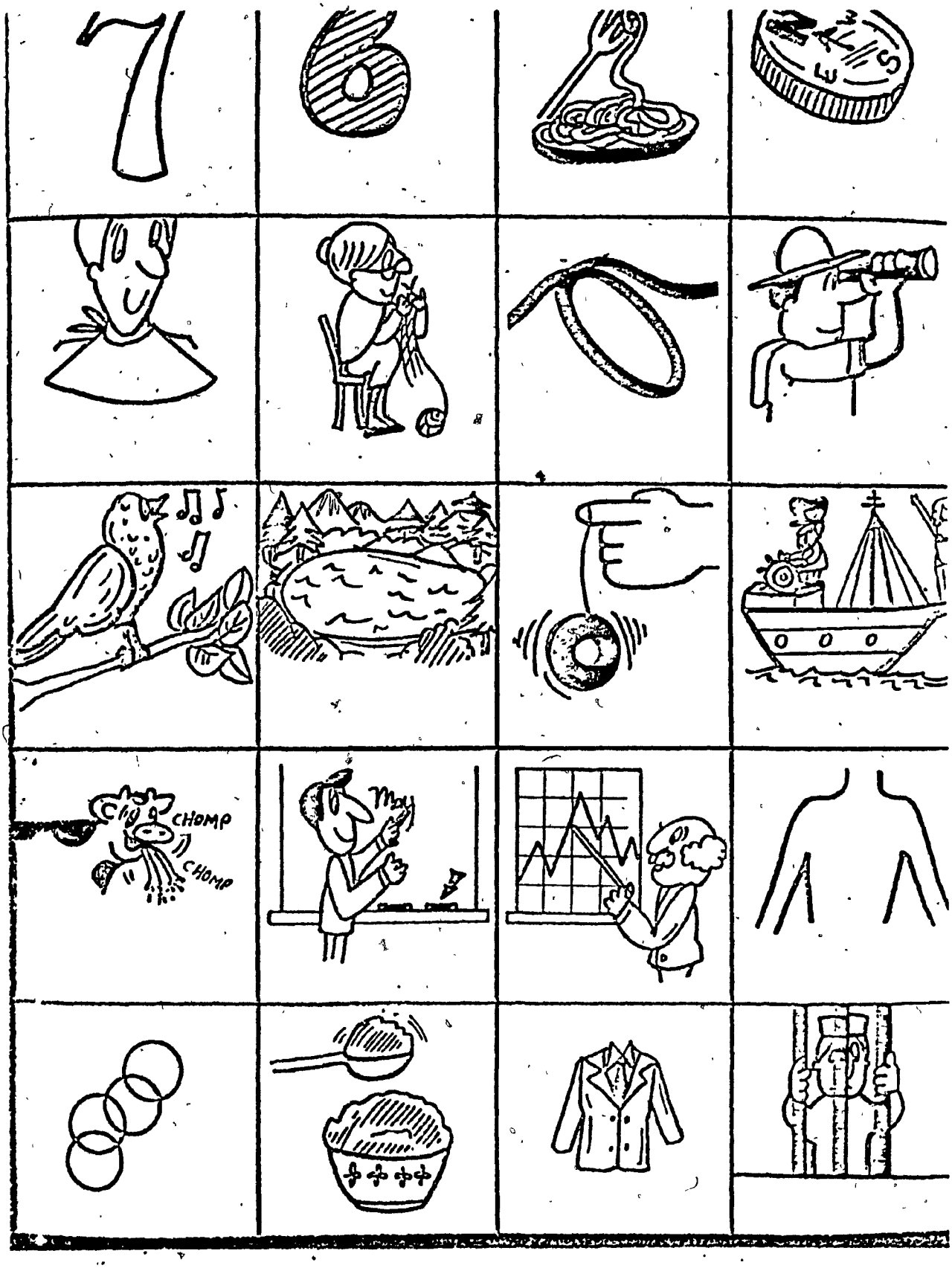


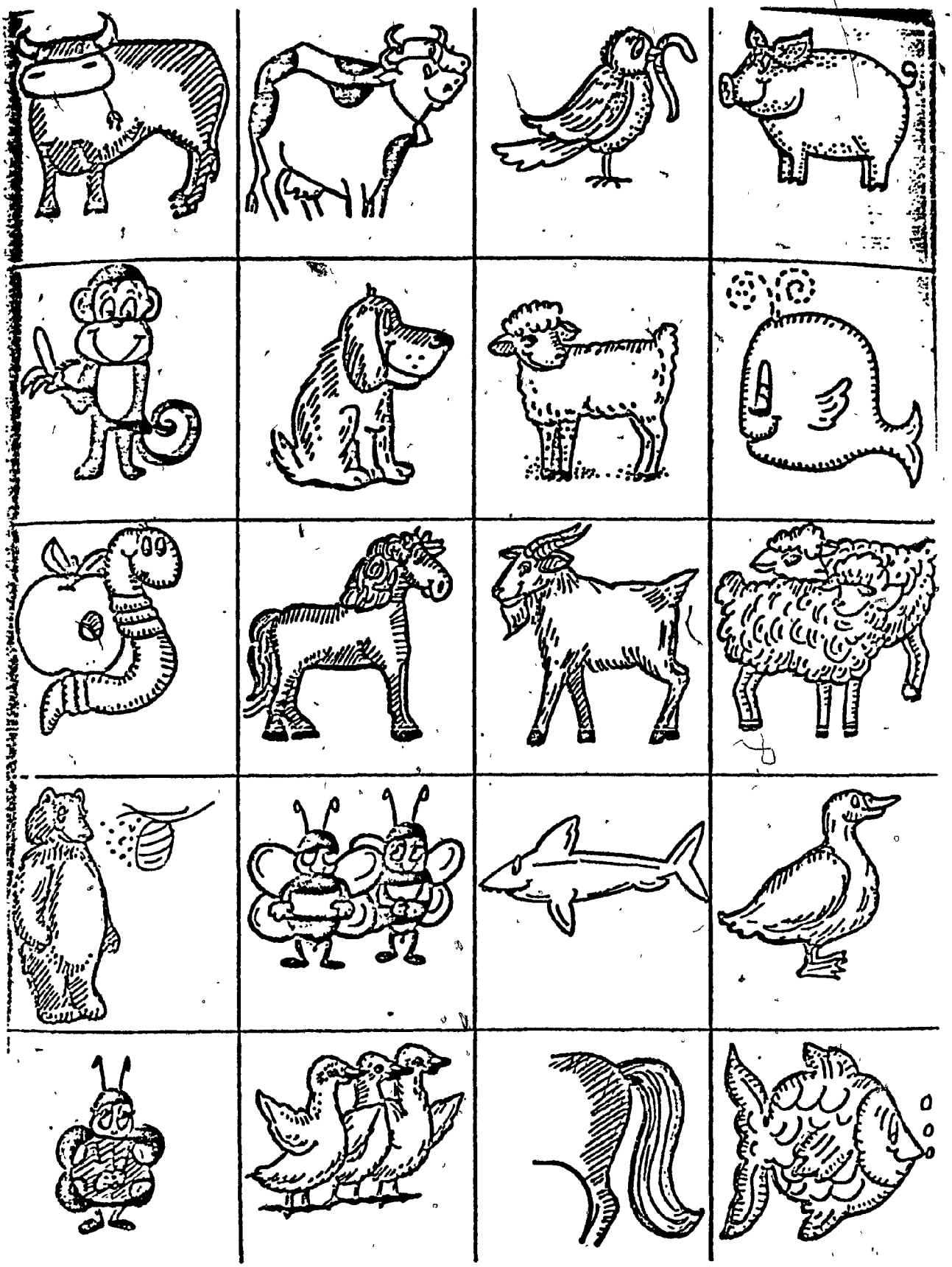
MARY HAD A
LITTLE LAMB
ITS FLEECE WAS
WHITE AS SNOW



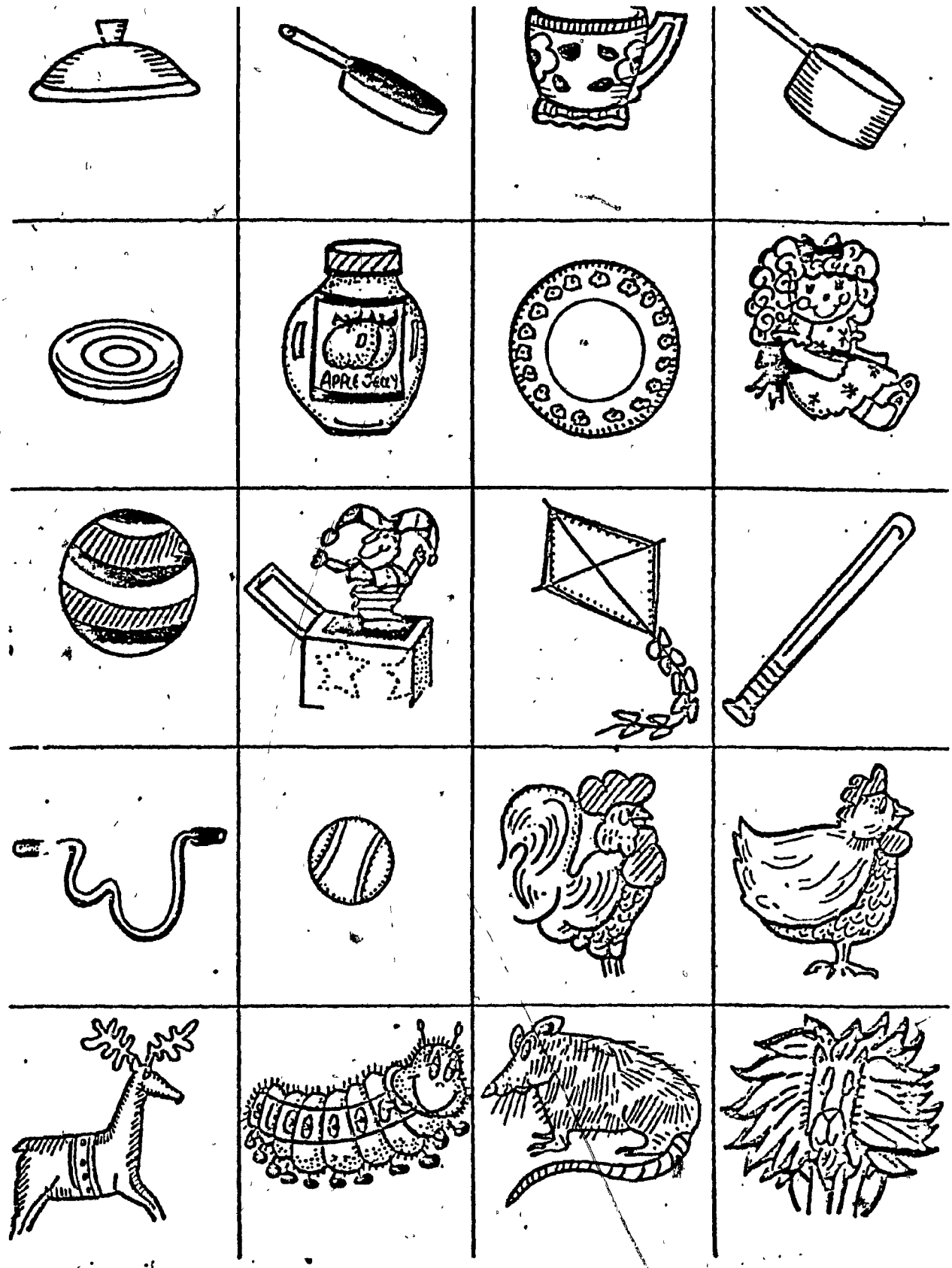

MAY
1 2 3 4 5
10

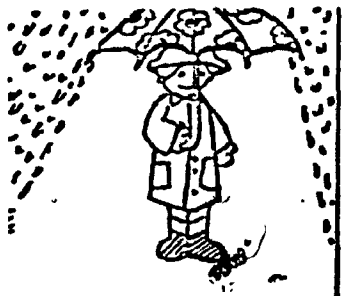


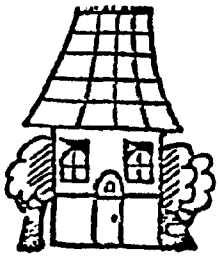

CHOMP
CHOMP

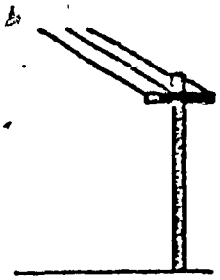


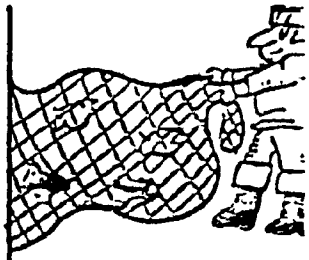

APPLE

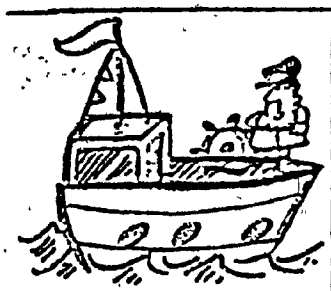

APPLE Jelly

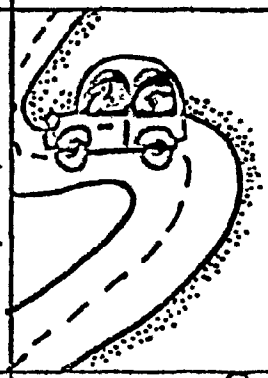


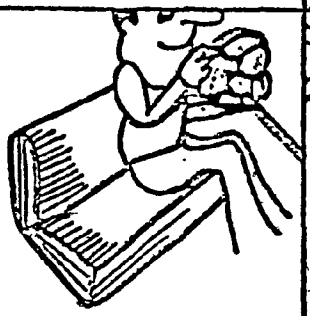


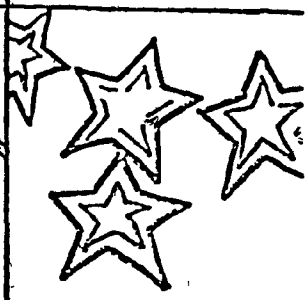


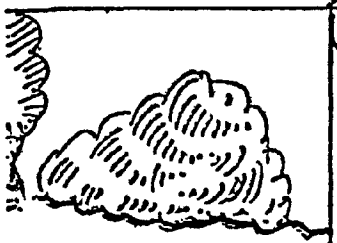


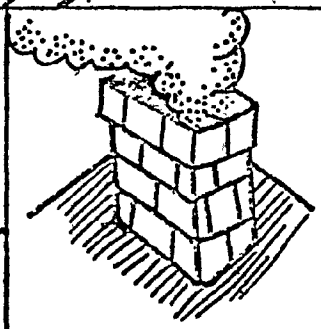


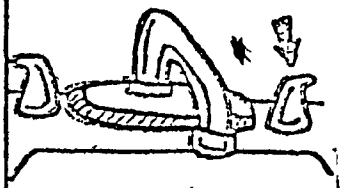












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APPENDIX C

Appendix C

PHRASES

The phrases containing Step 1 Consonants designed for use in training:

Throw me the ball.	I'm hungry.
Wait for me.	That's hot.
Bye bye mommy.	Hit the boy.
Watch me.	That hurts.
I have one.	Up there.
What happened?	Pull it out.
Hurry up.	Put it down.
I'm thirsty.	Pull it up.

The phrases containing Step II Consonants designed for use in training:

Don't push.	Sit down.	Show me.
I did it.	That's bad.	Hit the ball.
Don't do that.	You look nice.	Not yet.
Shut the door.	I love you.	That's terrific.
I like that.	No, thank you.	Good for you.
I don't like that.	What's your name?	I'm certain.
What do you have?	I'm sorry.	

The phrases containing Step III Consonants designed for use in training:

Be careful.	You're fooling.
I'm a good boy/girl.	I like cheese.
Go away.	I heard you.
Of course.	It is okay?
Give me that.	You're wrong.

APPENDIX D

APPENDIX D

CLASSROOM OBSERVATION
(Sample Sheet)

Child's Name: _____ Time: _____

Date: _____

Targets	Teacher Accepted Production	Teacher Reinforced Production	Teacher Corrected Production	Child Imitated	Child Omitted	Child Substituted
/θ/						
/h/						
/f/						
/d/						
/n/						
/j/						
/l/						
/av/						
/aI/						

APPENDIX E

Appendix E
PARENT PARTICIPATION

The following is a list of the students that participated in my study during the fall. Now, as a follow-up, I am interested in how you would rate the parental involvement of these children. Only rate those children in your class.

SCALE: 0 - child receives minimal assistance from parents
1 - parental cooperation and concern is poor
2 - occasional or sporadic involvement
3 - average: participates when absolutely essential
4 - good: parent often participates in school activities
5 - very good: regular and consistent communication between school and home
6 - excellent: the child's total well-being is a primary concern of the parent

C.S.	0	1	2	3	4	5	6
T.C.	0	1	2	3	4	5	6
S.L.	0	1	2	3	4	5	6
C.F.	0	1	2	3	4	5	6
B.O.	0	1	2	3	4	5	6
C.L.	0	1	2	3	4	5	6
C.R.	0	1	2	3	4	5	6
B.D.	0	1	2	3	4	5	6
B.K.	0	1	2	3	4	5	6
J.N.	0	1	2	3	4	5	6
D.W.	0	1	2	3	4	5	6
R.M.	0	1	2	3	4	5	6
L.B.	0	1	2	3	4	5	6

Thank you!!!