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LA THÈSE A ÉTÉ MICROFILMÉE TELLE QUE NOUS L'AVONS REÇUE

AN EXPERIMENTAL ANALYSIS OF THE RELATIONSHIP BETWEEN RECEPTIVE AND PRODUCTIVE LANGUAGE ACQUISITION IN DEVELOPMENTALLY DELAYED CHILDREN

by
Martha Freese Keller

Department of Psychology

Submitted in partial fulfillment
of the requirements for the degree of
Doctor of Philosophy

Faculty of Graduate Studies
The University of Western Ontario
London, Ontario
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ABSTRACT

Intervention for children with severe language deficits requires an empirical basis for sequencing instruction in the receptive and productive modes. The purpose of this research was to examine the relationship between these two modes of language functioning in moderately and severely retarded children. A single-subject operant methodology was employed to evaluate the effect of training in one mode on performance in the other mode. Six children with severe language delays and diagnoses of moderate to severe mental retardation participated in the experiment. Each subject learned to label a different set of five pictures in each of four training conditions. In the first condition, a set of pictures was trained in the receptive mode. In the second condition, a set was trained in the productive mode. These training conditions were then repeated using two additional sets of pictures. Training was done using reinforcement for correct responses and prompting for incorrect responses. Nonreinforced probes were conducted throughout training to assess performance in the untrained mode. The pictures in each set were trained successively so that generalization across the language modes could be studied picture-by-picture, as each was trained in one mode.

Each subject successfully met the criteria for learning each picture set in both the receptive and productive training conditions. The probe data indicated that performance in both untrained modes improved as a function of the training interventions.

After productive training, five of six subjects' performance was highly accurate on receptive probes. By contrast, receptive training resulted in limited correct productive performance. The extent of generalization in the receptive training conditions was negatively associated with the extent to which subjects persisted in using extra-experimental labels on productive probe trials. In addition to these competing response errors, subjects frequently exhibited articulation errors on productive probe trials. Thus, the probe data demonstrated that for five of six subjects, productive training was sufficient to establish accurate receptive performance. However, receptive training was neither a necessary nor a sufficient condition for productive performance. The implications of these results for language training interventions were discussed.

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Language is often described with reference to two response modes: reception or comprehension, which represents the behavior of the listener, and production or expression, which represents the behavior of the speaker. The relationship between these two modes of language functioning has been widely discussed among those interested in language development. Questions have centered on 1) the sequences in which the two modes emerge, and 2) the ways in which learning in one mode influences performance in the other mode. These questions are of special concern to those designing intervention programs for language-delayed children. The current observational and empirical data base is inadequate to provide unequivocal answers. Moreover, the majority of the data derives from studies of normal children. Hence, the sequencing of training in the receptive and productive modes is a major unresolved issue for language clinicians working with retarded children.

The purpose of this research was to study generalization between receptive and productive responses in the context of applied language training for retarded children. An experimental analysis was performed to examine the effect of training in one mode on performance in the other mode, using noun labels as the unit of analysis. It was anticipated that the data obtained from this study would have implications for sequencing instruction for children with severe language deficiencies.

General Issues in Language Intervention

The formulation of an intervention strategy is organized around three major considerations. It is necessary to 1) determine what language skills to teach, 2) determine in what sequence these skills should be taught, and 3) select an appropriate methodology for teaching these skills. Two main sources of evidence are currently available to aid the clinician in making these decisions. Developmental psycholinguistic research and operant analyses of behavior have both contributed to the development of language intervention strategies.

Recent reviews of the literature on language training for speech deficient children (Garcia & DeHaven, 1974; Harris, 1975) conclude that an operant methodology presently exists for the establishment and maintenance of expressive speech. The effectiveness of this approach for training vocal-verbal imitation (Lovaas, Berberich, Perloff, & Schaeffer, 1966; Risley & Baer, 1973), labelling (Bricker & Bricker, 1970; Stephens, Pear, Wray, & Jackson, 1975), and elementary grammar (Garcia, Guess, & Byrnes, 1973; Guess, Sailor, Rutherford, & Baer, 1968) has been amply demonstrated. However, since the time of the earliest operant studies of variables affecting the acquisition of language responses, a recurrent concern has been what to teach language-delayed children and in what sequence. Thus, while over a decade of behavioral research has established a reliable methodology for language intervention, the content and sequence of instruction remain prominent issues.

Empirically established guidelines are severely limited for building comprehensive language skills in the child who fails to meet language milestones, or who develops deviant speech patterns. In the absence of an empirical data base, it has been widely recommended that the normal developmental sequence be used as a model for language intervention programs. This view underlies several major language programs (Bricker & Bricker, 1974; Miller & Yoder, 1974) and has received widespread endorsement at a series of conferences on language and mental retardation.[1] As Schiefelbusch (1974) has pointed out, this approach implies that the processes, sequences and environmental conditions associated with normal language acquisition must be replicated in an inter-

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[1] Language and Mental Retardation, U.S. Office of Education, Lawrence, Kansas, 1963; Language of the Mentally Retarded, National Institute of Child Health and Human Development, Lawrence, Kansas, February, 1970; Language, Cognitive Deficits, and Retardation, Institute for Research into Mental and Multiple Handicap, London, England, December, 1972; Language Intervention with the Mentally Retarded, Wisconsin Dells, Wisconsin, June, 1973, sponsored by the Mental Retardation Program of the National Institute of Child Health and Human Development.

vention program. Taking this view to an extreme position, cognitive theorists (Clark, 1974; Sinclair, 1971; Slobin, 1973) argue that linguistic development maps cognitive structures which in turn depend on sensori-motor maturation. According to this position, language intervention will not be effective until the child possesses the requisite cognitive competencies.

The necessity of relying on the developmental model poses serious problems for the language clinician. First, the study of language acquisition and development in the normal child has a relatively brief history, resulting in a number of shortcomings in this model. Pioneering work, notably the single-case "diary" studies of Leopold (1939) and Lewis (1951), together with the more recent longitudinal collections of speech samples (Bloom, 1970; Braine, 1963; Brown & Bellugi, 1964; Miller & Ervin, 1964), have provided an observational base for descriptions of the course of language acquisition. An experimental methodology for validating these descriptions has been slow to develop. McNeill (1970) has pointed out the problems associated with analysis of the observational data, as well as the limitations of experimental paradigms used to study language acquisition. Nevertheless, most authorities do agree that certain topographical features of language, such as one- and two-word utterances and "telegraphic" speech, emerge in a relatively universal chronological sequence (Bellugi, 1972; Bloom, 1974; Menyuk, 1974b; McNeill, 1970). However, a clear picture of the processes and functions that underlie this pattern of language acquisition has not yet emerged.

A case in point is the controversy surrounding the interpretation of one-word utterances. Single-word productions have been described as names for concepts (Nelson, 1973, in Menyuk, 1974a), as representations of objects and events (Brown, 1970), and as representations of relationships between objects, persons, and events (Bloom, 1974; Greenfield, 1972). It has also been claimed that they reflect incipient grammatical structures (Leopold, 1939). In sum, it is generally agreed that one-word utterances often represent more than a naming response. However, since these inferences are based on poorly defined and uncontrolled contextual cues which are present during naturalistic observations, the resulting interpretations are tenuous.

In addition to the lack of empirical verification and the inconsistency of interpretation, there are periods of development which have been seriously neglected. In particular, there has been little attention given to the pre-linguistic stage extending from birth to production of the first words (Friedlander, 1970; Horton, 1974; Ruder, 1972). For instance, receptive processes, both during this period and subsequent to the onset of speech production, have been largely ignored (Bloom, 1974; Horton, 1974; Menyuk, 1974a).

Given the problems in interpretation and analysis that surround the existing observational data, the lack of attendant empirical tests, and areas of development that await investigation, the psycholinguistic literature provides useful but tenuous guidelines for designing an intervention schema.

The second issue in evaluating the utility of the developmental approach concerns its relevance to the population of language-delayed children. Several researchers (Guess, Sailor, & Baer, 1974; Turton, 1974) have challenged the notion that the normal developmental sequence should be imposed on individuals who show not only abnormal patterns of language development but also cognitive and sensori-motor impairments, and who are frequently four to five years of age before language intervention occurs. Guess and his colleagues have stated the case well:

> Linguists have not ... been able to determine any particular hierarchy of levels of complexity in speech and language acquisition, to determine whether it is necessary that one set of skills precedes another, or whether any number and variety of skills can be taught and learned in any order (Lenneberg, 1964). Thus, while normative data may indicate that most children use more pronouns, nouns, and verbs before they use adjectives, prepositions, and conjunctives, it is an empirical question as to whether <u>teaching</u> the former must precede the latter. It is not known whether a child must be taught to utter one- or two-word combinations before more lengthy responses are trained even though most normal children show a progression in the length of their utterances (e.g. verb-object, subject-verb-object, etc.). These questions still remain problems for the development of a speech and language training program for non-verbal children. (p. 543)

The literature comparing normal language development with that of the retarded population has often been used as a basis for evaluating the relevance issue. Miller and Yoder (1974) argued that language training should follow the normal developmental sequence, on the basis of a survey of the literature which indicated that retarded children's language acquisition follows the normal sequence but at a much slower pace. That is, when compared on the basis of mental age, these children's language shows a congruence with that of normal children in phonology, morphology, syntax, and semantics. Cromer (1974) and Menyuk (1974) similarly reviewed experimental reports addressed to this question. They cited evidence supporting the interpretation that language is merely delayed in retarded children, but they also discussed data pointing to deviant language patterns in various sub-groups of language-deficient children.

For several reasons it is unlikely that reference to this literature will prove fruitful in resolving the relevance issue. Firstly, the statistical bases for normal-retardate comparisons are controversial, resulting in interpretive problems (see Baumeister, 1967; Spradlin, 1974). Secondly, as Cromer (1974) and Menyuk (1974b) suggest, even if delay is found to be the predominant pattern, the delay in itself may result in alternate language processes and strategies coming into play. Finally, it may be unrealistic to expect severely delayed language learners to acquire comprehensive language abilities (Bateman, 1974). In this case, more practical goals may render the developmental sequence inappropriate for these children. Therefore, while the literature on normal language acquisition will no doubt continue to contribute to the formulation of intervention strategies, the validity of this approach for language-delayed children will remain in question.

An alternative to an indiscriminate use of the developmental model is provided by the experimental analyses of behavior which have grown out of the early operant demonstration studies. A series of these investigations, loosely termed generalization studies (e.g., DeHaven & Garcia, 1974; Garcia, 1974; Schumaker & Sherman, 1970; Wheeler & Sulzer, 1970), have been designed to examine variables governing the facilitation and expansion of language repertoires in speech-deficient subjects.

The purpose of the generalization studies is to identify relationships between trained and untrained language responses under specified conditions in experimental and naturalistic transfer settings. This approach pursues an objective similar to that of the developmental psycholinguistic work: to study interdependencies among language responses as a basis for identifying a hierarchical structure of language acquisition. However, it is not presupposed that an invariant structure will be revealed, but rather that, given targeted language behaviors, certain sequences of instruction may provide a greater degree of facilitation in reaching criterion performances than other sequences. The present study used this approach to examine a current issue in the language intervention area.

A Specific Issue in Language Intervention: The Relationship Between Receptive and Productive Language

Sequencing of instruction in the receptive and productive modes poses a major problem for language trainers. The consequences of training skills in either mode have only begun to be explored experimentally. In the interim, language clinicians have had to rely on what is known about the normal developmental sequence.

The developmental psycholinguistic literature has traditionally reflected the assumption that comprehension precedes production (Carroll, 1964; Lenneberg, 1962; McCarthy, 1954). This view gained prominence due to the widespread observation that children typically understand speech forms before they produce corresponding verbalizations. This view is now being reexamined and called into question. Renewed interest in the issue has led to more differentiated questions regarding the definition of comprehension and production (Bloom, 1974; Chapman, 1974), techniques for assessing both modes of language functioning (Bloom, 1974; Ingram, 1974; McNeill, 1970), and explanations for varying rates of acquisition in the two modalities (Chapman, 1974). The ensuing debate has effectively usurped the simple and unelaborated notion that receptive language development precedes and is a prerequisite for productive performance.

Revised formulations of the temporal relationship have emerged, with the range of possibilities now covering the following three propositions: (1) that at least some reception precedes production (Fraser, Bellugi, & Brown, 1963; Ingram, 1974, Lovell & Dixon, 1967; McNeill, 1970), (2) that reception and production are based on simultaneously developing and interdependent processes (Bloom, 1974; Fernald, 1972), (3) that production may in some cases precede and guide the development of comprehension (Bloom, 1974; Chapman & Miller, 1973; Keeney & Wolfe, 1972). It should be noted that these sequences are generally discussed with reference to the acquisition of grammatical structures rather than to the acquisition of lexical items.

The confused status of this issue is reflected in language training programs for retarded children. The prevailing instructional sequence calls for training at the receptive level before productive training is introduced (Bricker & Bricker, 1974; Kent, Klein, Falk, & Guenther, 1972). In summarizing proceedings of the most extensive conference to date on language and mental retardation, Schiefelbusch (1974) noted, "Receptive speech training should precede early speech production training. The receptive processes are simpler to acquire, more varied in content, and lead to productive rehearsal strategies which may be antecedent to spoken language."

On the other hand, several procedures depart from this common sequence. For example, training has been initiated at the productive level with either no attention to receptive performance or with subsequent probes to determine whether receptive training is necessary (Lovaas, et al., 1966; Risley & Wolf, 1967; Sloane, Johnston, & Harris, 1968). A third procedure, recommended by Guess and Baer (1973), employs concurrent rather than serial training, resulting in simultaneous acquisition in the receptive and productive modes.

Clearly, this is one issue which has not been resolved by using the developmental model as a prototype for language programming. Applied behavior analysis provides a useful approach for clarifying the relationship between receptive and productive responses in the context of language instruction for retarded children.

Behavioral Analyses of Receptive and Productive Language

Within the operant framework, receptive and productive responses are defined with reference to motor and vocal-verbal behaviors, respectively, which can be reliably observed. Procedures for assessing and training receptive performance have included use of an instruction-following paradigm (Frisch & Schumaker, 1974; Sailor & Taman, 1972), a two-choice discrimination paradigm (Bricker & Bricker, 1974), and a matching-to-sample paradigm (Ferster & Perrott, 1968; Rosenberger, Stoddard, & Sidman, 1972). Through each of these procedures a motor response (e.g. pointing, pressing a button, manipulating objects) comes under the control of an auditory verbal stimulus. The subject is said to "comprehend" when he responds appropriately and reliably to the experimenter's verbal cue. Productive performance is defined as the emission of an appropriate vocal-verbal response under the control of an auditory verbal and/or visual cue. Under varying stimulus conditions, productive responses are described as imitative, functional, or spontaneous verbalizations.

It has been demonstrated that under prompting and reinforcement conditions, retarded subjects can acquire target responses in both modes across a wide variety of response classes. At the receptive level, training has been used to teach the plural morpheme (Guess, 1969), adjectival inflections (Baer & Guess, 1971), articulation (Mann & Baer, 1971), prepositions (Frisch & Schumaker, 1974), complex sentence comprehension (Bucher & Mueller, 1976), and object labels (Bricker & Bricker, 1970).

Training at the productive level has included question-asking (Twardosz & Baer, 1973), singular and plural subject-verb agreement (Lutzer & Sherman, 1974; Garcia, et al., 1973), descriptive adjectives (Hart & Risley, 1968), pivot-open phrases (Jeffree & Whedall, 1973), simple and compound sentence structure (Stevens-Long & Rasmussen, 1974), and generative verb usage (Schumaker & Sherman, 1970).

Despite the variety of responses taught in both modes, little is known of how training in one mode influences acquisition in the other mode for most of these language responses. To date, this type of analysis has been limited to one response category. Researchers at the Kansas Neurological Institute (Guess, 1969; Guess & Baer, 1973) used the plural morpheme as the unit of analysis to investigate cross-modality generalization effects in severely retarded subjects. The first study reported an apparent lack of relationship between receptive and productive acquisition of the pluralization rule under sequential training conditions. Two subjects were reinforced for correctly pointing to single or paired objects after hearing singular or plural labels. When an errorless criterion was achieved, unreinforced probes were conducted to test productive acquisition of singular and plural labels. Neither subject showed generalization, as each continued to respond productively to paired objects with a singular label. Subsequently, subjects acquired plural labels rapidly during a productive training condition, suggesting that the preceding receptive training may have facilitated productive learning.

The findings reported by Guess were qualified by the later work which indicated that under concurrent training conditions for different response classes, generalization effects were observed in varying degrees for three of four severely retarded subjects (Guess & Baer, 1973). In this study, two different pluralization rules were taught: subjects learned a generative rule for using the -es ending in one mode while simultaneously learning use of the -s ending in the other mode. Only one subject showed clear cross-modality generalization.

It was then demonstrated that generalization effects could be enhanced or diminished by programming reinforcement for the desired response. On the basis of these results, Guess and Baer concluded that unprogrammed generalization between the receptive and productive modes is unlikely to occur in speech-deficient retarded children, and so recommended that language training should be conducted in both modes across the response classes to be learned.

It should be noted, however, that the results obtained in these two studies may have been influenced by subjects' baseline behavior. Prior to experimental training, subjects had already acquired the singular label for at least some of the objects used in the study. In this case, the well-established productive singular may have acted as a competing response for the productive plural. Pilot work conducted for the present study suggested that transfer of a response from the receptive to the productive mode will be delayed or will not occur if a stimulus already controls a different productive response.

<u>The Present Study</u>

This study examined patterns of cross-modality generalization during the early stage of language development when naming responses are first being acquired. At this stage, intervention strategies often call for receptive training to build vocabulary skills. This study investigated the effects of using training in either the receptive or productive mode. Effects were evaluated with respect to performance in the untrained mode.

A within-subject multiple-baseline design was used. Six retarded subjects were taught picture-labelling responses in alternating receptive and productive training conditions. In each condition the subject learned to label a set of five pictures in one mode, and performance in the other mode was tested repeatedly. Operant procedures were used to train subjects, and unreinforced probes were used to assess generalization. Thus it was determined whether children with severe language deficits could name a picture once they had learned to identify it non-verbally, and _vice-versa_, whether they could select a picture to match a spoken label once they had learned to name the picture.

Data of this nature is required to establish an empirical base for sequencing language instruction. While this study was not designed to determine the efficiency of various training strategies, it was designed to show how performance in the receptive and productive modes varies as a function of the two alternate training strategies currently in use.

METHOD

Subjects

Four males and two females, ranging in age from 7 to 15, served in the experiment. Subjects fell in the moderate and severe ranges of mental retardation according to psychometric and psychiatric classification made prior to, and independent of, this study. Estimates of mental age derived from the Peabody Picture Vocabulary Test, a measure of verbal intelligence, ranged from 2 years 1 month to 3 years 10 months just prior to experimental intervention. Individual subject characteristics are given in Table 1.

Subjects had severe deficits in language abilities. They were able to imitate one- to three-syllable words and displayed limited receptive and productive labelling vocabularies. They responded appropriately to simple instructions, such as "come here" and "sit down", but functional productive speech was poorly developed. One subject's speech was predominantly echolalic, i.e. he repeated the speech directed to him.

During the experiment, subjects were residents of a behavioral treatment unit at CPRI, a provincial facility in London, Ontario for developmentally disabled children. Their treatment program was designed to establish self-care and pre-academic skills.

TABLE 1

Individual Subject Characteristics

Subject	Sex	Chronological Age	Mental Age (PPVT)	Diagnosis	Psychometric Scores
Jimmy (S_1)	M	10-1	3-10	moderate mental retardation	Stanford-Binet IQ = 34 Leiter IQ = 43
Steven (S_2)	M	7-9	2-10	moderate mental retardation; emotional disturbance; convulsive disorder; hyperkinesis	untestable
Bobby (S_3)	M	11-10	2-2	severe mental retardation associated with psychotic disorder; major motor seizures	untestable
Wayne (S_4)	M	15-6	2-6	severe mental retardation with psychosocial environmental deprivation; behavior disorder of childhood	Stanford-Binet IQ = 25
Kelly (S_5)	F	9-7	2-1	moderate mental retardation	Stanford-Binet IQ = 28
Janet (S_6)	F	11-5	1-11	severe mental retardation; Down's Syndrome	Stanford-Binet IQ < 30

Experimental Stimuli and Responses

Experimental stimuli were 120 pictures from the Peabody Picture Vocabulary Test (Dunn, 1965) and the spoken labels assigned to them by the author shown in Appendix I. Each picture was mounted on a 4 x 6 inch index card. The pictures illustrated common household objects, animals, food items, articles of clothing, and forms of transportation. The labels chosen for the pictures did not exceed three syllables.

On each trial an array of pictures was presented. On receptive trials the experimenter said, "Point to the (label) ." The correct response was pointing to the picture that matched the spoken label. On productive trials the experimenter pointed to one picture and said "What is this?" The correct response was vocal production of the label for the designated picture.

Subject Selection

Staff members at CPRI were asked to submit the names of in-patients who 1) were diagnosed as retarded, 2) had poor verbal skills, and 3) were not currently receiving formal language training or speech therapy. These candidates were then subjected to a pretesting procedure which was designed to identify those who could produce verbal imitative responses reliably but who had only rudimentary labelling repertoires.

Pretests. Candidates were given the Imitation Pretest shown in Appendix II and the Labelling Pretest shown in Appendix III.

The purpose of the Imitation Pretest was to identify subjects who could reliably imitate the labels selected for the experiment. This was necessary to ensure that subjects had the requisite articulatory abilities to imitate training prompts and to produce productive responses after receptive training. The pretest was composed of 20 labels selected randomly from the total pool of 120 labels listed in Appendix I. Instructions for administration of the test are given in Appendix II. On each trial, the experimenter said "Say (label) ." and scored the child's response as 1) correct, 2) correct with articulation error, 3) incorrect, or 4) no vocal-verbal response. An articulation error was defined as an approximation to the imitative cue with a phoneme substitution, addition, or omission. To maintain subjects' sitting and attending behavior during the pretest session, the experimenter delivered edible rewards approximately 10 seconds after 50% of the imitative cues regardless of the subject's response. This noncontingent reward was delivered on a variable trial (VT2) schedule.

To be eligible for inclusion in the study, a child had to produce verbal approximations for at least 90% of the labels. The criterion required that 18 of 20 responses be scored "correct" or "correct with articulation error." Results for the children who participated in the experiment are shown in Table 2.

Subjects who met the imitation criterion were given the Labelling Pretest. This served two purposes: 1) to identify children who had limited labelling vocabularies, and 2) to identify

TABLE 2

Percentage of 20 Words Scored "Correct" and "Correct with Articulation Error" for Each Subject in the Imitation Pretest

Subject		% Correct	% Correct with Artic. Error	Total %
Jimmy	(S_1)	80	20	100
Steven	(S_2)	75	25	100
Bobby	(S_3)	65	35	100
Wayne	(S_4)	45	45	90
Kelly	(S_5)	70	25	95
Janet	(S_6)	70	30	100

24 pictures that the subject could not respond to correctly at the receptive or productive levels. These pictures were then used as training stimuli. The Labelling Pretest was administered according to the procedure specified in Appendix III. The 120 experimental pictures were grouped in sets of five, which were each tested twice. During testing on each set, the five pictures were placed before the subject and a random order of five receptive and five productive trials was presented until each picture had been tested once in both response modes. There was one restriction imposed on the random sequence: the receptive and productive trial for the same picture could not occur consecutively. Rewards were delivered noncontingently to maintain subjects in the setting.

This procedure yielded two receptive responses and two productive responses for each picture. A picture was failed if the subject responded incorrectly on all four trials, i.e. if he pointed to the wrong picture on receptive trials and failed to give the label assigned for the experiment on productive trials. However, if a synonym for the label was given on both productive trials (e.g. bike for bicycle), the picture was not failed. Testing continued until the subject failed 20%, or 24, of the 120 pictures. Children who passed more than 80% of the pictures were not included in the study. Results of the Labelling Pretest for children who participated in the experiment are shown in Table 3. It is interesting to note that the percentage of correct productive trials was consistently lower across the six subjects than the percentage

TABLE 3

Results of Labelling Pretest

Subject	Number of Pictures Tested	% Correct Receptive Trials	% Correct Productive Trials
Jimmy (S_1)	50	48	10
Steven (S_2)	115	52	19 (30)*
Bobby (S_3)	90	53	35
Wayne (S_4)	120	76	21 (48)
Kelly (S_5)	120	60	13 (22)
Janet (S_6)	120	66	22 (25)

*percentages shown in parenthesis include articulation errors treated as correct responses of correct receptive trials. Of the productive trials that were correct, 91% of the corresponding receptive trials were also correct. However, of the receptive trials correct, only 31% of the corresponding productive trials were correct. If articulation errors are treated as correct responses, 42% of the trials were correct.

Fifteen children were referred for pretesting. Of these, six met the pretest criteria. Among the nine who did not qualify, five did not demonstrate the requisite level of verbal imitation, three did not meet the Labelling Pretest criterion, and one child's vision was so severely impaired that she could not respond to the visual stimuli.

Parents of the six children identified by the pretesting procedure were contacted and all gave consent for their children to participate in the study. The letter and consent form will be found in Appendix IV.

Following subject selection, two additional measures were used to provide subject descriptors prior to experimental intervention. First, the Peabody Picture Vocabulary Test (Dunn, 1965) was administered. This is a standardized test which yields an estimate of mental age based on a sample of receptive vocabulary. Results for each subject are reported in Table 1 and described under Subjects.

The second measure was designed to assess the degree of echolalia exhibited by subjects. Pilot work had suggested that this language behavior might differentially affect a subject's response to receptive and productive training procedures, resulting in patterns of generalization unlike those of non-echolalic subjects. For example, repetition of experimental cues during receptive training might facilitate productive performance. The test shown in Appendix V was constructed to assess echolalic responding. The experimenter asked ten questions requiring both receptive and productive responses. Subjects' responses were scored "echolalic", "non-echolalic", or "no response." An echolalic response was defined as one which included repetition of any part of the question, with or without a subsequent appropriate answer.

On this test, three subjects exhibited echolalia. Bobby's responses were scored echolalic for 100% of the questions, Steven's for 50%, and Jimmy's for 10%. Echolalic responses were not recorded for Wayne, Kelly, and Janet. At the time of experimental intervention, Bobby was the only child described as "echolalic" by residential staff. However, references to this type of speech were present in Jimmy's and Steven's case histories.

Setting

Experimental sessions were conducted in the subjects' residential unit. Training took place in a 4 x 6 foot cubicle furnished with a table and two chairs. An observation window connected the cubicle to an adjoining ward office. Thirty-minute sessions were scheduled each weekday in this setting.

Tangible reinforcers were foods and liquids that could be consumed in small portions. These included raisins, nuts, cookies, Cheesies, Smarties, popcorn, apple juice, and soft drinks. Reinforcers were placed in small cups on the table between the subject and the experimenter. These items were presented in association with social reinforcement which consisted of verbal praise and physical contact (tickling, pat on the back, etc.).

Two experimenters trained the six subjects in this study. The author, who was designated $\underline{E}_1$, conducted experimental sessions for Jimmy ($\underline{S}_1$), who served as the pilot subject. The second experimenter ($\underline{E}_2$), who was employed as a research assistant and had extensive experience using operant techniques to train retarded children, conducted sessions for the remaining five subjects.

Training Stimuli and Target Responses

Training stimuli for each subject were the first 24 pictures failed in the Labelling Pretest and their associated labels. These were divided into four groups, referred to as training sets, by random assignment. Pictures in each set were numbered from 1 to 6. The first five in each set were designated training pictures and the sixth was reserved as an alternate training picture. The alternate was used to replace a picture in the training set if it was identified correctly in both response modes before training, during the first series of experimental probe trials. The final training sets for each subject are shown in Appendix VI.

General Procedure

Design. The study used a within-subject design to examine receptive performance as a function of productive training, and productive performance as a function of receptive training. Each subject was first taught to identify a set of pictures receptively. The subject learned to make the correct choice from an array of pictures when presented with a spoken label for one of the pictures. Throughout training, performance was tested in the productive response mode. This was done by presenting the subject with a picture and cueing him/her to produce a vocal-labelling response.

Then, identification of a second set of pictures was trained productively. The subject learned to produce a specific vocal-labelling response when presented with a picture. Performance was then tested in the receptive response mode. This was done by cueing the subject to make a choice from an array of pictures that matched the spoken label. In this manner receptive training alternated with productive training over four sets of pictures. Generalization was defined as correct performance in the untrained response mode in each training condition.

A set of five pictures was trained in each condition. The five pictures were trained successively, and probe trials were conducted after training on each picture. These were referred to as 5-card probes. Each sequence of 5-card probe trials measured receptive and productive performance on each card. The 5-card probes thus measured 1) acquisition of the trained response(s), 2) generalization of the trained response(s) to the opposite mode, and 3) provided a baseline for performance in both modes on untrained responses. Thus, acquisition and generalization of each response could be studied as a function of training.

After all five pictures in a given set had been trained, and the fifth set of probe trials had been given, three sequences of overtraining trials were given using all five cards. These sequences were designed to study the effects of continued training on generalization. Five-card probes occurred after each overtraining sequence. Thus, total training for each set of cards was completed in eight steps, and each step was followed by the sequence of 5-card probe trials.

A second series of probe trials was also given at specified times during the experiment. Before beginning training on each new set of cards, and following training on the final set, receptive and productive probes were taken on all 20 pictures in the four training sets. These are referred to as 20-card probes. They were given to provide-continuing baselines on untrained sets, and posttests on trained sets. During the 20-card probes, the four training sets were presented in a random order, in both receptive and productive modes.

Probe Procedure. The five pictures in a set were placed before the subject. Two ambiguous pictures (X and Y), which were randomly selected for each set from a pool of 12, were added to the array to reduce the probability of a chance correct pointing response. Examples of these pictures, based on the Peabody Picture Vocabulary Test materials, are shown in Appendix VII. Five receptive and five productive trials were presented in random order, so that each picture was tested once in both response modes. One restriction was imposed on the sequence of trials: the receptive and productive trial for the same picture could not occur consecutively. Noncontingent reward was delivered on a VT2 schedule. A sample data sheet illustrating this procedure is shown in Appendix VIII.

Training Procedure. Table 4 summarizes the training procedure and shows the 5-card probes which followed training on each picture (the five training stages), and the final three stages, which correspond to the three sequences of overtraining trials. During each of the five training stages, a new card was introduced and trained in isolation, and then the card was trained together with the previously trained card(s). Thus, training for each card was divided into single-cue and multiple-cue training.

During single-cue training, the experimenter always cued the subject to respond to the new picture, although other pictures

TABLE 4

Summary of Procedure for Receptive Training Conditions*

(1) Training Stage	(2) Type of Training	(3) Pictures Presented	(4) Response Cued	(5) Reinforcement Schedule	(6) Criterion
1	Single-cue Training	1,2	(Rec) 1	CRF	5 consec. correct
PROBE		1,2,3,4,5,X,Y	(Rec, Pro) 1,2,3,4,5	non-conting.	
2	Single-cue Training	1,2	(Rec) 2	CRF	5 consec. correct
	Multiple-cue Training	1,2	(Rec) 1,2	VR2	5 of 6 correct in 3 blocks
PROBE		1,2,3,4,5,X,Y	(Rec, Pro) 1,2,3,4,5	non-conting.	
3	Single-cue Training	1,2,3	(Rec) 3	CRF	5 consec. correct
	Multiple-cue Training	1,2,3	(Rec) 1,2,3	VR2	8 of 9 correct in 3 blocks
PROBE		1,2,3,4,5,X,Y	(Rec, Pro) 1,2,3,4,5	non-conting.	
4	Single-cue Training	1,2,3,4	(Rec) 4	CRF	5 consec. correct
	Multiple-cue Training	1,2,3,4	(Rec) 1,2,3,4	VR2	11 of 12 correct in 3 blocks
PROBE		1,2,3,4,5,X,Y	(Rec, Pro) 1,2,3,4,5	non-conting.	
5	Single-cue Training	1,2,3,4,5	(Rec) 5	CRF	5 consec. correct
	Multiple-cue Training	1,2,3,4,5	(Rec) 1,2,3,4,5	VR2	14 of 15 correct in 3 blocks
PROBE		1,2,3,4,5,X,Y	(Rec, Pro) 1,2,3,4,5	non-conting.	

Table 4 (continued)

(1) Training Stage	(2) Type of Training	(3) Pictures Presented	(4) Response Cued	(5) Reinforcement Schedule	(6) Criterion
6	Multiple-cue Training	1,2,3,4,5	(Rec) 1,2,3,4,5	VR2	14 of 15 correct in 3 blocks
PROBE		1,2,3,4,5,X,Y	(Rec, Pro) 1,2,3,4,5	non-conting.	
7	same as 6	"	"	"	"
PROBE					
8	same as 6	"	"	"	"
PROBE					

*Substitute (Pro) for (Rec) in Productive Training Conditions

X,Y = ambiguous pictures

Rec = Receptive

Pro = Productive

CRF = Continuous Reinforcement Schedule

VR2 = Variable Ratio 2 Schedule

non-conting. = non-contingent

consec. = consecutive

were included in the array. Positions of the pictures were varied randomly over training trials. Social and tangible reinforcement were delivered on a continuous reinforcement (CRF) schedule for correct responses. If the subject responded incorrectly or failed to respond within 10 seconds, a prompt was given. The experimenter said "No," repeated the cue, and then produced the correct response. On receptive trials this response was to point to the correct picture. On productive trials this response was to name the picture.

Prompted responses were reinforced the first three times they occurred. Reinforcement was then discontinued. Thereafter, a time-out was given after every 10 consecutive prompted trials. The experimenter removed materials from the table and turned her back to the subject for a 10 second period. Training was then resumed as specified above, without reinforcement for prompted responses. Single-cue training continued until a criterion of five consecutive correct responses was met.

Multiple-cue training followed single-cue training in Stages 2 through 5, and occurred exclusively in the overtraining stages, where single-cue training was not appropriate. On multiple-cue training trials, the experimenter cued the subject to respond to either the new picture or one of the previously trained pictures. Depending on the stage of training, one to five pictures were placed on the table with positions varied randomly over training trials. Cues were presented randomly without repetition in blocks of K trials, where K was the number of pictures trained and being trained.

For example, at Stage 3, the block contained three trials, one for each picture in the array. The sample data sheet in Appendix VIII illustrates this procedure.

During multiple-cue training, reinforcement was provided for correct responses on a variable ratio (VR2) schedule. Prompting was used after incorrect responses or a failure to respond within 10 seconds, but reinforcement was not available for prompted responses. Multiple-cue training continued until the subject met a criterion of one error or less in three consecutive blocks of trials. For example, to meet the criterion at Stage 5, the subject was required to produce at least 14 correct responses on the 15 trials in three consecutive blocks.

Scoring and Reliability

The experimenter scored responses directly on pre-coded data sheets which indicated the order of receptive and productive trials in probe phases of the study and the order of trials within blocks during multiple-cue training (Appendix VIII). Responses were scored correct (✓), correct with articulation error (X), or incorrect (x, with recording of exact response).

Reliability of the data was evaluated by having an observer independently record subjects' responses during approximately one-fourth of the sessions in each condition of the study. The reliability observer was given a copy of the pre-coded data sheet, and observed through a clear glass partition separating the session room from the ward.

The first observer ($\underline{O}_1$), who scored Jimmy's data with $\underline{E}_1$, was a university student who was paid to participate in the study. The second observer ($\underline{O}_2$) was the author who scored Steven's and Wayne's data with $\underline{E}_2$. Janet's and Kelly's sessions were run by $\underline{E}_2$ and observed by $\underline{O}_3$, a CPRI Volunteer who was paid for her participation in the study.

Individual Procedures

The following procedural revisions were made to accommodate problems encountered in training individual subjects.

Jimmy (S_1). Jimmy served as the pilot subject under procedural conditions which were modified for the next five subjects. The procedure deviated from theirs in three ways. First, 20, rather than 24, pictures were identified for training. Thus, alternate pictures were not available for substitution when the first 20-card probe showed correct performance in both response modes on several pictures. Secondly, the ambiguous pictures (X and Y) were not added to the probe array for receptive trials. Thus, the probability of a correct pointing response by chance was one in five, compared to one in seven for other subjects. Thirdly, in both productive training conditions, overtraining was discontinued at Stage 7, because Jimmy responded correctly to all five pictures at both the receptive and productive levels on two consecutive 5-card probes. In both receptive training conditions, all eight stages were conducted, as for subjects trained later.

Steven (S_2), Bobby (S_3), Wayne (S_4). Although the first two subjects successfully reached the single- and multiple-cue training criteria, their acquisition was not reliably reflected by probes for performance on the trained response. To strengthen their performance, higher criteria were established for the multiple-cue training series. The revised criteria were based on the trials in five consecutive blocks, rather than three. One error was allowed in five consecutive blocks in Stages 2 and 3, and two errors were allowed in five consecutive blocks in Stages 4 through 8. For example, to meet criterion at Stage 5, the subject had to produce correct responses on 23 of the 25 trials in five blocks. These criteria were implemented for Steven during training on the second picture in the first productive training condition. For Bobby, the change was made during training on the fifth picture in the first receptive training condition. The revised criteria were used throughout Wayne's training.

Kelly (S_5). Under the training conditions specified in "General Procedure", Kelly failed to meet the single- and multiple-cue criteria in both the receptive and productive modes. Accordingly, the procedure was modified to facilitate acquisition. Discriminations among the five experimental pictures in each set were shaped by first training Kelly to discriminate each experimental picture from a set of four "known" pictures (see below). Subsequently, multiple-cue training was conducted on the experimental pictures, introducing one picture at a time.

Kelly's procedure is summarized in Table 5. Known pictures, referred to as a, b, c, and d, were defined as those pictures for which she produced correct receptive and productive responses on each of the four trials in the Labelling Pretest. Four of these pictures were used with each training set. They were selected randomly from a total pool of 15 known pictures.

In each condition, the first experimental picture was trained to a criterion of five consecutive correct responses. This picture was then trained in a multiple-cue series with the first known picture (a) until a criterion of one error or less in three consecutive blocks of trials was reached. The remaining known pictures were introduced successively, with the same criterion required before introduction of each succeeding picture. When criterion was attained on the final multiple-cue series (experimental picture 1, plus known pictures a, b, c, d), probes were conducted in the receptive and productive modes across the five experimental pictures. The foregoing procedure was repeated for each picture in the training set.

After each of the five experimental pictures had been trained separately in the context of known pictures, training began at Stage 6 to strengthen discriminations among the five pictures in the training set. This was accomplished during four multiple-cue training series. The first trained Pictures 1 and 2,

TABLE 5

Summary of Kelly's Procedure for Receptive Training Conditions*

(1) Training Stage	(2) Type of Training	(3) Pictures Presented	(4) Response Cued	(5) Reinforcement Schedule	(6) Criterion
1	Single-cue Training	1,a	(Rec) 1	CRF	5 consec. correct
	Multiple-cue Training	1,a	(Rec) 1,a	VR2	1 error in 3 blocks
	"	1,a,b	(Rec) 1,a,b	"	
	"	1,a,b,c	(Rec) 1,a,b,c	"	
	"	1,a,b,c,d	(Rec) 1,a,b,c,d	"	"
PROBE		1,2,3,4,5	(Rec, Pro) 1,2,3,4,5	non-conting.	
2	(same as above)	2			
PROBE					
3	(same as above)	3			
PROBE					
4	(same as above)	4			
PROBE					
5	(same as above)	5			
PROBE					
6	Multiple-cue Training	1,2	(Rec) 1,2	VR2	1 error in 3 blocks
	"	1,2,3	(Rec) 1,2,3	"	
	"	1,2,3,4	(Rec) 1,2,3,4	"	"
	"	1,2,3,4,5	(Rec) 1,2,3,4,5	"	"
PROBE		1,2,3,4,5	(Rec, Pro) 1,2,3,4,5	non-conting.	

*Substitute (Pro) for (Rec) in Productive Training Conditions
a,b,c,d = known pictures; CRF = continuous reinforcement; VR2 = variable ratio 2; consec. = consecutive

and the next three pictures were added successively. The criterion for each series was one error or less in three consecutive blocks of trials. When this criterion was reached, the next picture was introduced. Correct responses were reinforced on a VR2 schedule. Following the final multiple-cue series in Stage 6, probes were conducted in both response modes across the five trained pictures. Due to time limitations, Kelly did not receive overtraining in any condition.

Procedural errors occurred in the first receptive training condition. The 5-card probes were omitted after training Stages 1 through 5. Stage 6 was also omitted in the productive training conditions.

In summary, although Kelly's training was conducted within the same experimental paradigm used for the other five subjects, additional steps were required at each stage of training to facilitate acquisition of the experimental responses. The prolonged training procedure in turn necessitated the elimination of overtraining sequences which other subjects received.

RESULTS

The six subjects completed the experimental program in a total of 302 sessions. Individual subjects required from 38 to 62 sessions to complete the program, ranging over 31 to 77 days from the pretest to the final posttest. Table 6 shows the number of sessions and duration of the experiment for each subject.

Reliability Data

Interobserver reliability was calculated using the following equation:

$$\% \text{ Agreement} = \frac{\text{Number of Agreements}}{\text{Number of Disagreements + Agreements}} \times 100$$

Table 7 displays the percentage agreement in the receptive and productive response categories for each experimenter-observer pair on the pretest, training, and probe measures of the study. The overall reliability, based on 2281 trials, was 97 percent with a range of 90 to 100 percent. Experimenter-observer pairs rarely disagreed in rating receptive responses, as indicated by reliability estimates ranging from 95 to 100 percent. However, productive responses, which could be scored "correct", "correct with articulation error", or "incorrect", were judged less reliably. Estimates in this category ranged from 90 to 100 percent.

TABLE 6

Number of Sessions and Duration of Experimental Program for Each Subject

Subject	Number of Sessions			Duration in Days: Pretest to Final Posttest
	Pretest	Training and Probe	Total	
Jimmy (S_1)	7	31	38	31
Steven (S_2)	10	36	46	45
Bobby (S_3)	15	45	60	66
Wayne (S_4)	12	50	62	45
Kelly (S_5)	10	37	47	52
Janet (S_6)	15	34	49	77

TABLE 7

Percent Agreement for Experimenter-Observer Pairs by Response Category Across Experimental Measures

Experimenter-Observer Pair	Response Category	Experimental Measures				Average Agreement	Number of Trials
		Pretest	20-Card Probes	Training	5-Card Probes		
E_1 and O_1	Receptive	95	100	100	100	99	384
	Productive	100	100	92	93	96	
E_2 and O_2	Receptive	--	100	99	100	99	936
	Productive	--	94	96	94	95	
E_2 and O_3	Receptive	100	98	99	99	99	961
	Productive	100	93	90	97	95	
Average Agreement		99	97	96	97	97	
Number of Trials		239	350	1312	380		

In order to determine the source of error in the productive response category, ratings in this category were further analyzed. Trials on which one or both raters scored an articulation error were first identified, yielding a total of 126 trials. Experimenter-observer pairs agreed that an articulation error had occurred in 76 of these instances, yielding an overall reliability of 60%, with a higher estimate (68%) for the probe measures only. On the remaining 50 trials, an incorrect response was scored 47% of the time and a correct response was scored on 53% of the trials, accounting for 65% of the disagreements in the productive response category. Scoring of articulation errors was almost equally divided between the experimenters, who scored 55% of the articulation errors, and the observers, who scored 45% of these errors. Clearly, some subjects produced approximations to correct productive responses, however the adequacy of these approximations proved difficult to rate.

Training Data

Given the procedural modifications noted in the Method section, each subject met the single- and multiple-cue training criteria for the 10 responses targeted in each of the receptive and productive training conditions. Trials to criterion for the single-cue series are given in Table 8. During single-cue training, subjects generally acquired receptive responses rapidly, with a mean per word of 6.8 trials (s.d. = 1.24). Subjects' acquisition of productive responses during single-cue training was accom-

TABLE 8

Mean Number of Single-Cue Training Trials to Criterion for Each Subject in the Receptive and Productive Training Conditions

Subject	Training Condition			
	Receptive I	Receptive II	Productive I	Productive II
Jimmy (S_1)	5.0	6.0	7.2	8.2
Steven (S_2)	6.0	6.0	11.4	6.0
Bobby (S_3)	10.4	7.2	7.0	8.4
Wayne (S_4)	8.0	6.2	18.8	21.8
Kelly (S_5)	6.6	6.8	35.0	37.0
Janet (S_6)	6.8	6.6	21.4	20.0
Group Mean	6.8		16.9	

plished with more variability. The mean number of trials per word was 16.9 with a standard deviation of 9.9. Wayne (S_4), Kelly (S_5), and Janet (S_6) learned productive responses at a considerably slower rate than they learned receptive responses.

Trials to criterion for the multiple-due training series are shown in Table 9. Comparisons cannot be made across conditions since procedural changes occurred at this stage of training for three subjects. Steven (S_2), Bobby (S_3), and Wayne (S_4), worked to a higher criterion than the remaining subjects during the majority of their multiple-cue series, as noted in the Individual Procedures section.

Probe Data

The bar graphs in Figures 1 through 6 show the results for each subject collapsed across the five pictures in each condition. The pairs of bars showing results for the 20-card probes are labelled PI to PV along the abscissa. These measured baseline and posttest performance on each set. The 5-card probes are labelled 1-8 on the abscissa. These measured acquisition and generalization after training at each stage. The open bars depict the number of pictures correctly labelled in the trained mode. Closed bars show the number of pictures correctly labelled in the untrained mode, and represent generalized responses. The hatched portion of closed bars indicates articulation errors scored by the experimenter during productive probes.

TABLE 9

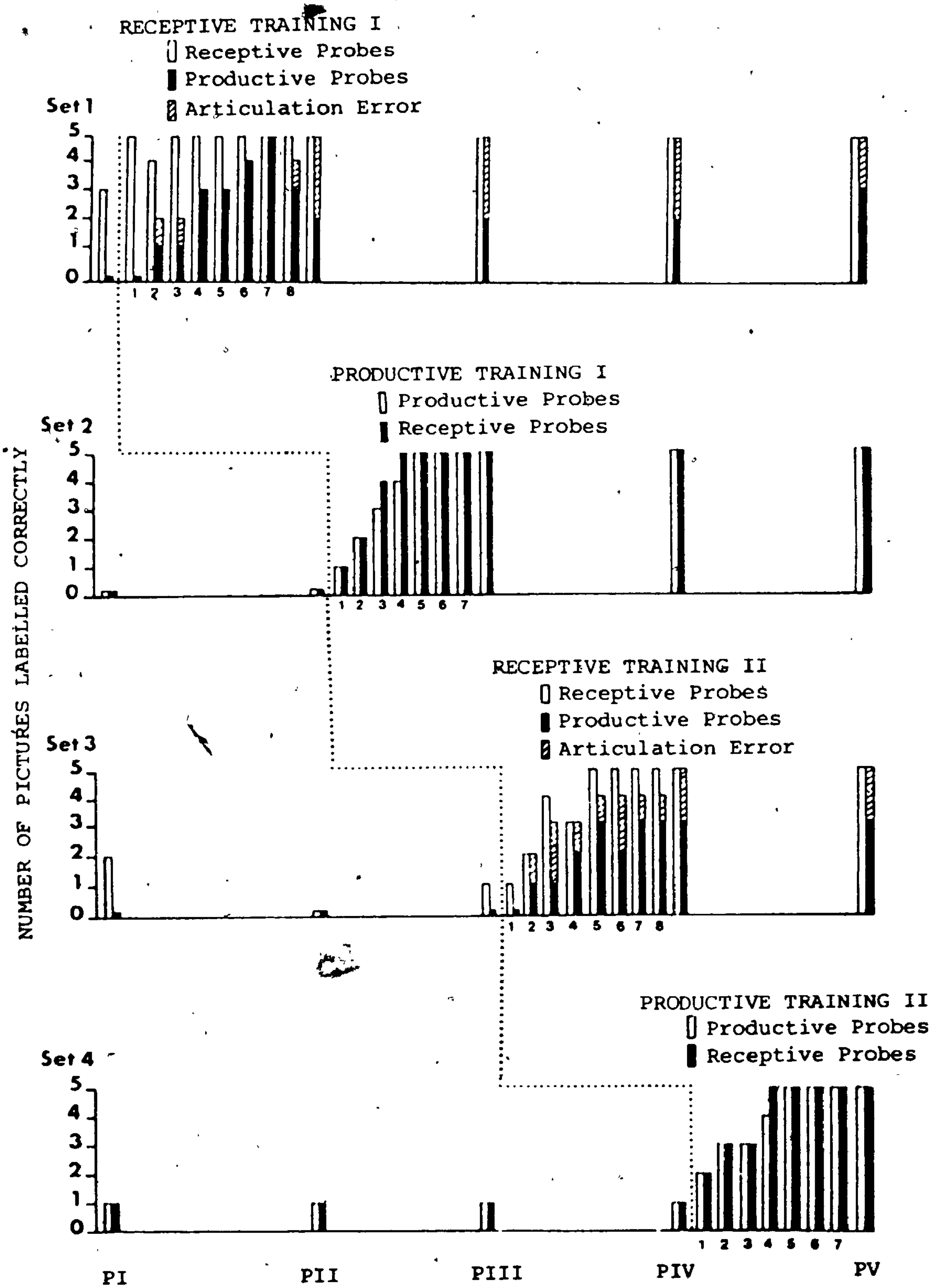
Number of Multiple-Cue Training Trials to Criterion for Five Subjects in the Receptive and Productive Training Conditions

Subject	Training Condition			
	Receptive I	Receptive II	Productive I	Productive II
Jimmy (S_1)	100	90	100	75
Steven (S_2)	87	178	236	155
Bobby (S_3)	386	153	143	154
Wayne (S_4)	191	207	276	253
Janet (S_6)	92	87	105	128
Total	856	715	860	765

Figure 1

Jimmy's probe data collapsed across the five pictures of a set in each training condition. The number of pictures correctly labelled on receptive and productive probe trials is shown for each set. Open bars depict trained responses and closed bars represent untrained, generalized responses. The dotted line indicates when training began on each set of pictures.

JIMMY: S_1



20-Card Probes (PI-V) and 5-Card Probes (1-8)

Figure 1a

Jimmy's probe data for each picture across four training conditions. Solid lines depict trained responses and broken lines represent untrained, generalized responses. Each response was scored correct (+), articulation error ($\underline{+}$), or incorrect (-). The descending vertical line indicates when training began on each picture.

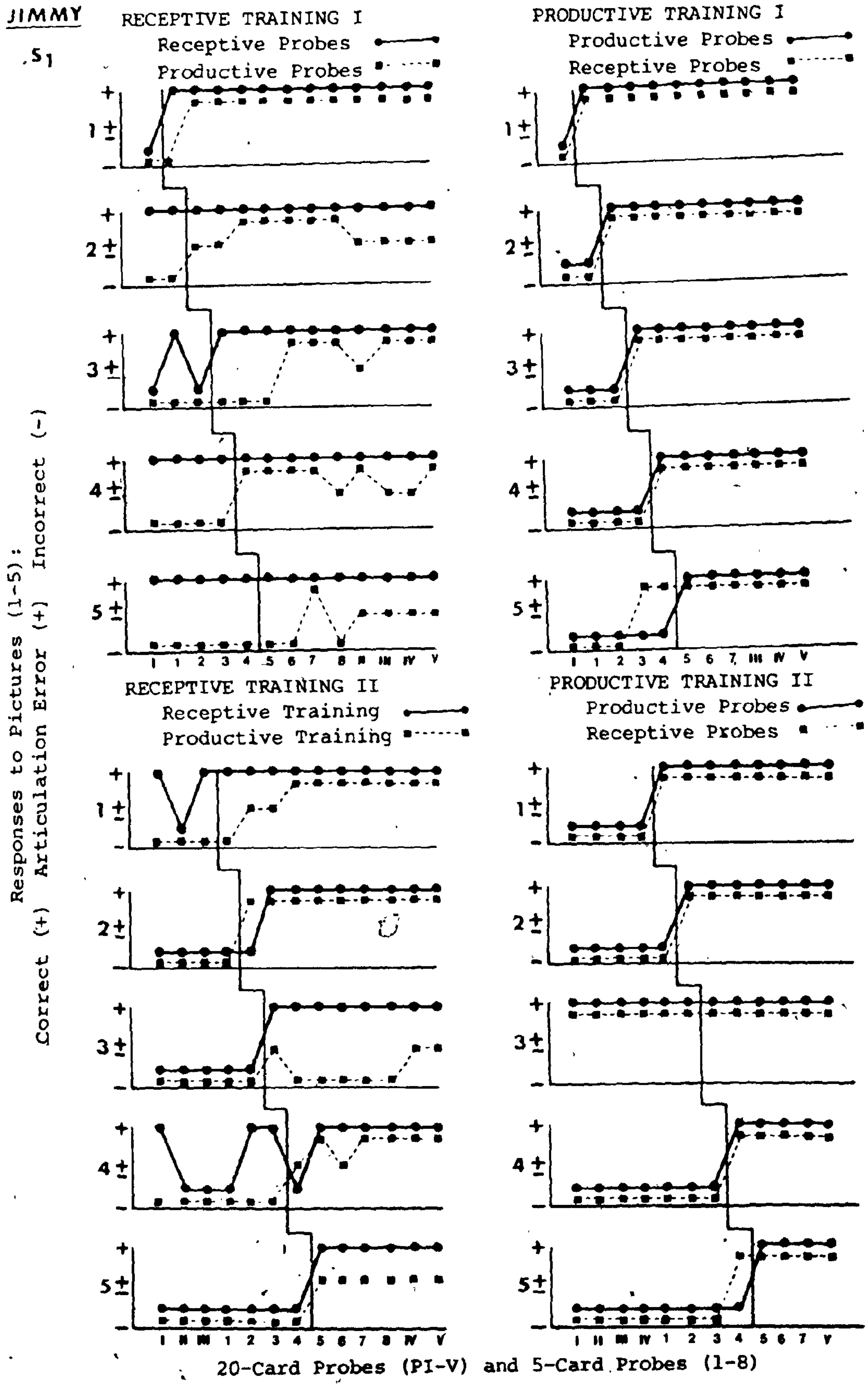
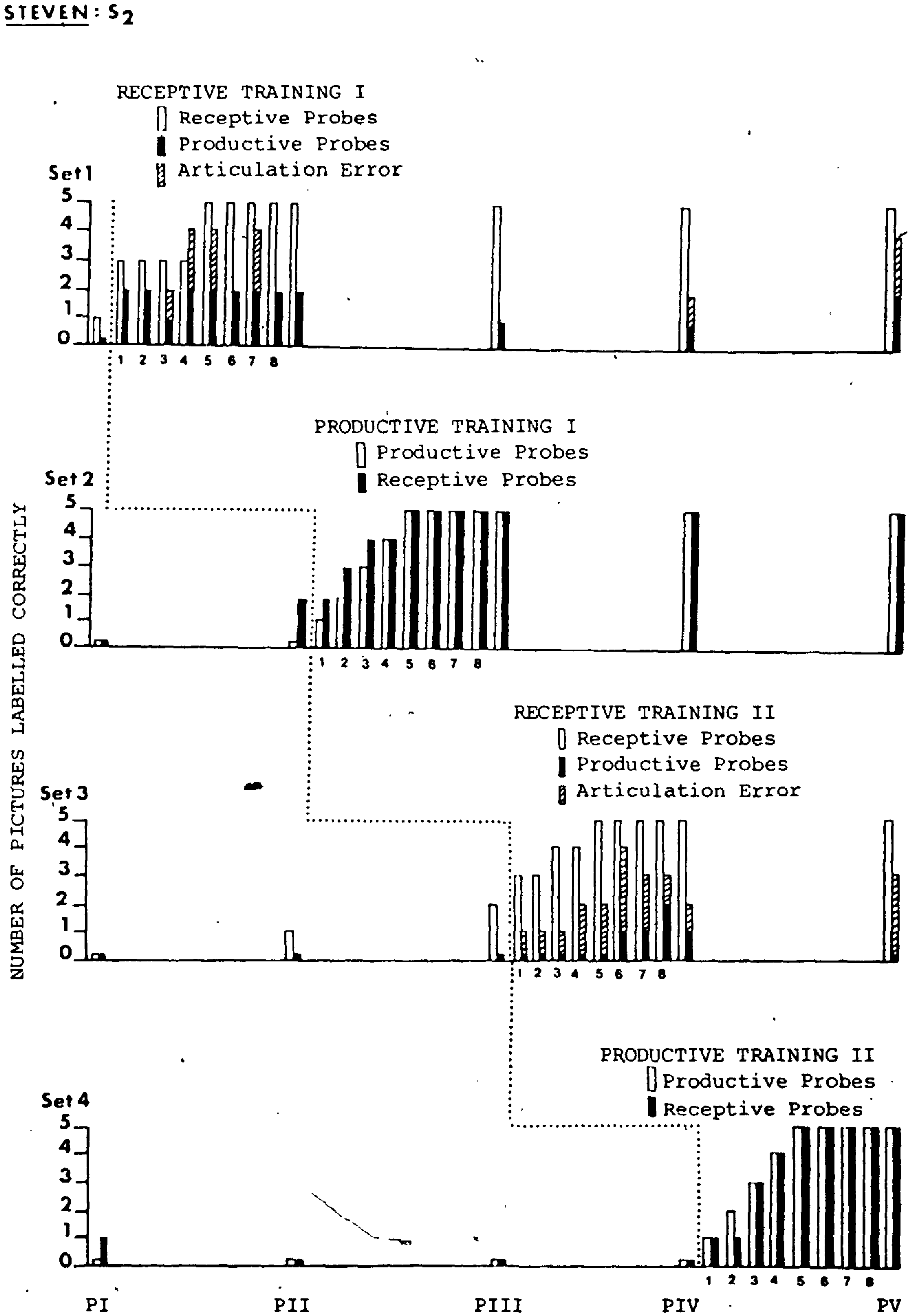

JIMMY
S1
RECEPTIVE TRAINING I
Receptive Probes
Productive Probes
PRODUCTIVE TRAINING I
Productive Probes
Receptive Probes
RECEPTIVE TRAINING II
Receptive Training
Productive Training
PRODUCTIVE TRAINING II
Productive Probes
Receptive Probes
Responses to Pictures (1-5):
Correct (+) Articulation Error (±) Incorrect (-)
20-Card Probes (PI-V) and 5-Card Probes (1-8)

Figure 2

Steven's probe data collapsed across the five pictures of a set in each training condition. The number of pictures correctly labelled on receptive and productive probe trials is shown for each set. Open bars depict trained responses and closed bars represent untrained, generalized responses. The dotted line indicates when training began on each set of pictures.



20-Card Probes (PI-V) and 5-Card Probes (1-8)

Figure 2a

Steven's probe data for each picture across four training conditions. Solid lines depict trained responses and broken lines represent untrained, generalized responses. Each response was scored correct (+), articulation error (±), or incorrect (-). The descending vertical line indicates when training began on each picture.

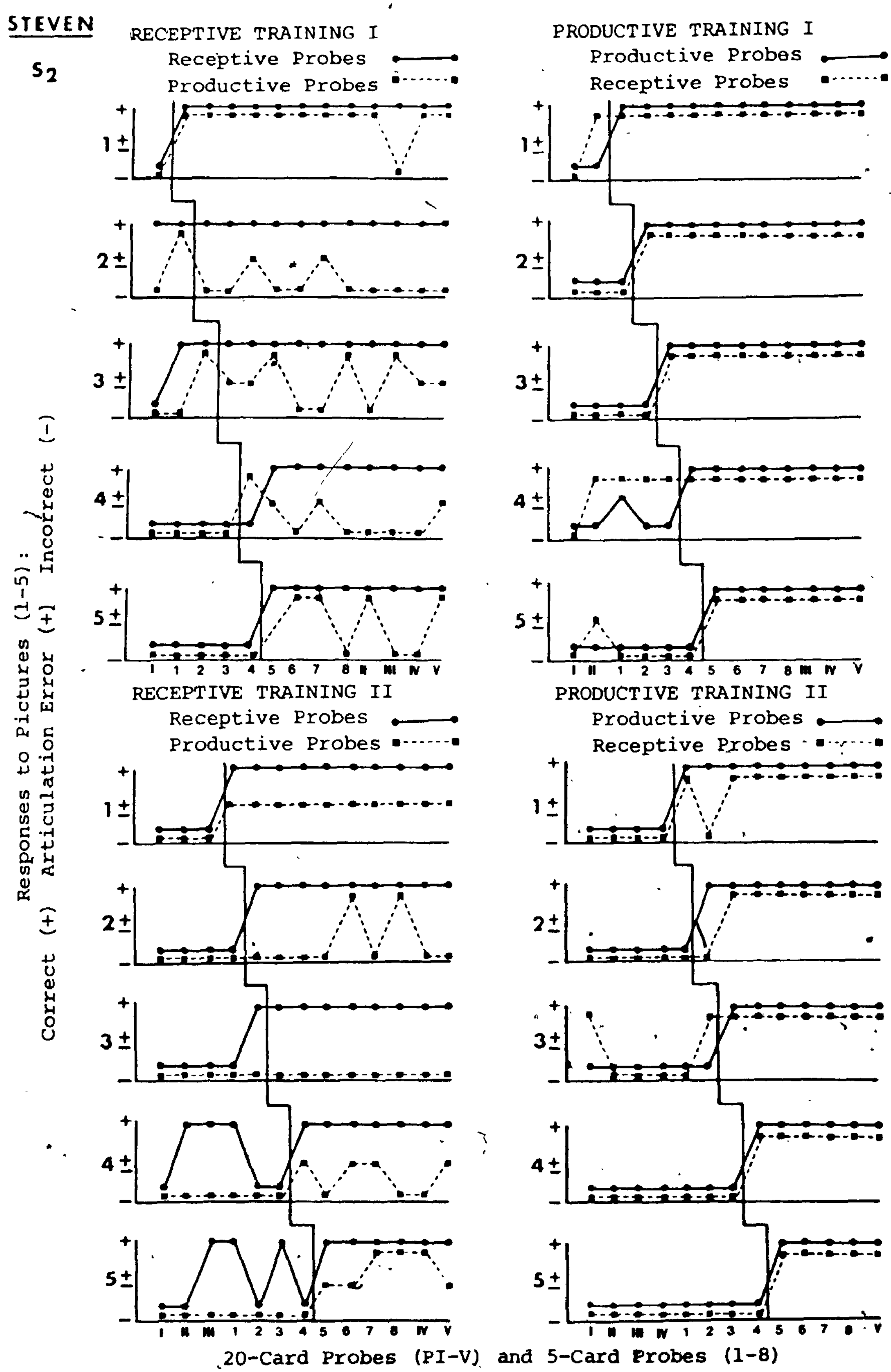
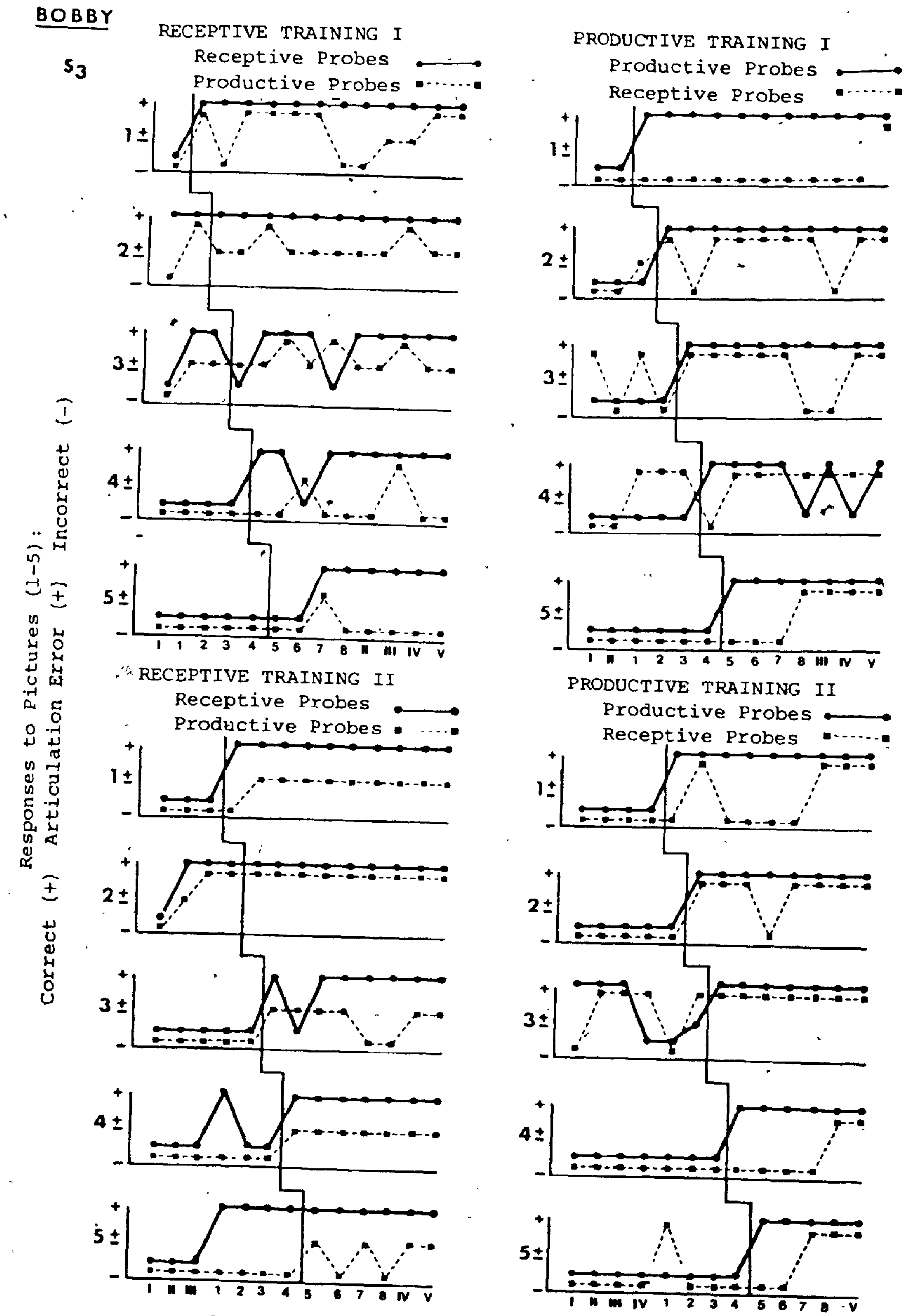

STEVEN
S_2
RECEPTIVE TRAINING I
Receptive Probes
Productive Probes
PRODUCTIVE TRAINING I
Productive Probes
Receptive Probes
RECEPTIVE TRAINING II
Receptive Probes
Productive Probes
PRODUCTIVE TRAINING II
Productive Probes
Receptive Probes
Responses to Pictures (1-5): Correct (+) Articulation Error (+) Incorrect (-)
20-Card Probes (PI-V) and 5-Card Probes (1-8)

Figure 3

Bobby's probe data collapsed across the five pictures of a set in each training condition. The number of pictures correctly labelled on receptive and productive probe trials is shown for each set. Open bars depict trained responses and closed bars represent untrained, generalized responses. The dotted line indicates when training began on each set of pictures.

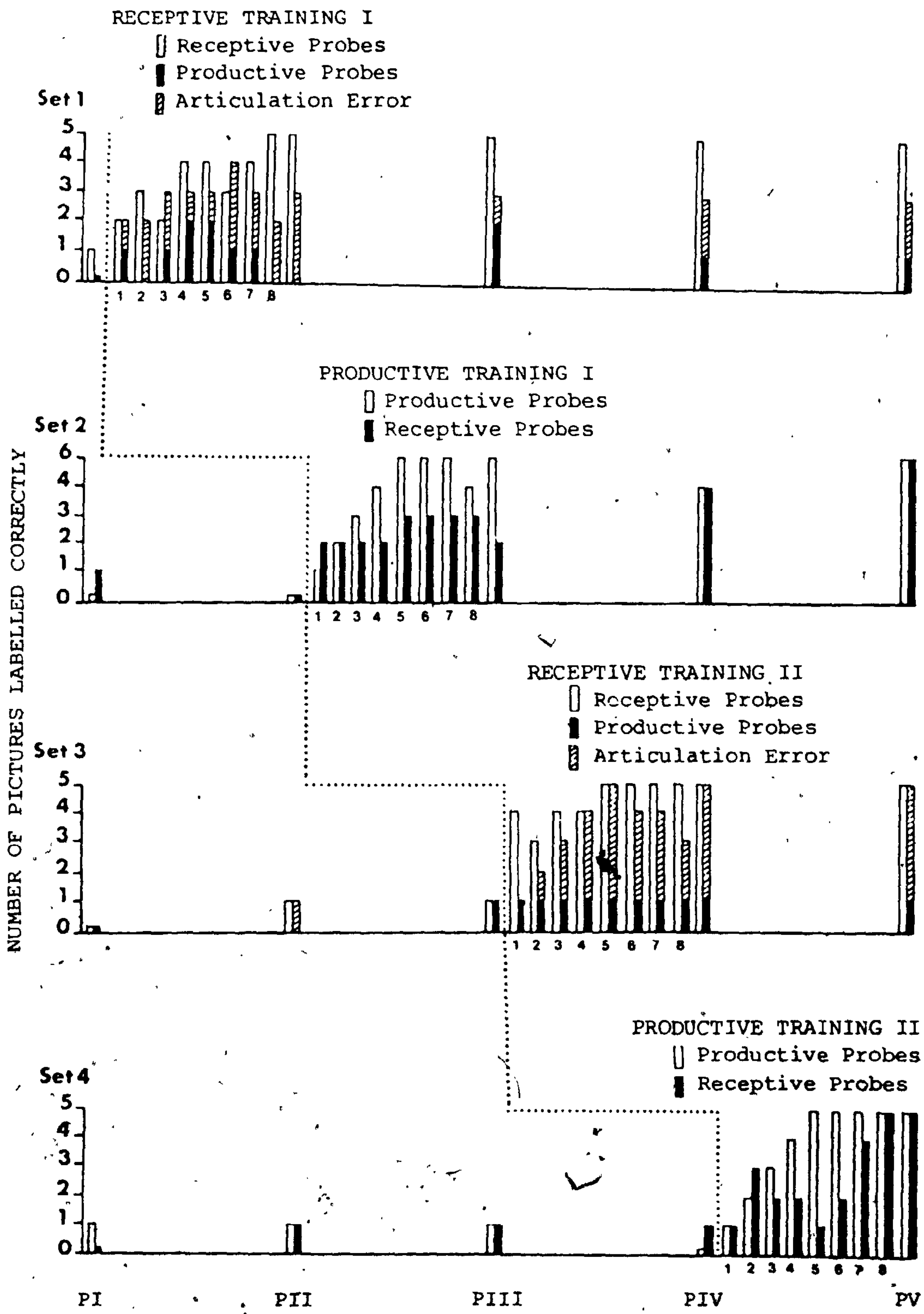


20-Card Probes (PI-V) and 5-Card Probes (1-8)

Figure 3a

Bobby's probe data for each picture across four training conditions. Solid lines depict trained responses and broken lines represent untrained, generalized responses. Each response was scored correct (+), articulation error (±), or incorrect (-). The descending vertical line indicates when training began on each picture.

BOBBY: S_3

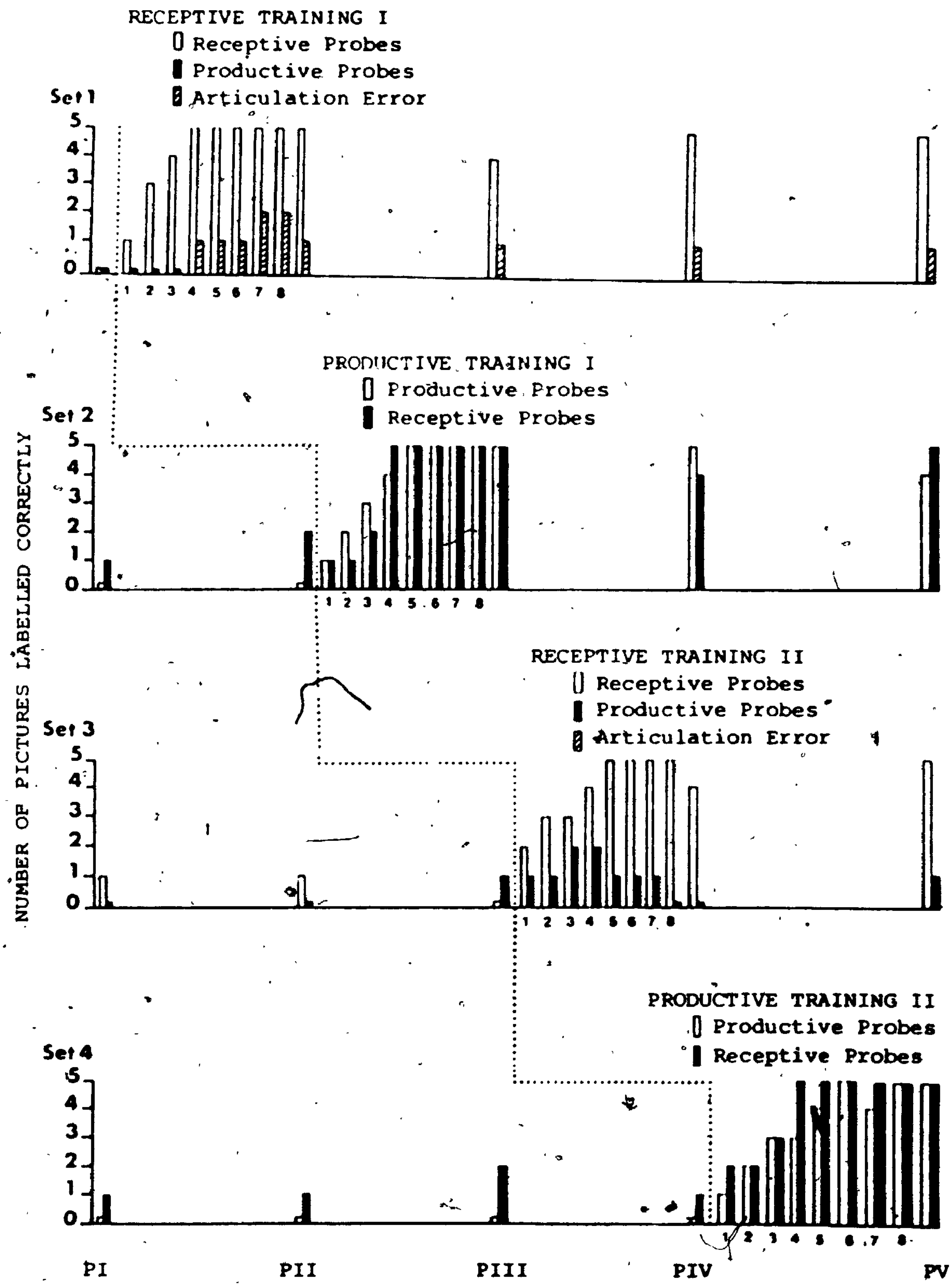


20-Card Probes (PI-V) and 5-Card Probes (1-8)

Figure 4

Wayne's probe data collapsed across the five pictures of a set in each training condition. The number of pictures correctly labelled on receptive and productive probe trials is shown for each set. Open bars depict trained responses and closed bars represent untrained, generalized responses. The dotted line indicates when training began on each set of pictures.

WAYNE: S4



20-Card Probes (PI-V) and 5-Card Probes (1-8)

Figure 4a

Wayne's probe data for each picture across four training conditions. Solid lines depict trained responses and broken lines represent untrained, generalized responses. Each response was scored correct (+), articulation error ($\pm$), or incorrect (-). The descending vertical line indicates when training began on each picture.

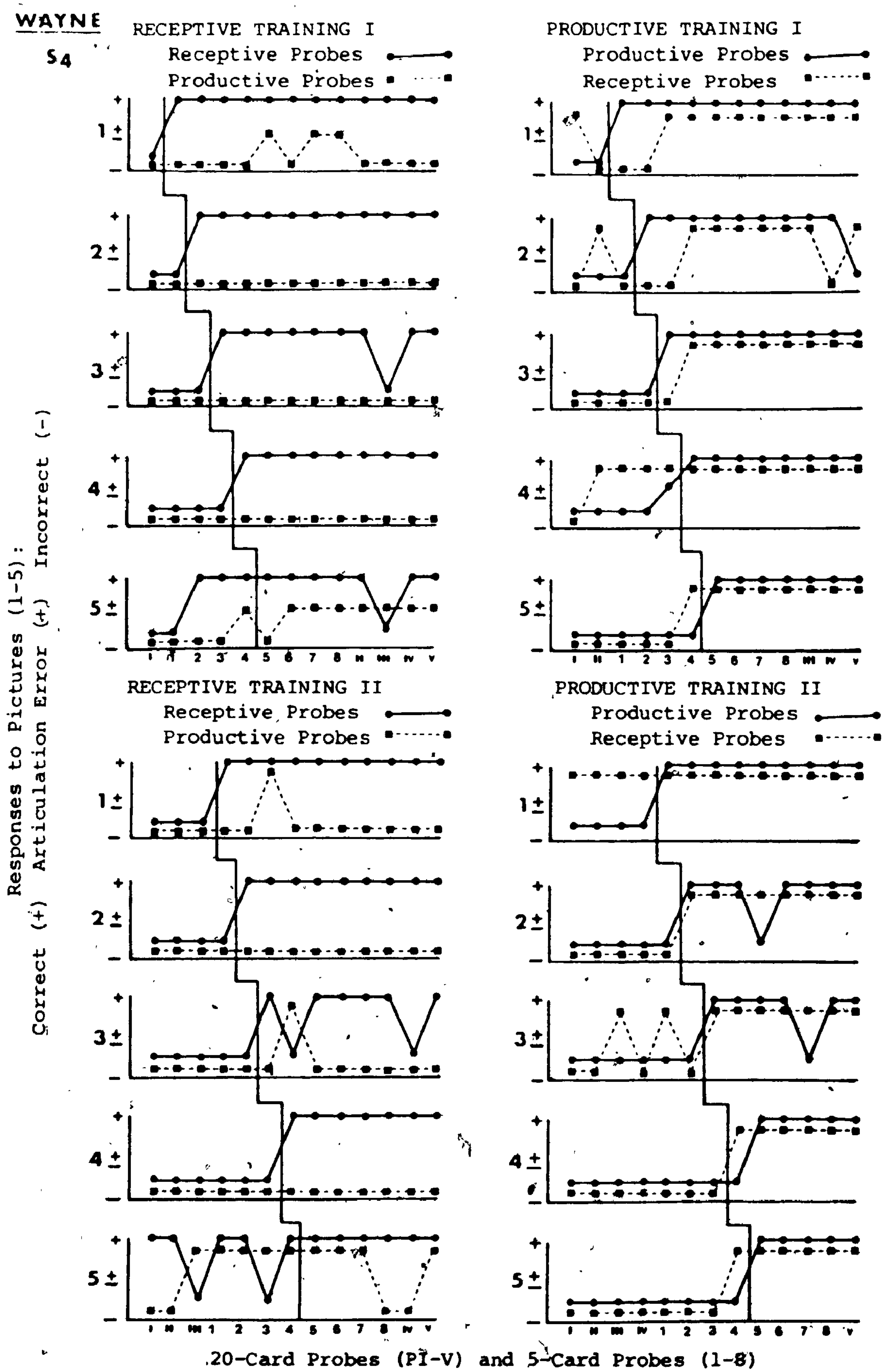
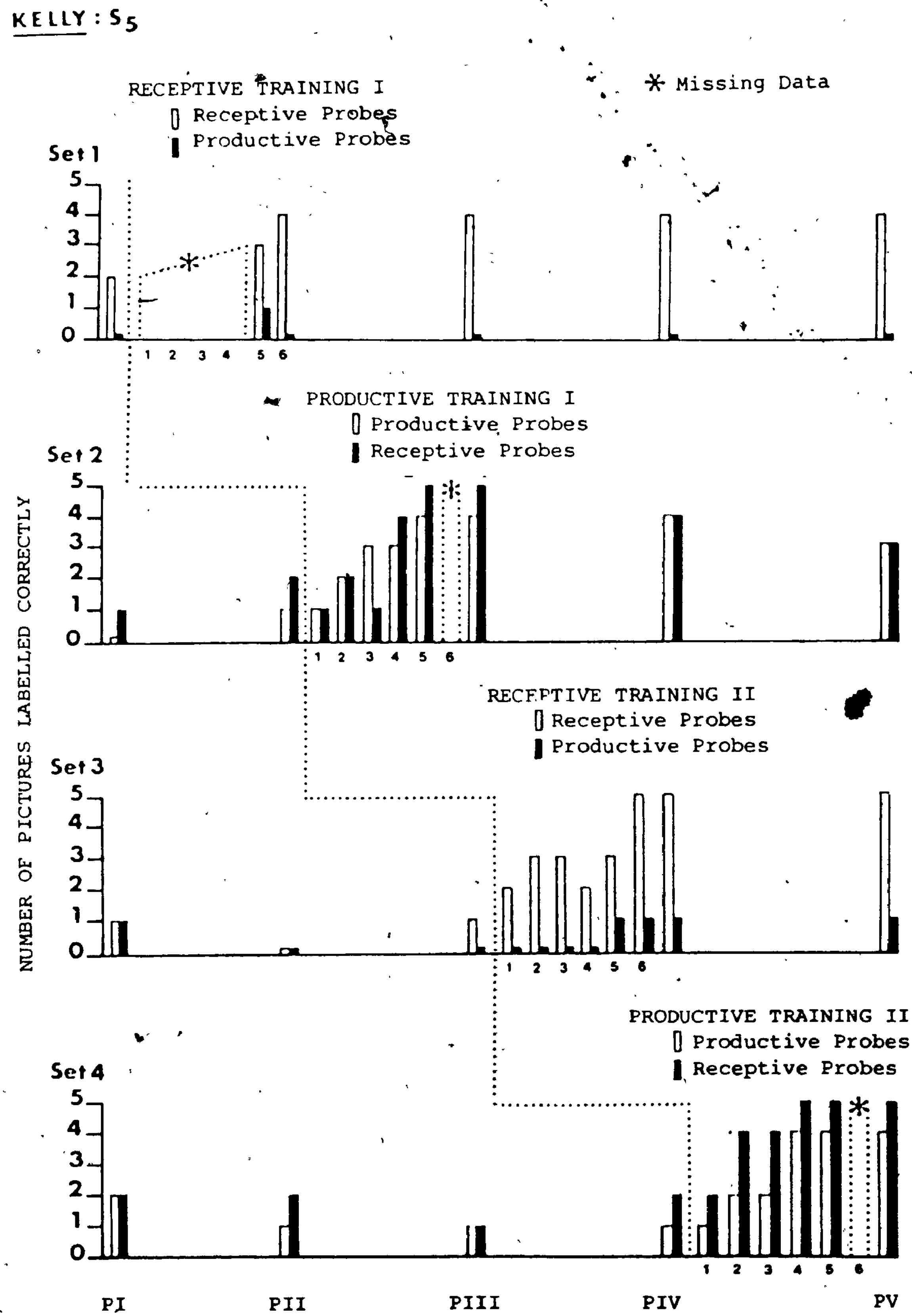

WAYNE
S4
RECEPTIVE TRAINING I
Receptive Probes
Productive Probes
PRODUCTIVE TRAINING I
Productive Probes
Receptive Probes
RECEPTIVE TRAINING II
Receptive Probes
Productive Probes
PRODUCTIVE TRAINING II
Productive Probes
Receptive Probes
Responses to Pictures (1-5):
Correct (+) Articulation Error (±) Incorrect (-)
20-Card Probes (PI-V) and 5-Card Probes (1-8)

Figure 5

Kelly's probe data collapsed across the five pictures of a set in each training condition. The number of pictures correctly labelled on receptive and productive trials is shown for each set. Open bars depict trained responses and closed bars represent untrained, generalized responses. The dotted line indicates when training began on each set of pictures.



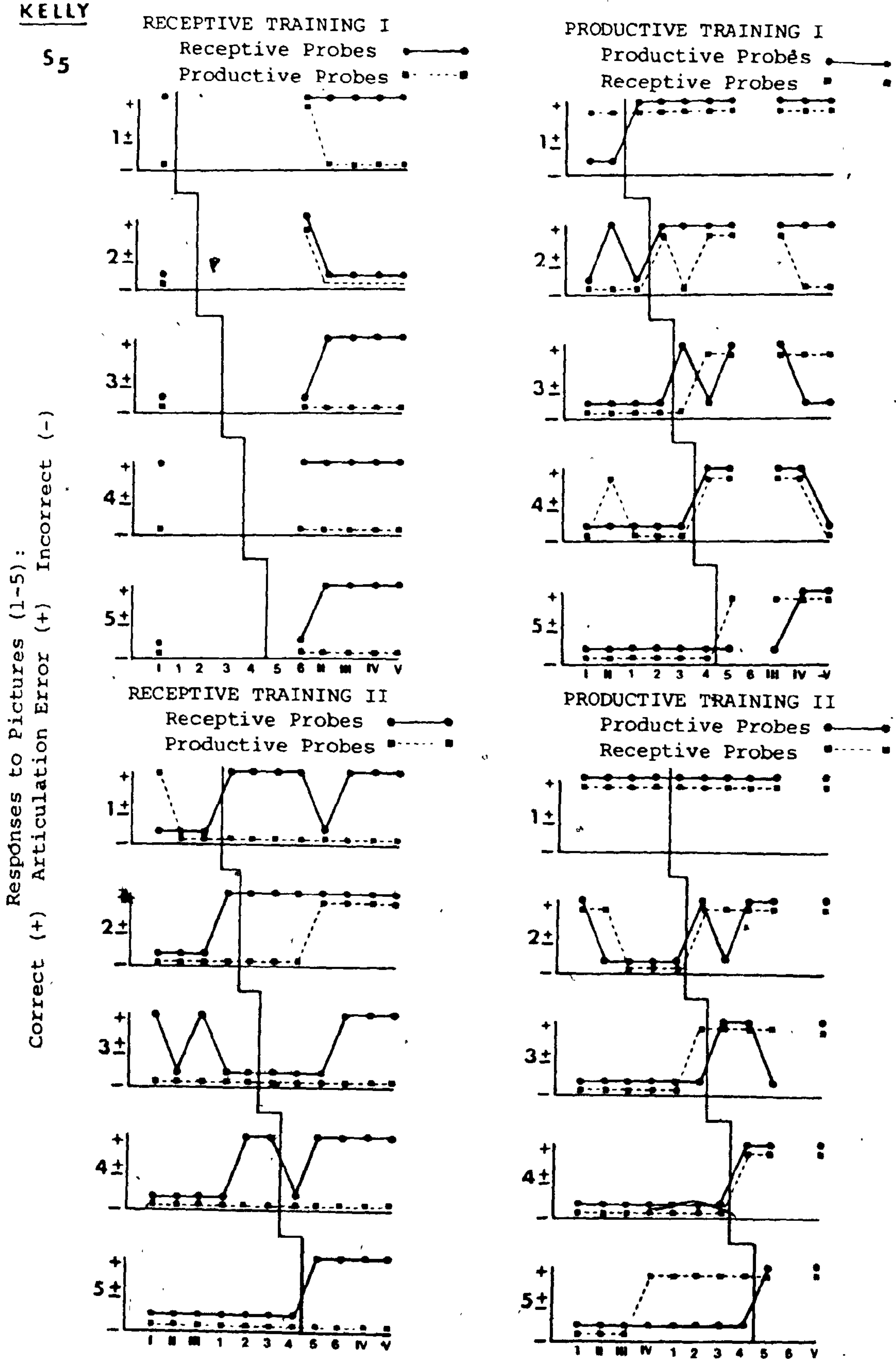
20-Card Probes (PI-V) and 5-Card Probes (1-8)

Figure 5a

Kelly's probe data for each picture across four training conditions. Solid lines depict trained responses and broken lines represent untrained, generalized responses. Each response was scored correct (+), articulation error (±), or incorrect (-). The descending vertical line indicates when training began on each picture.

KELLY

S_5

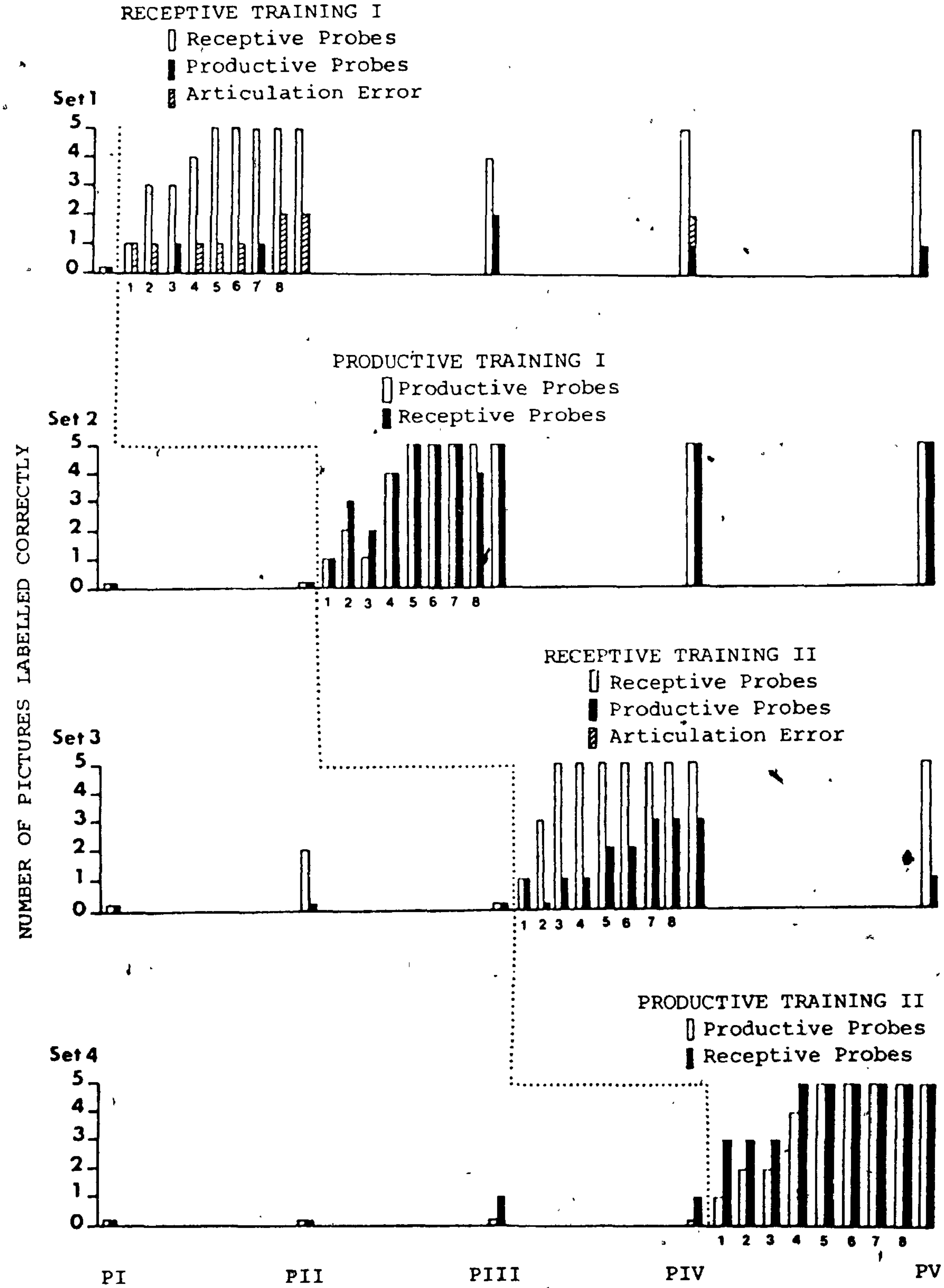


20-Card Probes (PI-V) and 5-Card Probes (1-8)

Figure 6

Janet's probe data collapsed across the five pictures of a set in each training condition. The number of pictures correctly labelled on receptive and productive probe trials is shown for each set. Open bars depict trained responses and closed bars represent untrained, generalized responses. The dotted line indicates when training began on each set of pictures.

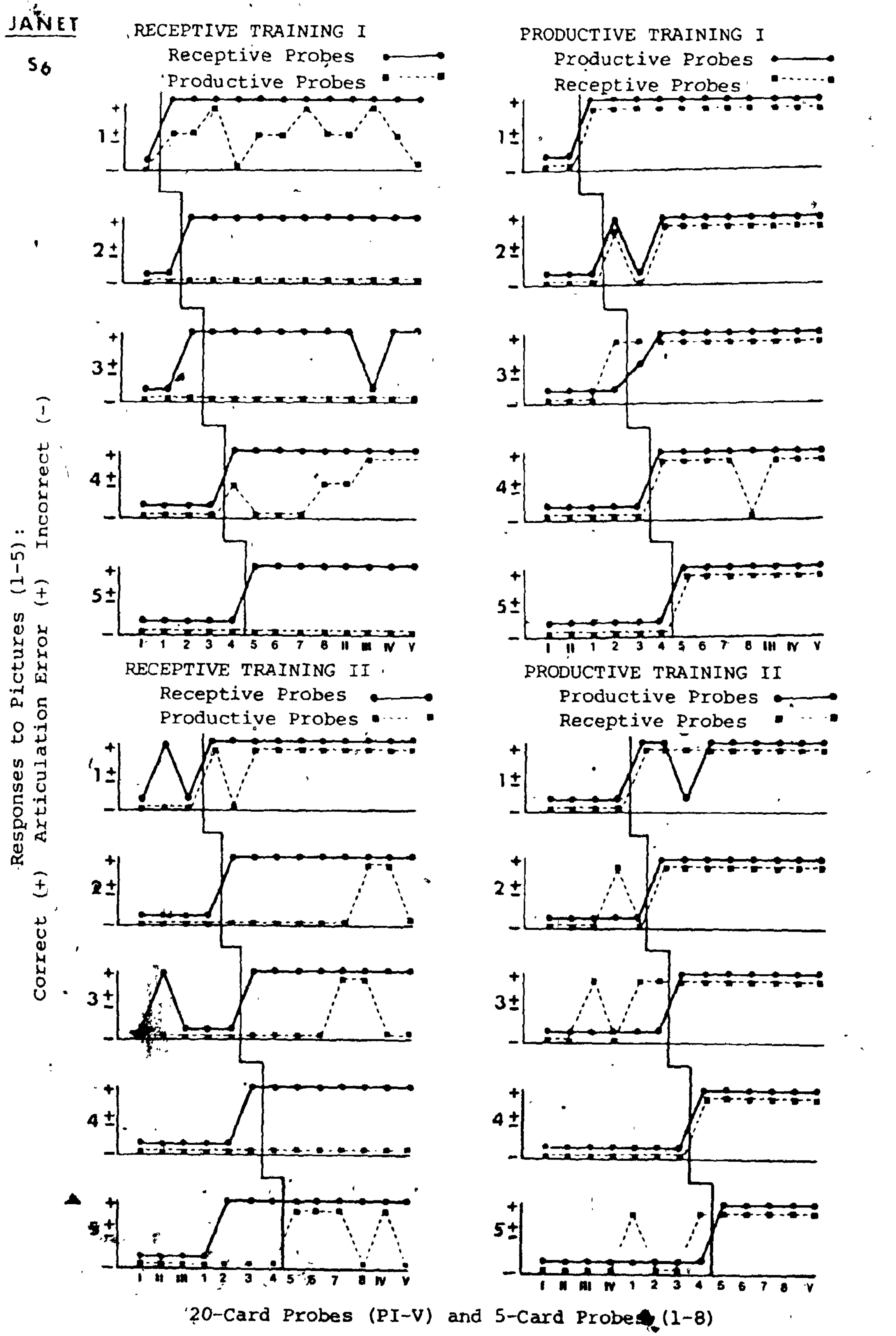
JANET: S6



20-Card Probes (PI-V) and 5-Card Probes (1-8)

Figure 6a

Janet's probe data for each picture across four training conditions. Solid lines depict trained responses and broken lines represent untrained, generalized responses. Each response was scored correct (+), articulation error ($\pm$), or incorrect (-). The descending vertical line indicates when training began on each picture.


JANET
S6
RECEPTIVE TRAINING I
Receptive Probes
Productive Probes
PRODUCTIVE TRAINING I
Productive Probes
Receptive Probes
RECEPTIVE TRAINING II
Receptive Probes
Productive Probes
PRODUCTIVE TRAINING II
Productive Probes
Receptive Probes
Responses to Pictures (1-5):
Correct (+) Articulation Error (±) Incorrect (-)
20-Card Probes (PI-V) and 5-Card Probes (1-8)

In Figures 1a through 6a, each subject's probe data is plotted for each picture. Examination of these figures discloses the relationship between training on a specific response and acquisition of that response in the trained and untrained modes. Trained responses are indicated by solid lines, while untrained responses are depicted by the broken lines. Responses are plotted as correct (+), correct with articulation error ($\pm$), or incorrect (-).

Summary statistics based on the probe data are displayed in Tables 10 and 11. Table 10 shows the percentage of responses in the trained mode that were correct on 1) probe trials before training on each picture, and 2) probe trials after training on each picture. Similarly, Table 11 shows the percentage of responses in the untrained mode that were correct on probe trials before and after training on each picture. With reference to Figures 1a through 6a, probes "before" training are those shown to the left of the descending vertical line in each condition, and probes "after" training are those to the right of this line.

<u>Probes for Responses in the Trained Mode</u>. Examination of Figures 1 through 6 indicates that the receptive and productive training was successful for each subject. The number of pictures correctly labelled in the trained response mode rose from relatively low baseline levels to almost perfect performance as training progressed on each set of pictures. Subjects generally labelled all five pictures in the set correctly on the probes

TABLE 10

Percentage of Responses in the Trained Mode
Correct on Probe Trials
Before and After Training for Six Subjects

	Training Condition			
	Receptive Tr. I	Receptive Tr. II	Productive Tr. I	Productive Tr. II
Before	34%	24%	3%	8%
After	93%	95%	95%	96%

TABLE 11

Percentage of Responses in the Untrained Mode Correct on Probe Trials Before and After Training

SUBJECT	TYPE OF PROBE							
	PRODUCTIVE Receptive Training I		PRODUCTIVE Receptive Training II		RECEPTIVE Productive Training I		RECEPTIVE Productive Training II	
	Before	After	Before	After	Before	After	Before	After
Jimmy (S_1)	0	58 (86)*	0	53 (85)	13	100	23	100
Steven (S_2)	13	38 (58)	0	13 (55)	25	100	07	94
Bobby (S_3)	07 (20)	26 (66)	08 (12)	23 ([illegible]8)	25	60	17	66
Wayne (S_4)	0 (07)	0 (20)	20	15	35	87	23	100
Kelly (S_5)	0	08	04	13	15	83	40	100
Janet (S_6)	0	12 (32)	0	43	05	96	20	100
$\bar{X}$ %	03 (07)	24 (45)	05 (06)	27 (50)	20	88	22	93

*Numbers in parenthesis indicate % correct when articulation errors are treated as correct responses after training Stage 5.

Figures 1a through 6a show the relationship between training on each picture and acquisition. In general, these data demonstrate that correct performance on probes in the trained response mode occurred as a function of experimental intervention. In the receptive training conditions subject's performance averaged 29% before training on each picture and 94% after training. In productive training conditions, subjects' mean rate of correct responding before training was 5%, compared to 95% after training. The relatively high proportion of correct receptive responses before training is consistent with the 14% chance of correct responding on the receptive task.

Probes for Responses in the Untrained Mode: Productive Probes. Visual inspection of the data in the two receptive training conditions in Figures 1 through 6 indicates that each subject's performance improved on productive probes following training. The summary statistics reported in Table 11 confirm this observation. Each subject, with the exception of Wayne (S_4), produced a higher percentage of correct responses on the productive probe trials which followed receptive training on each picture than on those which preceded this training.

During the first receptive training condition, subjects performed at a mean rate of 3% correct on productive probes prior to training on each picture, compared to a mean rate of 24% correct after training. If articulation errors are treated as correct responses, correct responding becomes 45% after training. These figures are generally representative of each subject's data, in that: 1) productive performance increased after receptive training and 2) the rate of correct productive responding is higher when articulation errors are treated as correct responses. The exceptions are Wayne (S_4), who displayed a 0% response rate on productive probes both before and after training, and Kelly (S_5), who did not produce any articulation errors.

The results obtained in the second receptive training condition are similar to those reported above. Subjects' performance on the productive probes preceding receptive training averaged 5%, compared to 27% after training. The analysis which includes articulation errors as correct responses again yields a higher rate of correct responding: 50% after training. Each subject's data are consistent with the trends expressed in the group averages, with two exceptions. Wayne (S_4) exhibited a slightly lower rate of correct responding after training, and did not produce any articulation errors. Similarly, there were no articulation errors scored for Kelly (S_5) on these probes.

Inspection of the probe data for the receptive training conditions in Figures 1a through 6a reveals that the pattern of generalization was characterized by intra- and inter-subject variability. Correct responding on productive probes did not always occur immediately after training, and performance was unstable over time.

During productive probe trials (Receptive Training I and II), it was noted that subjects often produced extra-experimental labels which they continued to use for specific pictures, despite the acquisition of a new receptive label for the picture. Examples of these perseverative competing responses included horse for giraffe, duck for peacock, paper for letter, and cup for funnel. The remaining error responses were classifiable in two groups. The first group included intra-experimental labels, that is labels for other experimental pictures either within the same set or in one of the other three sets. The third group consisted of non-labelling responses. These included nonsense syllables such as "dat", "boo", and "ha", irrelevant verbalizations such as "can't", "dunno", and "what's this?", and no response. The relationships between these three types of errors and the degree of generalization was examined.

Three error scores were derived for each subject by calculating the percentage of productive probe trials on which each type of error occurred before training began in each receptive condition. The results for five subjects are shown in Table 12. Incorrect verbal responses on productive probes were not recorded for Jimmy.

Each set of error scores was correlated with the generalization scores, averaged for the two receptive conditions, reported in Table 11. For the purposes of this analysis, articulation errors are treated as correct responses. The results indicate a negative rela-

TABLE 12

Percentage of Productive Probe Trials before Training on which Three Types of Errors Occurred for Five Subjects

Subject	Type of Error		
	Extra-Experimental Labelling	Intra-Experimental Labelling	Non-Labelling
Steven (S_2)	25	30	38
Bobby (S_3)	10	05	68
Wayne (S_4)	53	05	28
Kelly (S_5)	73	10	13
Janet (S_6)	78	00	23

tionship between extra-experimental labelling errors and generalization ($\rho = -.70$, $p > .05$), a positive relationship between non-labelling responses and generalization ($\rho = +.90$, $p < .05$), and no discernible relationship between intra-experimental labelling errors and generalization ($\rho = -.03$, n.s.). This pattern of relationships indicates that high frequencies of extra-experimental labelling responses are associated with low rates of generalization, and that the more frequently a child generates non-labelling responses, the more likely he is to later generalize new labelling responses learned in the receptive mode. These findings should be considered tentative, but they do suggest that pre-established labelling responses tend to interfere with receptive to productive generalization. These data lend support to the hypothesis that competition is one variable which influences generalization in this direction.

Probes for Responses in the Untrained Mode: Receptive Probes. Figures 1 through 6 show that in the productive training conditions, subjects' performance was high on receptive probes which followed training. After productive training on a set was completed, five of six subjects generally responded correctly on the receptive probe trials for each of the five pictures. Performance remained at a high and stable rate during the overtraining probes (6-8) and during posttests. The summary statistics reported in Table 11 show the percentage of probe trials correct before and after training. The data across subjects are consistent in showing that productive training resulted in substantial gains in receptive performance.

During the first productive training condition, subjects performed at a mean rate of 20% correct on receptive probes prior to training on each picture, compared to a mean rate of 88% correct after training. These figures represent the trend in each subject's data, although Bobby (S_3) performed at a lower rate (60%) than other subjects, whose rates ranged from 83 to 100% correct.

Data obtained in the second productive training condition show very similar results. Subjects' performance on the receptive probes preceding productive training averaged 22%, compared to 93% after training. Subjects' performance ranged from Bobby's (S_3) relatively low rate of correct responding (66%) to four subjects' performance at 100% levels.

Examination of data for the productive training conditions in Figures 1a through 6a shows a pattern of generalization which is reliably associated in time with training on the corresponding productive response. Generalized responses also remain stable over time. The exception is Bobby's (S_3) inconsistent performance on receptive probes.

Comparison of Productive and Receptive Probes. For each of the six subjects, receptive performance after productive training was higher than productive performance after receptive training. However, receptive performance prior to training was also higher than baseline levels of productive responding. A further analysis was performed to determine whether differing baseline levels accounted for the effects observed in this study.

Rates of correct generalized responses were calculated for pictures on which subjects responded at 0% levels in both modes prior to training. The results, based on 48% of the pictures trained across subjects, indicate that subjects' mean rate of correct responding after receptive training was 26%, compared to an average of 88% correct receptive responses after productive training. Treating articulation errors as correct responses, the rate for productive probes increases to 46%. These results are highly comparable to those based on the probe data for all pictures. Thus, differing baseline levels in the receptive and productive training conditions did not appear to influence the results significantly.

In summary, the results obtained in the receptive training conditions indicate that productive performance improved for all subjects as a function of receptive training, however the rate of improvement was modest for most subjects. More substantial gains were seen for five of six subjects, when articulation errors were treated as correct responses. Patterns of generalization varied both within and between subjects. Generally, productive performance was unstable and was not reliably associated in time with acquisition of the corresponding receptive response.

The results obtained in the productive training conditions indicate that receptive performance improved substantially for five of six subjects as a function of productive training. These subjects exhibited close to perfect performance on receptive probes after productive training. The sixth subject's receptive responding also increased after productive training, but his performance was variable, resulting in a more modest improvement in receptive responding. The pattern of generalization was consistent across five of six subjects: correct responding on receptive probe trials was closely associated in time with acquisition of the productive response and was stable over time.

DISCUSSION

The results of the experimental training, which were replicated both within and across the six subjects, showed that noun labelling in the two language modes can be established independently. Thus, in teaching retarded children concrete vocabulary, neither type of training appears to be a necessary prerequisite to the other. The unreinforced probes which assessed performance in the untrained response mode demonstrated that productive training was sufficient to establish accurate receptive performance for five of six subjects, but the opposite relationship did not hold. Receptive training resulted in only a limited degree of correct production, and these responses frequently contained articulation errors. For these subjects further training would have been necessary to establish competence in the productive mode for responses initially trained in the receptive mode. Thus, receptive training was neither a necessary nor a sufficient condition for productive performance.

The findings are consistent with the distribution of receptive and productive responses in the pretest data, which presumably reflect language acquisition as a function of processes in the natural environment. These data revealed that the relationship between receptive and productive responses was virtually exhausted by three categories: (1) both responses correct, (2) receptive correct, productive incorrect, and (3) both responses incorrect. The fourth possible category, receptive incorrect and productive correct, accounted for a negligible proportion of the cases. Furthermore, these three categories seem to be roughly correlated with word difficulty, as indicated by the developmental order in which the associated pictures occur in the Peabody plates. According to the labelling pretest results, subjects knew very common labels at both levels, followed by an intermediate group of labels which they knew at the receptive but not the productive level. More advanced labels were not known at either level. These data in conjunction with the results of the experimental treatments suggest that 1) production of lexical items lags behind reception, and 2) where there is referential production of a label, there is almost always comprehension.

The data obtained in this study suggest that subjects acquire receptive responses more readily than productive responses, both under original training and transfer conditions. A logical analysis of the two tasks indicates that they are associated with different response probabilities. The receptive task conforms to a matching-to-sample paradigm in which the subject is given an auditory verbal sample. The child must then supply the correct visual match from a limited number of choices. In this study, seven choices were available on probe trials. By comparison, in the productive task, the subject is given a visual sample and must retrieve the correct match from his entire productive repertoire. Numerous response choices are available, and these are likely to compete with the correct choice. Examination of subjects' errors on productive probe trials lent credence to this analysis. Instead of transferring the response learned in the receptive mode, subjects often persisted in using alternate labels which were presumably members of their pre-experimental verbal repertoires. These labels were generally names of similar objects (e.g. glasses for goggles, bee for wasp), the class name (e.g. bird for eagle, man for soldier), or based on an association to the picture (e.g. horse for saddle, egg for nest). Across the five subjects for whom these data were available, the frequency of these competing responses was inversely related to the frequency of responses correctly transferred from the receptive mode. It seemed, then, that when a picture controlled a previously learned productive response, a new label learned in the receptive mode was not likely to be used productively. These results suggest that the amount of training given in the receptive mode did not establish a new response strongly enough in the productive mode to replace previously learned responses. Whether or not continued training at the receptive level would eventually alter the relative strengths of competing responses sufficiently to yield correct productive performance is a question that awaits investigation.

In general, the results of this study demonstrated that in learning new vocabulary, retarded children's receptive and productive repertoires are functionally related. However, production seems to be tenuously related to prior receptive acquisition, while the relationship between productive acquisition and receptive performance appears to be a highly predictable one, i.e. five of six subjects could reliably identify a picture non-verbally once they had learned to name it. There is little agreement between these findings and the outcomes of related research. Previous studies of retarded children's cross-modality generalization (Guess, 1969; Guess & Baer, 1973) employed the plural morpheme as the unit of analysis, rather than the single lexical items used here. After training subjects to point correctly to singular and plural objects, Guess found an almost total absence of correct performance on productive probes. Correct productive responding was then trained until subjects reached an errorless criterion in labelling singular and paired objects. In a third condition, the receptive repertoire was reversed. Subjects were reinforced for pointing to pairs when given a singular label, and vice-versa. Unreinforced probes for productive plural usage again showed the independence of the two repertoires, in that subjects did not reverse their productive responses. According to Guess, these results demonstrated that the two language repertoires can be separate and functionally independent classes of behavior, although the influence of productive training on reception was not tested. Subsequently, Guess and Baer (1973) also concluded that "automatic" generalization between the two language modes is unlikely to occur in speech-deficient children after finding that three of four subjects showed limited gains on unreinforced probes following the acquisition of opposite-modality responses.

A second group of studies examined the relationships among imitation, comprehension, and production in the context of second language learning. These studies are of questionable relevance to the applied concerns of the present research since they employed college students (Asher, 1972; Winitz & Reeds, 1972) and intellectually normal preschoolers (Ruder, Smith, & Hermann, 1974) and 6 to 8 year olds (Ruder, Hermann, & Schiefelbusch, 1977). However, they are interesting because they used noun labels, the same response form studied in the present experiment. Asher (1972), and Winitz and Reeds (1972) found that comprehension training alone was sufficient to establish accurate verbal production, and hence ruled out imitation as a functional component of training. In contrast to these findings, Ruder and his colleagues (1974, 1977) concluded that for younger subjects, imitation and comprehension training are both necessary to achieve criterion on productive responses. The foregoing investigations did not compare the efficacy of comprehension and imitation training sequences with direct training in the productive mode.

To date, then, the inconsistencies in the results generated by the research in this area raise several questions. A priority for future research is to identify and systematically manipulate variables that control the direction and degree of generalization. The present data suggest several variables that merit attention. First, there is ample reason to suppose that competition plays a role in cross-modality generalization, particularly from the receptive to the productive mode. As noted in the introduction, competition may have influenced the results of earlier studies in this area. Learning pluralization rules (Guess, 1969; Guess & Baer, 1973) requires subjects to make discriminations between responses that are similar topographically, and so may be associated with a high degree of competition. In order for generalization to occur in this task, the productive singular, which Guess and Baer's subjects had acquired prior to experimental intervention, had to be replaced by the productive plural. The low degree of generalization exhibited by the majority of subjects tested suggested that the receptive training given was not sufficient to alter response strengths in the productive mode.

On the other hand, competition may be minimally involved in the second language learning experiments. Ruder et al. (1974, 1977) selected subjects who had not previously been exposed to the second language (Spanish) from which the experimental items were chosen. Since subjects had no prior learning history for the language content taught, they would not have a repertoire of alternate labels. Under these conditions, competition would be minimal and one could expect the relatively high rates of generalization seen in this group of studies. However, younger subjects (Ruder et al., 1974; 1977) did require imitation training to facil-

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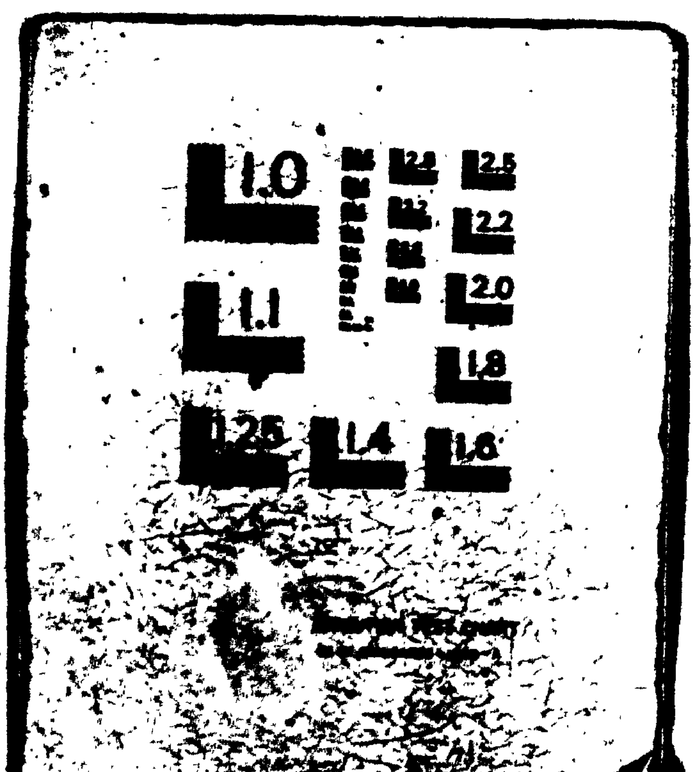

itate productive performance, and thus the absence of competing responses was not associated with "automatic" generalization.

This raises the question of the role that imitation and articulatory abilities play in receptive to productive generalization. Subjects clearly had difficulty articulating labels trained only in the receptive mode. An important question the present study did not answer is whether imitation training given either before or after receptive training, as in the preceding studies, would have contributed to a greater degree of generalization to the productive mode. An attempt was made to control the imitation component by pretesting subjects to ensure that they could articulate labels used in the experiment. However, there were two problems with the method used to do this. First, subjects were only required to demonstrate the ability to imitate a random sample of the experimental labels, and this sample did not include all the phoneme combinations required by the experimental responses. Secondly, it has been reported that developmentally delayed children tend to imitate a word more accurately than they can reproduce it spontaneously (Lenneberg, 1967). Thus, imitative practice may be necessary before subjects can articulate a word correctly without a model. There is some anecdotal evidence (Ruder et al., 1977) indicating that during comprehension training, intellectually normal subjects obtain this type of practice by rehearsing the relevant part of the receptive cue. Retarded subjects do not typically engage in such rehearsal activities, although with instruction they are able to utilize these strategies profitably (Ashcraft & Kellas, 1974). It seems then that imitative practice, either through direct training or through rehearsal, may be necessary as an adjunct to comprehension training in order for these subjects to achieve proficiency in the productive mode.

An interesting question is whether echolalia can operate as a rehearsal mechanism, facilitating acquisition of productive responses. Of the six subjects who participated in this experiment, Jimmy ($\underline{S}_1$), Steven ($\underline{S}_2$), and Bobby ($\underline{S}_3$) had histories of echolalia. This feature of their language behavior was manifested in varying degrees on the test for echolalia. These three subjects also showed higher rates of receptive to productive generalization (with articulation errors treated as correct responses) than the non-echolalic subjects. However, echolalic responses were only recorded during Bobby's sessions and consequently, it is unclear to what extent Jimmy and Steven echoed receptive cues.

Echoing of receptive cues could be expected to facilitate production for two reasons: 1) because the child is obtaining articulatory practice with a model, and 2) because in the process of being reinforced for the correct pointing response, the child's echolalic response is adventitiously reinforced. However, echolalia might not always play a facilitative role. If a child echoes the receptive cue incorrectly, he will be reinforced accidentally for poor approximations to the verbal response. Under these conditions, errors in articulation may be strengthened during receptive training and interfere with subsequent training of correctly articulated productive responses. The performance of two echolalic subjects who exhibit different levels of articulatory competence is currently being examined in the context of receptive and productive training tasks.

Bobby's performance suggested that echolalia may also be associated with atypical generalization in the opposite direction, from the productive to the receptive mode. He was the most severely echolalic subject, and his data deviated appreciably from that of other subjects. His pattern of partial generalization was unlike the reliable effect associated with productive training for other subjects. Bobby was often unable to identify the picture that matched a spoken label, although he was able to supply the label himself when the picture was presented. The severe comprehension deficits of echolalic children have previously been noted (Premack & Premack, 1974) and recent empirical evidence (Carr, Schreibman, & Lovaas, 1975) supports the proposition that the occurrence of echolalia is highly associated with the incomprehensibility of a verbal stimulus. Bobby's data were consistent with the possibility that these children show an abnormal dissociation between comprehension and production, however the contribution of echolalia to his idiosyncratic performance is unclear.

Clinical Implications

What are the implications of these results for promoting language development in children with delayed speech? It is useful to consider this question from two vantage points. First, the data obtained in this study have implications for sequencing instruction in formal language training programs. Secondly, the findings can be evaluated with respect to a child's functioning in natural language-learning environments.

With reference to sequencing language curricula, the results show conclusively that for imitative children, receptive vocabulary training is not a necessary prerequisite to productive training. Moreover, learning in both response modes is essentially complete after productive training. While these results indicate that training at the productive level is a parsimonious approach to establishing labelling responses in both linguistic modes, this does not preclude the possibility that receptive training may accelerate subsequent productive learning, yielding a more efficient procedure overall. The degree of facilitation afforded by receptive training was not directly evaluated in this study. Assessment of generalized responses indicated that subjects learned something about productive responses, but it is unclear how this knowledge would affect subsequent productive training. Would it significantly accelerate that training or would these responses have to essentially be retrained at the productive level, with no savings afforded by the prior receptive training? As a third possibility, are there conditions under which receptive pretraining might interfere with later productive training of the same responses? These questions are presently being investigated in a study which 1) compares trials to criterion required for productive training alone with trials to criterion required for productive training after a receptive training sequence for the same labels. This study allows a comparison of generalization and retraining trials to criterion as measures of the facilitation afforded by receptive pretraining.

Questions of efficiency aside, the present results do not support the commonly used reception-then-production training sequence modeled on traditional notions of normal language acquisition. Although the data did suggest that functional production lags behind receptive acquisition of lexical items, it is neither necessary nor appropriate to replicate this process in a language intervention program unless empirical support emerges for this practice. In the interim, the present results should temper the current predilection for initiating vocabulary training at the receptive level.

The results of this study also have implications for intervention in natural language learning environments. There is a growing body of literature documenting the discrepancies between language-learning environments of normal and retarded children. For example, Buium, Rynders, and Turnure (1974) found that maternal speech addressed to 24-month old children with Down's Syndrome contained a significantly higher percentage of imperatives than maternal speech addressed to nondelayed children. Marshall, Hegrens, and Goldstein (1973) also reported that mothers of retarded children manded at a significantly greater frequency than mothers of non-retarded children. In their study, manding included demanding, commanding, requesting and asking. In a third study comparing interactions between mother-retardate and mother-normal pairs, Kogen, Wimberger, and Bobbitt (1969) also found that mothers of retardates gave orders to their children almost twice as often as the comparison mothers. In institutional settings, where custodial care often takes precedence over teaching functions, the rate of command statements may be even higher. In one study (Harris, Veit, Allen, & Chinsky, 1974) around 75% of the statements directed to residents were rated as mands which were defined as commands, orders, and requests. Marshall, et al. (1973) speculate that retarded children receive a large number of imperatives because 1) their social and intellectual deficits necessitate extensive external control, 2) the child's verbal expressive deficits extinguish adults' attempts to converse with him, and 3) mands may be followed by motor compliance which is reinforcing to the adult issuing the command.

These observational data strongly imply that adult-child interactions in the retarded population favor the development of a receptive repertoire. Opportunities for growth of productive skills are probably more limited, and may be severely restricted in institutional settings. Since, as shown in this study, retarded children can be expected to transfer little of their receptive knowledge to productive use, their expressive speech repertoires will in all likelihood be arrested at a rudimentary level. This prediction is consonant with clinical observation and assessment, although evidence documenting the abnormally divergent status of the two language repertoires is not available to date.

One approach to remediating productive deficits has already been discussed, i.e. providing direct training in that mode. A second type of intervention, which potentially exploits conditions prevailing in the natural environment, focuses on training procedures that promote generalization from the receptive to the productive mode. Guess and Baer (1973) explored one procedure for doing this after three of their four subjects failed to show a high degree of cross-modality generalization in either direction. Reinforcement was programmed for correct probe responses, and when performance rose to a near perfect level of accuracy, reinforcement was discontinued. This manipulation resulted in continued generalized responding, even after reinforcement for these responses had been withdrawn. However, the researchers did not examine the extended durability of these effects. In addition, because of the design specifications, it is unclear whether maintenance was occurring for novel responses, or whether because of the recycling of training items, some of the responses had been previously reinforced. For these reasons, the effect seen in this study requires replication and extension to other response classes.

Training-to-generalize might also be based on rehearsal. As noted previously, intellectually normal subjects undergoing comprehension training during a second language learning experiment spontaneously adopted a rehearsal strategy which seemed to facilitate productive performance (Ruder, Hermann, & Schiefelbusch, 1977). This involved vocal repetition of the label given in the receptive cue. Subjects persisted in rehearsing even when explicitly instructed not to, and thus this behavior was difficult to suppress. Recently, there has been widespread speculation, supported by observational data, that retarded children are deficient in using such language acquisition strategies (Mahoney, 1975; Mahoney & Seely, 1976; Snyder & McLean, 1976). While strategic behavior does not appear to occur spontaneously among these children, it has been demonstrated that they can be instructed to rehearse with a resulting improvement on a verbal recall task (Ashcraft & Kellas, 1974). Research should be designed to determine the conditions under which rehearsal can facilitate retarded subjects' receptive to productive generalization.

Conclusions

This series of replicated single-subject designs demonstrated that there is a mutual influence between retarded children's acquisition of receptive and productive labelling responses. While these results may predict training and generalization outcomes for the simple word-object associations studied here, outcomes may differ for other types of labelling. For example, research in progress indicates that labels for simple concepts, such as shape, color, and size, learned in the receptive mode may reliably control productive performance (Batstone, personal communication).

Clearly, there are many questions that must be answered before an adequate empirical basis for sequencing language instruction will be available. Two general directions for future research are indicated. First, it is necessary to identify variables that control the direction and degree of cross-modality generalization so that the effects of training will be predictable across subjects, response classes, and stimulus conditions. An important suggestion that emerged from this investigation is that features of a child's language repertoire prior to intervention may significantly influence patterns of generalization. In this study, echolalia and competing responses seemed to figure prominently in generalization outcomes. In the future, more attention should be given to the role that pre-established language behaviors play in cross-modality generalization effects.

Secondly, it has probably been too widely assumed that developmental data have generality for language interventions in the retarded population. The present experimental analysis of behavior, which used subjects from the target population, was instructive in demonstrating that replication of the reception-then-production sequence observed in normal development is not necessary in teaching vocabulary to delayed language learners. Further research using this approach is required to establish alternative training models for children who exhibit severe delays in language development.

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APPENDIX I

Labels Assigned to the 120 Pictures

from the

Peabody Picture Vocabulary Test

1. cat
2. spoon
3. chair
4. banana
5. sock
6. pencil
7. apple
8. brush
9. table
10. butterfly
11. cow
12. bus
13. orange
14. wagon
15. tree
16. broom
17. dog
18. truck
19. ball
20. cup
21. shoe
22. gun
23. stove
24. suitcase
25. boat
26. flag
27. bell
28. pie
29. umbrella
30. bear
31. chicken
32. squirrel
33. lamp
34. fan
35. deer
36. sink
37. skirt
38. jacket
39. mitten
40. belt
41. drum
42. ring
43. pear
44. nail
45. leaf
46. thread
47. fence
48. axe
49. tire
50. chimney
51. bat
52. ladder
53. snake
54. camel
55. bee
56. mountain
57. cone
58. kite
59. feather
60. arrow
61. crayons
62. mouse
63. kangaroo
64. goat
65. nest
66. bicycle
67. ambulance
68. tank
69. caboose
70. letter
71. trunk
72. saw
73. pitcher
74. hook
75. propeller
76. shovel
77. tweezers
78. goggles
79. lobster
80. peacock
81. wasp
82. soldier
83. parachute
84. carriage
85. whip
86. track
87. saddle
88. bucket
89. net
90. spider
91. whale
92. eagle
93. giraffe
94. present
95. coin
96. web
97. hinge
98. dial
99. hydrant
100. train

101. submarine
102. thermos
103. drill
104. globe
105. anchor
106. moose
107. funnel
108. scissors
109. penguin
110. stag
111. iron
112. canteen
113. igloo
114. guitar
115. queen
116. judge
117. Indian
118. well
119. bulb
120. window

APPENDIX II

Imitation Pretest

Imitation Pretest: Instructions for Administration

1. Cue: "Say (label) ."

2. Deliver reward on starred (*) trials approximately 10 seconds after cue regardless of subject's response.

3. Scoring: Check (✓) in appropriate column if subject produces:

    a) correct response: accurate imitation of label

    b) correct response with articulation error: an approximation to the label containing a phoneme substitution, addition, or omission; record exact response

    c) incorrect response: poor approximations to the label containing more than one phoneme substitution, addition, or omission; irrelevant verbalizations or vocalizations; record exact response

    d) no response: no verbalization or vocalization within 10 seconds after cue

PRETEST: IMITATION   Keller/Psychology

SUBJECT: (Steven, Bobby, Wayne, Kelly, Janet)   E: ________

DATE: ________   O: ________

Response Class: ________

		RESPONSE	CORRECT	ARTIC. ERROR	INCORRECT	NO RESPONSE
		chair				
	*	banana				
	*	dog				
5		pie				
		train				
	*	wagon				
	*	broom				
		spoon				
		sink				
10	*	butterfly				
		shovel				
	*	mouse				
		ball				
	*	spider				
15	*	pear				
	*	camel				
	*	cow				
		fence				
		apple				
20	*	table				
Total						

% Correct ________

Reliability ________

PRETEST: IMITATION Keller/Psychology

SUBJECT: Jimmy (S_1) E: ______

DATE: ______ O: ______

Response Class: ______

		RESPONSE	CORRECT	ARTIC. ERROR	INCORRECT	NO RESPONSE
	*	peacock				
		cone				
		bee				
	*	bat				
5	*	leaf				
		spider				
		squirrel				
	*	jacket				
	*	suitcase				
10		tree				
	*	banana				
		cat				
	*	letter				
		orange				
15		bicycle				
	*	deer				
		butterfly				
	*	bulb				
	*	chicken				
20		flag				
Total						

% Correct ______

Reliability ______

APPENDIX III

Labelling Pretest

Labelling Pretest

Materials:

1) 120 pictures from the Peabody Picture Vocabulary Test mounted on 4 x 6 inch index cards

2) Labels assigned to each picture are listed in Appendix I

3) Pictures are grouped in sets of five for testing

Instructions for Administration:

1) Prepare data sheet with random order of 5 receptive and 5 productive trials. Receptive and productive trials for the same picture should not occur consecutively. Star (*) trials on a VT2 schedule.

2) Place 5 pictures on table in front of subject

3) Cues:

   a) Receptive trials: Say "Point to the (label) ."

   b) Productive trials: Point to picture and say "What is this?"

4) Deliver reward on starred (*) trials approximately 10 seconds after cue regardless of subject's response

5) Scoring and recording: see General Procedure

6) Test 3 sets per session. Test each set once on two consecutive days.

APPENDIX IV

Letter to Parents and Consent Form

Ontario

A REGIONAL DEVELOPMENTAL SERVICES CENTRE

Ministry of Community and Social Services

519/471-2540

CPRI
Sanatorium Road,
P.O. Box 2460,
London, Ontario.
N6A 4G6

Mr. & Mrs.
General Delivery
Nanticoke, Ontario

Dear Mr. & Mrs.

Re: ____________

CPRI is currently sponsoring a research program with several children. We are interested in determining what kind of language training procedures are most effective for teaching vocabulary to children with delayed speech. Your child is one who is suitable for this program. No unusual or harmful procedures are involved, but we feel you should be consulted before your child is included. We will try to describe the program in this letter, and I hope you will then grant permission for us to proceed, by filling out the enclosed form and returning it in the stamped-addressed envelope.

In this program, each child will be involved for about twenty minutes, five days a week, for several weeks. He will be taught to respond to pictures with appropriate labels and will be rewarded with food such as cheesies and juice for performing this task. The procedures used in this experiment are like those used in teaching exceptional children at CPRI and elsewhere. It is intended that the children will find the sessions enjoyable, and each should profit from the learning experience.

If you would like more information, the principal experimenter for the project, Dr. Bradley Bucher, will be glad to discuss the work in more detail. Dr. Bucher is a part-time Consultant at CPRI, and an Associate Professor in the Department of Psychology at the University of Western Ontario, specializing in the treatment of behavior problems in children. His telephone number here is 471-2540, Ext. 271.

If you are willing to cooperate in this research, please sign the enclosed form and send it back to us as soon as possible. If later for any reason, you wish to withdraw your agreement, you will be quite free to do so. We will appreciate your cooperation. However, if you do not wish your child to participate, please return the form and indicate this fact and we will not send a second request.

Sincerely,

Bradley Bucher, Ph.D.
Consulting Psychologist

BB:th

Encls.

CONSENT FORM

Date: ____________________

RE: Child concerned: ____________________

Project: ____________________

I consent for ____________________ to participate in the research study described in the attached letter.

I agree: ____________________
Parent or Guardian

I do not agree: ____________________
Parent or Guardian

Attention: Dr. B. Bucher

APPENDIX V

Test for Echolalia

TEST FOR ECHOLALIA Keller/Psychology

SUBJECT: ____________________ E: ____________________

DATE: ____________________ O: ____________________

	Echolalic	Non Echolalic	No Response
1. What's your name?			
2. How old are you?			
3. What day is it today?			
4. Point to the door.			
5. What are you doing?			
6. What's my name?			
7. What do you want to do?			
8. What do you want?			
9. Do you want a (reinforcer)?			
10. Do you want to do out?			
Total			
Percent			

Recording:

Underline words echoed.

Score response (✓) as echolalic, non-echolalic, or no response.

APPENDIX VI

Training Sets for Each Subject

TRAINING SETS

Subject: Jimmy (S_1)

Set 1

1. mountain
2. feather
3. trunk
4. goggles
5. propeller

Set 2

1. pitcher
2. parachute
3. submarine
4. stag
5. bulb

Set 3

1. present
2. tank
3. arrow
4. carriage
5. caboose

Set 4

1. lobster
2. well
3. ambulance
4. hydrant
5. letter

TRAINING SETS

Subject: Steven (S_2)

Set 1

1. bear
2. peacock
3. axe
4. camel
5. eagle

Set 2

1. saddle
2. track
3. hook
4. bucket
5. bat

Set 3

1. spider
2. goat
3. wasp
4. letter
5. skirt

Set 4

1. whip
2. iron
3. mouse
4. kangaroo
5. web

TRAINING SETS

Subject: Bobby (S_3)

Set 1	Set 3
1. kangaroo	1. camel
2. goat	2. snake
3. mouse	3. peacock
4. fence	4. squirrel
5. clown	5. caboose

Set 2	Set 4
1. leaf	1. nest
2. pitcher	2. bee
3. chimney	3. umbrella
4. belt	4. chicken
5. suitcase	5. wasp

TRAINING SETS

Subject: Wayne (S_4)

Set 1	Set 3
1. eagle	1. funnel
2. coin	2. whale
3. pitcher	3. anchor
4. globe	4. wasp
5. axe	5. tank

Set 2	Set 4
1. hinge	1. sock
2. hydrant	2. saddle
3. canteen	3. net
4. feather	4. moose
5. dial	5. arrow

TRAINING SETS

Subject: Kelly (S_5)

Set 1

1. iron
2. net
3. camel
4. soldier
5. axe

Set 2

1. Indian
2. tank
3. drill
4. arrow
5. bucket

Set 3

1. web
2. tweezers
3. moose
4. wasp
5. funnel

Set 4

1. track
2. hinge
3. fan
4. saddle
5. canteen

TRAINING SETS

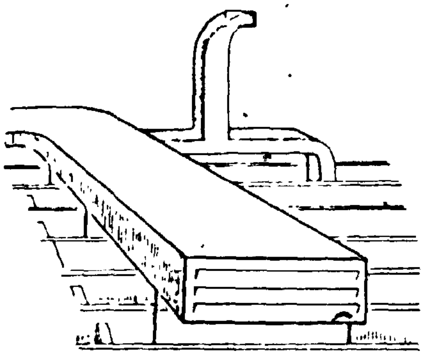
Subject: Janet (S_6)

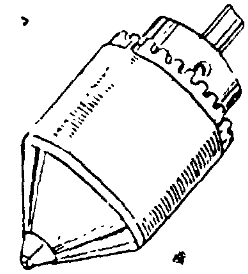
Set 1	Set 3
1. camel	1. tank
2. giraffe	2. whale
3. tweezers	3. igloo
4. caboose	4. soldier
5. nest	5. peacock

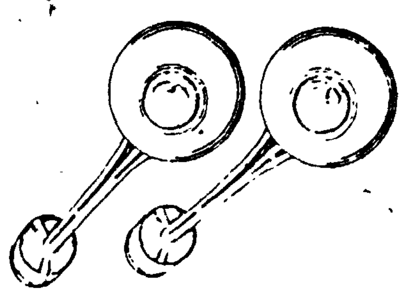
Set 2	Set 4
1. bear	1. dial
2. eagle	2. canteen
3. fence	3. thread
4. anchor	4. hydrant
5. track	5. thermos

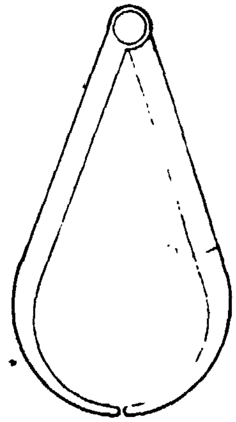
APPENDIX VII

Ambiguous Pictures









APPENDIX VIII

Sample Data Forms

SUBJECT: WAYNE E: JMC

DATE: JAN. 30th S# 36-3 O: ________

Condition: (R) 1 (2) 3 E 1 2 3 I II (III) IV V VI T RP (P)

	R		E		
R	WHALE	✓			
E			FUNNEL	✓	
E			WASP	X BEE	
R	ANCHOR	✓			
E			WHALE	X FUNNEL	
R	FUNNEL	✓			
R	TANK	X A			
E			ANCHOR	X CANTEEN	
E			TANK	✓	
R	WASP	X ANCHOR			
Total					

% Correct ________

Reliability ________

SUBJECT: WAYNE E: JMC

DATE: JAN 30th/76 S#36-1 O:

Condition: (R) 1 2 3 E 1 2 3 I II (III) IV V VI (T) (RP) P

		FUNNEL	WHALE	ANCHOR		
	R			X		
	E			✓		
	E			✓		
	R			✓		
5	E			✓		
	R			✓		
	R	(✓)				
	E		(✓)			
	E			(✓)		
10	R		(✓)			
		(✓)				
				(✓)		
		(✓)				
				(✓)		
15			(X)			
		(✓)				
			(✓)			
				(✓)		
			(✓)			
20				(✓)		
Total		(X)				

% Correct ______

Reliability ______