

AN EXPERIMENTAL ANALYSIS OF COMPREHENSION AND PRODUCTION IN CHILDREN'S ACQUISITION OF MORPHOLOGICAL RULES

Gary Holdgrafer,
University of Alberta

Leija McReynolds,
University of Kansas Medical Center
Kansas City, Kansas

RESUME

A quatre enfants normaux on a enseigné une règle morphologique inventée qui contrastait **peu** et **beaucoup** («few» et «many») de noms pluraux pour la compréhension en même temps que pour la production. Ensuite la règle à été renversée dans l'une modalité et puis dans l'autre, pendant l'instruction simultanée des deux modalités. Chaque condition d'instruction comprenait l'instruction continue de paire substantives, l'un des substantifs enseigné pour la compréhension, et l'autre pour la production. Par des épreuves de la modalité non enseignée de chaque substantif enseigné, et des deux modalités de chaque substantif non enseigné, on a essayé de déterminer si les sujets choisiraient d'apprendre par la compréhension ou la production pour étendre une règle. Les résultats pour tous les sujets ont indiqué qu'après l'acquisition d'une règle dans les épreuves. Les sujets n'ont renversé la règle dans les deux modalités que pour les substantifs enseignés directement dans le renversement de la règle dans l'une ou l'autre modalité. Ainsi la compréhension et la production ont fonctionné comme unité intégrale pour ces

Correspondence should be directed to:

Gary Holdgrafer,
Division of Speech Pathology and Audiology
School of Rehabilitation Medicine
Corbett Hall
University of Alberta
Edmonton, Alberta CANADA
T6G 2G4

sujets-ci dan l'application d'une règle ou du renversement d'une règle. Les résultats ont été reproduits par une seconde règle morphologique inventée avec un seul sujet.

ABSTRACT

Four normal children were taught a contrived morphological rule contrasting **Few** and **Many** of plural nouns simultaneously in comprehension and production. The rule was then reversed in one modality and then the other modality during simultaneous training of both modalities. Each training condition involved the sequential training of noun pairs with one noun being trained in comprehension and the other noun in production. Probes of the untrained modality of each noun trained and of both modalities of untrained nouns were administered to determine if subjects would choose comprehension or production learning for extending a rule. Results for all subjects indicated that after rule acquisition in both modalities, rule reversal training in either comprehension or production was not sufficient to reverse the rule on the probes. Subjects reversed the rule in both modalities for only those nouns trained directly in rule reversal in one or the other modality. Thus comprehension and production functioned as an integral unit for these subjects in applying a rule or rule reversal. The results were replicated across a second contrived morphological rule with one subject.

The roles of comprehension and production in children's language learning constitute a controversial issue. Evidence summarized by Sherman (1971) demonstrated that production training of simple grammatical responses, using imitation and differential reinforcement, resulted in "rule governed" or "generative" productive speech in language deficient subjects.

In contrast, Winitz and Reeds (1972) view language learning as a comprehension based process. They deliberately avoid production practice in the design of their language training procedures. According to Winitz and Reeds, production of grammatical responses would develop from comprehension of those grammatical responses. Direct training of production would be of little value in language learning.

The studies reviewed by Sherman did not discuss or assess the possible effects of production training on the subject's comprehension of the language responses trained. The development of comprehension appears to be an implicit component of the production via imitation training (Ruder, Smith and Hermann, 1974). Subjects must abstract the regularities present in the modeled stimuli and relate them to a referent prior to spontaneous production (Whitehurst, in press).

Guess and Baer (1973) have investigated the effects of comprehension training of language responses on subjects' production of those responses and vice versa. They taught four mentally retarded subjects the plural morpheme simultaneously in production (via imitation) and comprehension but with different allomorphs in each modality (i.e., /s/-/es/). Subjects were trained to name singular and paired objects (e.g., cup-cups) and to point to singular and paired objects (e.g., watch-watches) in response to singular and plural labels spoken by the experimenter. Comprehension and production probe trials were inserted into the production and comprehension training trials, respectively, to determine if correct use of the allomorphs would emerge in the untrained modalities. The results showed that either type of training resulted in intra-modality, generative performance. Subjects extended the plural rule taught in each modality to untrained exemplars in that modality, but, except for one subject, did not adopt the rule on exemplars in the untrained modality.

Guess and Baer successfully demonstrated that children can acquire at least simple generative language behavior with **either** a comprehension **or** production training procedure. Unfortunately, the particular rule did not extend readily to the untrained modality. Such results fail to clarify if one or the other type of learning (comprehension or production) plays the primary role in children's eventual comprehension **and** production of novel utterances. The Guess and Baer study seems to suggest, as does an earlier study (Guess, 1969) that comprehension and production are independent classes of behavior.

Procedures used to study modality inter-relationships (Guess, 1969; Guess and Baer, 1973) involve training a language rule in one modality and assessing the emergence of that rule in the other modality. That is, the modality in which a rule is initially learned is controlled by the experimenter. Restriction of a child's language learning to one modality is probably quite unlike the natural environment where, for example, children have the opportunity to repeat parental models and to respond to a variety of commands. Moreover, requiring a child to adopt one modality for language learning to the exclusion of the other may preclude correct use of a rule in the untrained modality unless the experimenter makes that strategy explicit for the subject. Guess and Baer found that their subjects did generalize across modalities when probe responses were reinforced.

In the present study, young normal children were taught the identical morphological rule simultaneously in comprehension and production. Thus, the subjects' trained acquisition of a rule was not restricted to one modality as in the Guess and Baer study. When generative use of the morphological rule was established in the subjects' comprehension and production modalities, a contradiction was created between modalities in applying the rule. The rule was reversed in one modality and then the other modality during simultaneous training of both modalities. The purpose of the present study was to provide

children a relatively unrestricted opportunity to demonstrate the type of learning they rely on when both types are made available to them. That is, in the face of contradictory information between the two modalities, would children choose comprehension or production as the basis for extending a rule to **both** comprehension and production of probe items?

METHOD

Subjects and Experimental Setting

The subjects for the study were four normal girls ranging in age from 3 years, 4 months to 3 years, 11 months. Their mental ages on Form B of the Peabody Picture Vocabulary Test ranged from five to 16 months above their chronological ages. All subjects were from middle class backgrounds in Lawrence, Kansas, and had normal developmental histories. A child size table and chairs were present in the experimental setting. The experimenter sat at the subject's right side, thus minimizing any facial cues (e.g., experimenter looking at correct picture on comprehension trials).

Morphological Rules and Stimulus Materials

Two morphological rules were contrived for the study. Rule 1 was a **Few-Many** contrast of plural nouns where the plural label for **Many** was inflected with the morpheme /pa/ (e.g., Few: cats; Many: catspa).

Fifteen monosyllabic, CVC nouns ending in /p/, /t/ or /k/ were used (see Table 1). Each noun was illustrated in a separate black and white picture as **Few** (two, three or four instances of a noun) and **Many** (eight, nine or ten instances of a noun).

Table 1

Comprehension, production and novel noun stimuli for Rule 1 and Rule 2.

| Comprehension | | Production | | Novel Nouns | |
|---------------|-------------|--------------|-------------|--------------|-------------|
| Rule 1 | | | | | |
| <u>Few</u> | <u>Many</u> | <u>Few</u> | <u>Many</u> | <u>Few</u> | <u>Many</u> |
| cats | catspa | coats | coatspa | pipes | pipespa |
| caps | capspa | cups | cupspa | boots | bootspa |
| boats | boatspa | bats | batspa | bikes | bikespa |
| mops | mopspa | tops | topspa | | |
| ducks | duckspa | books | bookspa | | |
| kites | kitepa | goats | goatspa | | |
| Comprehension | | Production | | Novel Nouns | |
| Rule 2 | | | | | |
| <u>Small</u> | <u>Big</u> | <u>Small</u> | <u>Big</u> | <u>Small</u> | <u>Big</u> |
| cow | cowat | pig | pigat | soap | soapat |
| dog | dogat | horse | horseat | comb | combat |
| gun | gunat | ball | ballat | pan | panat |
| bus | busat | purse | purseat | | |
| fork | forkat | knife | knifeat | | |
| bed | bedat | bird | birdat | | |

Original colored pictures of each noun were taken from the Peabody Language Development Kit. They were xeroxed several times at one half their original size. Each copy was cut out around its outline and the number of instances corresponding to **Few** and **Many** were mounted on 8½ by 11 inch white bond paper and xeroxed to provide the two picture stimuli for each noun. Twelve of the plural nouns were organized into six noun pairs. One noun was assigned to comprehension training (e.g., cats) and the other noun to production training (e.g., coats). An attempt was made to equalize words assigned to each type of training with respect to their phonemic characteristics and general classifications (e.g., animals, toys, etc.). The three remaining nouns were not assigned to either type of training. They served as a special purpose probe to assess subjects' performance on nouns never presented in training (i.e., novel nouns).

Rule 2 was a **Big-Small** contrast of singular nouns where the label for the bigger of two instances of a given noun was inflected with the morpheme /at/ (e.g., Small: cow; Big: cowat). Stimuli were constructed and organized in a similar manner to the stimuli for Rule 1.

Comprehension and Production Trials

A comprehension trial throughout the study consisted of the experimenter placing the two picture stimuli for a given noun (e.g., cats) in front of the subject and saying "Show me (e.g., catspa)". Only one response was requested per trial. The subject indicated her choice by placing her finger on either the **Few** or **Many** picture. The experimenter recorded the response on a score sheet as F or M, respectively.

A production trial throughout the study consisted of the experimenter placing the two picture stimuli for a given noun (e.g., coats) in front of the subject. The experimenter then placed his finger on one of the pictures and said "What do you see?" The subject responded with either an inflected (e.g., coatspa) or uninflected¹ (e.g., coats) verbal label. Responses were recorded as **spa** or **s**, respectively on the score sheet.

Preliminary Testing and Training

All subjects received training on Rule 1. Prior to training, an imitative pretest was administered to each subject to determine if she could articulate the inflected verbal response (e.g., coatspa) so it would be easily distinguished from the uninflected response form (e.g., coats). The imitative pretest for Rule 1 consisted of 15 nonsense stimuli constructed by deleting the initial consonant from each of the 15 plural noun labels and adding the morpheme /pa/ (e.g., cats/atspa). The experimenter instructed the subject to "Say what I say" and then spoke each of the fifteen items for the subject to imitate. All subjects were able to produce the morpheme easily in phonetic contexts similar to the noun stimuli.

Because the **Few-Many** morphological rule was superimposed upon the English plural rule, it was necessary to pretest subjects to insure that they possessed that rule in comprehension and production. The singular-plural pretest was comprised of the same 15 nouns used for Rule 1. Each noun was pictured as a singular instance (e.g., one cat) and in pairs (e.g., two cats). The experimenter presented each pair of pictures, asking for the singular label for some nouns and the plural label for others. Each pair of pictures was presented a second time to obtain a response for the picture in a pair (e.g., plural instance) that was not tested during the first presentation. The same procedure was employed for comprehension testing except that the subject was asked to point to one of the pictures in a pair.

If a subject was unable to give the appropriate noun label for a given noun (e.g., toy for top), it was excluded from the pretest. All subjects provided the appropriate noun label for at least ten of the 15 nouns and used the correct singular and plural forms on the production pretests. They also responded correctly on the comprehension pretest for those nouns when the singular and plural forms were spoken by the experimenter. No consequences were given for any pretest responses.

A short period of pretraining was conducted to teach the subjects the labels of the nouns excluded from the pretest. The pictures of the singular instances only were presented and the correct label modeled for the subject to imitate. The pictures were then interspersed with the other singular pictures and the subject was asked to name each one when it was presented to her. Incorrect labelling or no response by the subject was followed by an imitative prompt. Correct labelling responses were conequated with praise ("Good"). When a subject had successfully provided the correct labels for three successive presentations of the 15 nouns, pretraining on singular labels was terminated. No more than one 20 minute session was required for any subject.

Baselines

Because the morphological rules were contrived they could not already have existed in the subjects' speech. A production baseline was administered to insure that subjects consistently provided the correct plural label for each **Few** and **Many** picture. The picture pairs (**Few** and **Many**) for each of the 15 nouns were presented four times in succession in the same order. Trials were varied systematically so that if the **Few** picture of a noun was tested during one series of 15 trials, the **Many** picture was tested in the following series of 15 trials and vice versa. The position (left or right) of the test picture before the subject was also varied. Each **Few** and **Many** picture was tested twice for each plural noun for a total of 60 trials.

A similar procedure was used for the comprehension baseline. The comprehension baseline was administered to demonstrate chance level responding

to the pictures. The experimenter spoke the uninflected and inflected labels associated with **Few** and **Many**, respectively, and recorded the subject's pointing responses. No consequence was provided for responses on either baseline. All subjects gave the plural label (e.g., "cats") for both the **Few** and **Many** pictures for each noun. They were correct in response to all **Few** pictures or 50% of the production trials. Correct responses on the comprehension baseline ranged from 42% to 55%.

Training Conditions

Three training conditions followed baseline measures. Table 2 illustrates the experimental design for Rule 1.

Table 2

Sequence of experimental conditions for Rule 1.

| Condition I Training | Condition II Training | Condition III Training |
|------------------------------|---|--------------------------------------|
| <u>Comprehension Stimuli</u> | <u>Comprehension (REVERSED) Stimuli</u> | <u>Comprehension Stimuli</u> |
| "(-)s" "(-)spa" | "(-)s" "(-)spa" | "(-)s" "(-)spa" |
| <u>Response</u> | <u>Response</u> | <u>Response</u> |
| Few Many | Many Few | Few Many |
| <u>Production Stimuli</u> | <u>Production Stimuli</u> | <u>Production (REVERSED) Stimuli</u> |
| Few Many | Few Many | Few Many |
| <u>Response</u> | <u>Response</u> | <u>Response</u> |
| "(-)s" "(-)spa" | "(-)s" "(-)spa" | "(-)spa" "(-)s" |

Condition I. The purpose of Condition I was to establish Rule 1 in the subjects' comprehension and production modalities. The subject pointed to **Few** in response to an uninflected stimulus (e.g., "cats") and to **Many** in response to an inflected stimulus (e.g., "catspa"). The subject named **Few** with an uninflected response (e.g., "coats") and **Many** with an inflected response (e.g., "coatspa").

Condition II. Rule 1 was **reversed** in comprehension. The subject now pointed to **Many** in response to an uninflected stimulus (e.g., "cats") and to **Few** in response to an inflected stimulus (e.g., "catspa"). A correct response in comprehension was now the exact opposite of a correct response in production. Rule 1 was maintained in production. The purpose of Condition II was to provide subjects with contradictory information about rule application in comprehension and production to determine if they would respond on probes as trained in one modality or the other.

Condition III. Rule 1 was **reversed** in production. The subject named **Few** with an inflected response (e.g., "coatspa") and **Many** with an uninflected response (e.g., "coats"). Rule 1 was re-trained in comprehension. The subject now pointed to **Few** in response to an uninflected stimulus (e.g., "cats") and to **Many** in response to an inflected stimulus (e.g., "catspa") as she had in Condition I. The purpose of this condition was to replicate the findings of Condition II but with the rule reversal in the opposite modality. That is, would subjects respond on probes as trained in comprehension or production?

Subject 4 received rule reversal training in production first. She served as a control for counterbalancing of reversal conditions to determine if order of reversal conditions might influence results.

Each condition involved the successive training of the same sequence of noun pairs presented in Table 1. One noun pair at a time was trained to criterion. One noun (e.g., cats) was trained in comprehension and the other noun (e.g., coats) was trained in production. A production and comprehension probe was administered when training criterion for a noun pair was achieved. Following the probe, another noun pair was trained to criterion and the production and comprehension probe was again administered. This sequence of noun pair training and probes was continued until a maximum of all six noun pairs were trained and six probes administered in each condition.

Probes

The probes were identical to the baselines except that pipes, boats and bikes were excluded and each **Few** and **Many** picture was tested once instead of twice in production and comprehension. The three novel nouns were probed **only** in the final production and comprehension probes in Conditions II and III to assess performance on nouns that had not been trained and to which the subjects had had little exposure in the experimental procedures. The production probe was always administered first. Responses on the probes were not consequted.

The production probe assessed 1) **maintenance** of the trained production responses (e.g., "coats-coatspa") and production performance on the remaining

nouns designated for production training and 2) production performance on the trained comprehension nouns (e.g., cats-catspa) and on the remaining nouns designated for comprehension training. In other words, all twelve nouns were tested including those trained in production or comprehension.

The comprehension probe assessed 1) **maintenance** of the trained comprehension responses (e.g., **Few**: cats; **Many**: catspa) and comprehension performance on the remaining nouns designated for comprehension training and 2) comprehension performance on the trained production nouns (e.g., coats-coatspa) and on the remaining nouns designated for production training. In other words, all twelve nouns were tested including those trained in production or comprehension.

Condition I was terminated when a subject had demonstrated "generative" language. This was defined as at least 90% correct performance in production and comprehension of untrained probe items (responses in the untrained modality of the trained nouns and in both modalities of nouns not yet trained) following completion of training for any noun pair.

Reliance on either type of learning on any probe during rule reversal conditions (II and III) was defined by at least 90% rule reversal **or** maintenance of Rule 1 in the untrained modality of trained nouns and in both modalities of nouns not yet trained in those conditions. That is, the subject had to either apply the reversed rule to 90% of the untrained probe items or Rule 1. All six noun pairs were trained in Conditions II and III to determine if the subjects' modality reliance would remain consistent.

Training Procedures

Sessions. Subjects were seen for sessions four and five days per week. A session consisted of 100 trials divided into five sets of 20 trials. Within each set of 20 trials, there were 10 comprehension and 10 production trials. Each trial was varied systematically for 1) type of trial (comprehension or production), 2) inflected or uninflected with /pa/ and 3) position in which the corresponding picture was placed in front of the subject (left or right).

In order to expedite the acquisition of the contrived morpheme, the initial training sets for each new noun pair contained more inflected than uninflected trials. The proportion of trials was gradually changed each time the subject achieved at least 90% performance on a set until there was an even amount of inflected and uninflected trials. A set of 20 trials for each additional noun pair trained included four review trials for previous noun pairs trained in that condition.

Correction procedures. If a subject made no more than two errors (18 to 20 correct) on a set, she was responding at the required 90% criterion level and there was no need to introduce correction procedures. A correction procedure was introduced on the third error and on any subsequent error in a set.

The correction procedure for an error on a comprehension trial consisted of the experimenter pointing to the correct picture, naming it, and asking the subject to point again (e.g., "This is catspa . . . show me catspa"). For production errors, the experimenter pointed to the picture on which the error occurred and gave the subject an imitative prompt (e.g., "Say coatspa").

Reinforcement procedures. During training, correct responses were consequted initially on a fixed-ratio 1 schedule of reinforcement with social praise (e.g., "good", "right") and a marble dropped into a plexiglass cylinder. Marbles were exchangeable for plastic tokens used to purchase candy and small toys. Consequation was shifted to a fixed-ratio 3 schedule of reinforcement when a subject achieved a 90% or better performance for three consecutive sets of 20 trials having an equal proportion of inflected and uninflected trials. The probes were administered when a subject achieved a 90% or better performance for three consecutive sets on the fixed-ratio 3 schedule.

Rule 2. Subjects 1 and 2 received training on Rule 2 as an attempt to extend findings on Rule 1 across a second language behavior. The imitative pretest, baseline, training and probe procedures were similar to those for Rule 1. Both subjects gave the correct noun label (e.g., cow, pig, etc.) for both the **Big** and **Small** pictures or 50% of the production baseline trials. Neither subject was above chance level on the comprehension baseline (34% and 47%).

Reliability

Reliability measures were obtained during baselines and during one criterion session and subsequent production and comprehension probes in each of the three training conditions. Observer scoring of responses was compared item by item with the experimenter's scoring. There was 100% agreement except for one item! It was on a production training trial for Subject 1 on Rule 2.

RESULTS

Condition I Results for Rule 1

The purpose of Condition I was to establish Rule 1 in the subjects' comprehension and production modalities. Condition I was terminated when a subject was at least 90% correct in production and comprehension of untrained probe items. Table 3 shows the number of noun pairs trained for each subject prior to reaching probe criterion as well as the percentage of Rule 1 response on each probe subsequent to training each noun pair. The percentage of Rule 1 responses on successive probes shows faster rule acquisition in comprehension for the first three subjects. Subject 4 showed little generative effect of the training through the first two probes.

Table 3

Number of noun pairs trained for each subject in Condition I and the percentage of Rule 1 responses on each probe subsequent to training each noun pair.

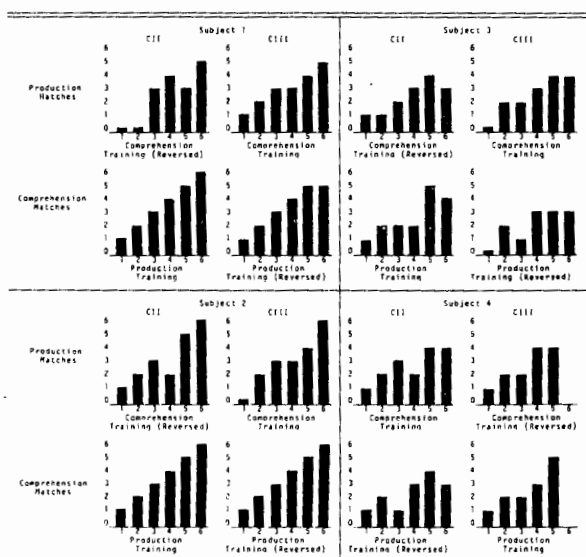
| Subjects | Noun Pairs Trained | Production Probe | Comprehension Probe |
|----------|--------------------|------------------|---------------------|
| S1 | 1) cats-coats | 1) 59% | 1) 95% |
| | 2) caps-cups | 2) 100% | 2) 100% |
| S2 | 1) cats-coats | 1) 55% | 1) 55% |
| | 2) caps-cups | 2) 60% | 2) 85% |
| | 3) boats-bats | 3) 94% | 3) 100% |
| S3 | 1) cats-coats | 1) 50% | 1) 55% |
| | 2) caps-cups | 2) 60% | 2) 60% |
| | 3) boats-bats | 3) 56% | 3) 61% |
| | 4) mops-tops | 4) 69% | 4) 88% |
| | 5) ducks-BOOKS | 5) 100% | 5) 100% |
| S4 | 1) cats-coats | 1) 55% | 1) 59% |
| | 2) caps-cups | 2) 55% | 2) 70% |
| | 3) boats-bats | 3) 94% | 3) 94% |

Probe Results for Rule 1 Reversal Conditions

The effect of rule reversal training on probe items for all subjects was evident in the untrained modality only of each noun trained in rule reversal. Table 4 illustrates that effect for each of the four subjects in Conditions II and III. The sequence of nouns trained in each modality is represented on each abscissa by the numbers 1-6. The numbers 1-6 on each ordinate represent the subjects' responses in the untrained modality of those same nouns on each successive probe. These responses are expressed as "matches" meaning that subjects responded in the untrained modality of a noun as they had been trained in the opposite modality (i.e., with Rule 1 or rule reversal).

Table 4

Modality matching performance for the four subjects on the six nouns trained in each modality in both rule reversal conditions for Rule 1.



The bars on each graph indicate the number of modality matches that occurred on the nouns that had been trained (e.g., after comprehension rule reversal training on **cats**, **caps** and **boats**, a subject might reverse the rule in production for two of the three nouns). As each of the six nouns (e.g., **cats**, **caps**, etc., in comprehension) were trained in rule reversal, the subjects reversed the rule in the opposite modality of only those same nouns on the subsequent probes. Rule reversal training in either comprehension or production failed to result in rule reversal criterion on the probes.

Subject 1 had zero production matches on the first two nouns (**cats**, **caps**) trained in comprehension rule reversal in Condition II. Her production responses on probes for those two nouns represented a failure to apply any rule. She gave the same label for the **Few** and **Many** pictures of those two nouns (e.g., catspa, caps). On the two subsequent probes (three and four) Subject 1 reversed the rule in production of each noun trained in comprehension rule reversal. She matched production to comprehension for each noun trained (i.e., three nouns trained, three production matches; four nouns trained, four production matches). On the fifth probe, Subject 1 had three production matches of the five nouns trained. She gave the same label (e.g., duckspa) for the **Few** and **Many** pictures of the remaining two trained nouns. On the final probe, Subject 1 reversed the rule on five of the six nouns trained in comprehension rule reversal (i.e., six nouns trained, five production matches). She again failed to apply any rule in the production of one noun.

Subject 1 consistently matched comprehension to production on each successive comprehension probe of the nouns being trained in production of Rule 1. She applied Rule 1 in the comprehension of each of those six nouns.

In Condition III, Subject 1 received rule reversal training in production and retraining of Rule 1 in comprehension. She consistently reversed the rule in comprehension of each noun (e.g., coats) trained in production rule reversal through the first five probes. For each noun trained, Subject 1 matched comprehension to production (i.e., one noun trained, one comprehension match; two nouns trained, two comprehension matches, etc.) On the final probe, she reversed the rule in comprehension of five of the six nouns trained in production rule reversal and applied Rule 1 in comprehension of the remaining noun.

Comprehension nouns retrained on Rule 1 and production matches were equal for Subject 1 through the first three probes. On the final three probes she had one less production match than the number of nouns trained in comprehension (e.g., four nouns trained, three production matches). Subject 1 applied no rule in production of one trained comprehension noun on each of those successive probes.

The performance of Subject 2 was very similar to that of Subject 1. She reversed the rule only in production of each noun (i.e., production match)

trained in comprehension rule reversal in Condition II (except on the fourth probe where she applied no rule in production of two of four nouns trained in comprehension rule reversal). In Condition III, Subject 2 consistently reversed the rule in comprehension of each noun (i.e., comprehension match) trained in production rule reversal. She also matched production to comprehension of nouns retrained on Rule 1.

Subject 3 demonstrated more variability in modality matching than the previous two subjects. She either reversed the rule or applied no rule in the production of nouns trained in comprehension rule reversal in Condition II. On the final probe, Subject 3 matched production to comprehension on three of the six nouns trained. She applied Rule 1 or no rule (i.e., pointed to the same picture in response to inflected and uninflected stimuli) in comprehension of nouns trained in production of Rule 1. The fifth probe in Condition II has the greatest similarity to the performance of Subjects 1 and 2. Subject 3 had production matches on four of five nouns trained in comprehension rule reversal and comprehension matches on all five nouns trained in production of Rule 1.

In Condition III, Subject 3 either reversed the rule or applied no rule in comprehension of nouns trained in production rule reversal. She also either applied Rule 1 or no rule in production of comprehension nouns retrained on Rule 1. Subject 3's performance in the untrained modality of the 12 training nouns suggests an apparent confusion in rule application resulting from the simultaneous contradictory training.

Subject 4 received rule reversal training in production in Condition II. Similar to Subject 3, she showed an apparent confusion in rule application in the untrained modality of the training nouns. Her comprehension performance on nouns trained in production rule reversal was varied. She reversed the rule (i.e., comprehension match), applied no rule or applied Rule 1. Subject 4 either applied Rule 1 or no rule in production of comprehension nouns trained on Rule 1. The fifth probe shows the greatest similarity to the performance of the other subjects. Subject 4 had modality matches on four of five nouns trained in each modality. Subject 4 went on summer vacation prior to completing Condition III. Her performance shows a more consistent pattern of modality matching than in Condition II. On the fifth (and final) probe, she had production matches on four of five nouns trained in comprehension rule reversal and comprehension matches on all five nouns retrained in production of Rule 1.

Probe Results on Novel Nouns for Rule 1

Table 5 contains the comprehension and production responses of the four subjects on the three novel nouns presented after completion of each rule reversal condition. Subjects could apply Rule 1 (R1), rule reversal (RR) or no rule (NR) for each noun.

Table 5

Subjects' responses in both modalities of the three novel nouns following each rule reversal condition.

| Subjects | CII | | CIII | |
|----------|------------|---------------------------|------------------------|---------------|
| | Production | Reversed Comprehension | Reversed Production | Comprehension |
| S1 | | | | |
| pipes | RI | RI | NR | RI |
| boots | RI | RI | RI | RI |
| bikes | NR | RI | RR | RI |
| S2 | | | | |
| pipes | RI | RI | RI | RI |
| boots | RI | RI | RI | RI |
| bikes | RI | RI | NR | RI |
| S3 | | | | |
| pipes | RI | RI | RR | RI |
| boots | RI | RI | RI | NR |
| bikes | NR | RI | RI | RI |
| S4 | | | | |
| pipes | RI | RI | RI | RI |
| boots | RI | RR | RI | RI |
| bikes | RI | RI | RI | RI |

RI = Rule I
RR = Rule Reversal
NR = No Rule

Responses for all subjects were primarily applications of Rule 1 in comprehension and production. Rule reversal training in either modality had little effect on the subjects' performance on novel nouns.

Condition I Results for Rule 2

Subjects 1 and 2 received training on Rule 2 in an attempt to extend the findings from Rule 1 across a second language behavior. Subject 1 again showed faster rule acquisition in comprehension. She reached comprehension probe criterion after training on two noun pairs and production probe criterion after training on four noun pairs. Subject 2 reached comprehension probe criterion after training on one noun pair. Training on each subsequent noun pair failed to result in production rule acquisition and furthermore, Subject 2's performance in comprehension deteriorated to chance level in the final three probes. Failure to meet probe criterion is in striking contrast to her very consistent performance in Rule 1 training. She simply failed to exhibit rule performance

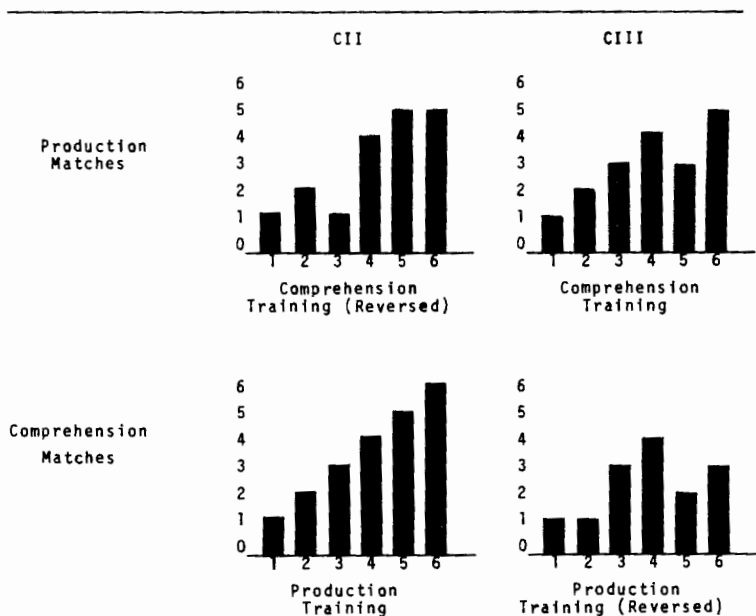
in the absence of reinforcement on the probes. Subject 2 was dismissed from further experimentation.

Probe Results for Rule 2 Reversal Conditions

Table 6 contains the probe results for Subject 1 in each rule reversal condition. Her performance on Rule 2 was similar to the performance of all subjects on Rule 1. Across the six probes in Condition II, Subject 1 either reversed the rule in production (i.e., production match) of each noun only after it was trained in comprehension rule reversal or she applied no rule. She consistently matched comprehension to production on each successive comprehension probe of the nouns being trained in production of Rule 1. In Condition III, Subject 1 showed nearly perfect modality matching for the first four nouns as each was trained successively in each modality. Her comprehension matching of nouns trained in production rule reversal varied on the final two probes. She reversed the rule, applied no rule or applied Rule 1. Except for one No Rule production response, Subject 4 applied Rule 2 in the production and comprehension of the three novel nouns after both rule reversal conditions.

Table 6

Modality matching performance for Subject 1 on the six nouns trained in each modality in both rule reversal conditions for Rule 2.



Training results in Condition I suggest that, given equal exposure to a rule in each modality, more exemplars are required for children to acquire a morphological rule in production than are required in comprehension. The difference between modalities in rule acquisition is minimal, however, in view of the rapid rule acquisition for these subjects.

The general question of the study was whether young normal children rely on production or on comprehension learning to extend a morphological rule to comprehension and production responses not directly trained. In other words, can either a comprehension or production procedure alone account for children's generative language behavior in both modalities?

As demonstrated by each subject on Rule 1 and replicated by Subject 1 on Rule 2, rule reversal in neither comprehension nor production resulted in rule reversal criterion performance on the probes (at least 90% rule reversal on all untrained probe items). In addition, subjects typically applied the original rule (Rule 1 or 2) in both modalities of the three novel nouns regardless of which modality was trained in rule reversal. It appeared that rule reversal training in one or the other modality was not sufficient to reverse the original rule established in both modalities. In essence, reversing the rule on any noun resulted in that noun being treated by subjects as an exception to the original rule. That is, subjects did not reverse the rule on any noun without direct training in one or the other modality.

The subjects responded in production of a noun as trained in comprehension of that noun and vice versa. Although the results from Subjects 3 and 4 are not as consistent as those of Subjects 1 and 2, they suggested the same pattern of responding. Thus, comprehension and production appeared to function as an integral unit for subjects in applying a rule or rule reversal to any given noun.

The present study raises some doubt that children's acquisition of generative language can be attributed solely to linguistic information acquired in a single modality. The failure of rule reversal training in either modality to generate rule reversal on the probes suggest that subjects perhaps relied upon both types of training during initial rule acquisition.

The procedures of this study provided equal exposure or practice in each modality in order to eliminate amount of exposure as a variable influencing the subjects' modality reliance. In other words, it is possible that children would rely on the modality to which they were most frequently exposed. The amount of exposure or practice in each modality may be a variable influencing children's modality reliance in the natural environment and should be investigated systematically within the present procedures.

The subjects of this study are an additional consideration in discussing the results. All subjects were developing at least normally in linguistic ability.

They already possessed at least one morphological rule (plural morpheme) on which they had undoubtedly had considerable comprehension and production experience. Consequently, the level of comprehension and production skill of these subjects may have precluded any reliance on a single modality in acquiring an additional morphological rule.

In contrast to the findings of Guess (1969) and Guess and Baer (1973) the present subjects showed an interdependence of modalities in applying rules and rules reversals to specific nouns regardless of which modality was trained. Subject 1 and 2 demonstrated modality interdependence to a greater degree than the other two subjects. Modality independence would have been demonstrated if subjects had applied the rule as trained in production (e.g., Rule 1) to all production probe items and the rule as trained in comprehension (e.g., rule reversal) to all comprehension probe items. In other words, there would have been a contradiction in rule application between modalities on the same nouns.

Modality independence was found by Guess and Guess and Baer with severely language deficient subjects. Those findings may reflect the type of procedures employed as suggested earlier, however, it may also be that modality interdependence is a function of the level of linguistic development of the subjects studied. The children in the present study responded in a systematic fashion when confronted with contradictory information about rule application between modalities. Similar experimental procedures should be extended to subjects who are less advanced linguistically to explore whether modality independence might be a function of linguistic ability rather than experimental procedures. That is, those subjects might demonstrate modality independence regardless of what procedure is employed. As such, the developmental relationship between modalities may be as Premack and Premack (1974) have suggested. Comprehension and production may be independent initially but complete interdependence of modalities may emerge during the course of language development.

FOOTNOTE

¹The term **uninflected** is used simply to indicate that the contrived inflection was not added to the normal English plural label form.

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