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The Role of Modeling and Automatic Reinforcement in the Construction of the Passive Voice

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Language acquisition has been a contentious topic among linguists, psycholinguists, and behaviorists for decades. Although numerous theories of language acquisition have surfaced, none have sufficiently accounted for the subtleties of the language that children acquire. The present study attempts to explain the role of modeling and automatic reinforcement in the acquisition of the passive voice. Six children, ages 3 to 5, participated in this study. The results indicated that the children began using the passive voice only after the experimenter modeled passive sentences. Furthermore, the usage of the passive voice increased with repeated exposure to the experimenter's verbal behavior. Given that the children were not explicitly reinforced, it is proposed that their behavior was automatically reinforced for using the passive voice.

Key words: verbal behavior, modeling, automatic reinforcement, joint control.

Language acquisition has been a perplexing topic for many psycholinguists in the last several decades. Although several theories have surfaced, one widespread theory posits that imitation plays a crucial role in language acquisition (Guess, Sailor, Rutherford, & Baer, 1968; Sherman 1971; Whitehurst, 1972; Whitehurst & Novak, 1973). Positions on this contentious issue range from the assertion that imitation is required for language acquisition (Bandura & Harris, 1966) to the notion that imitation serves no function (Ervin, 1964). Although there has been ample research examining the effects of imitation on language acquisition, opponents argue that the theory insufficiently accounts for novel utterances and grammatical features of much of child speech. As Slobin (1968a) suggests, "[I]f a child were to spend a lifetime imitating the sentences he heard we could never account for the outstanding ability of every human being to speak and understand sentences he has never heard before . . . "(p. 437).

Chomsky (1980) proposes that an innate neural module selected by evolution, because of apparent adaptive functions to the verbal community, accounts for the acquisition of language. This theory is a molar interpretation of language acquisition, whereas B. F. Skinner's 1957 interpretation is a molecular one, which addresses the complexity of language while avoiding the circularity inherent in molar interpretations.

Verbal behavior is defined as behavior which achieves its reinforcement through the mediation of other persons' behavior (Skinner, 1989). Verbal behavior is explained by identifying classes of verbal operants (mand, tact, intraverbal, autoclitic, echoic) and the independent variables of which these classes are a function (Skinner, 1957). However, a paradigmatic criticism of behavioral interpretations by linguists and cognitive psychologists is that the reinforcing practices of the verbal community do not appear sufficient to shape the many subtleties of children's verbal behavior. In contrast to this viewpoint, many behaviorists argue that the practices of the verbal community do in fact account for language acquisition, whether the reinforcement is implicit or explicit. According to Palmer (1998):

> Three variables play an important role in determining the orderly arrangement of verbal operants or grammar. All three are distinguished by their reference to the role of speaker-as-listener. The first variable is the intraverbal control exerted by "frames" over the grammatical structure of an utterance; the second is the discriminative control exerted by the auditory properties of the speaker's own verbal behavior as he or she speaks (e.g., the role of speaker

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> as listener) and the third is the "automatic" shaping of verbal responses toward parity with practices of the verbal community, mediated by the speaker's repertoire as listener (p. 9). This orderly arrangement of verbal operants provides a potential explanation for syntactic transformations. Thus, one can change, for example, an active sentence into a passive construction by moving a few words around and making a few other alterations.

The first variable that plays an important role in determining the orderly arrangement of verbal operants is the *intraverbal control* exerted by patterns of behavior, or intraverbal frames. In the case of the passive voice, the intraverbal frame is *The Z is being Y-ed by the X.* While *is being* and *by the* are fixed elements of the frame, X, Y and Z are variable elements that depend on the context, but from example to example, the frame remains constant. It is inferred that the child covertly echoes the adults' verbal behavior as he or she hears the frame. Over repeated instances of echoing, the frame acquires strength as a new intraverbal sequence in the child's repertoire. Eventually, it is this repeated exposure to intraverbal frames that establishes intraverbal control over the child's verbal behavior.

Palmer (1998) demonstrated the role of modeling in the formation of compound nouns providing evidence for intraverbal control. In the experiment, Palmer praised the child's performance but modeled behavior that differed from the child's. For example,

Model: This is a monster that eats mud. He is a mud-eater.

Model: This monster eats mice. He must be a—

Subject: A mice eater.

Model: That's right. He's a mice-eater. Now this monster over here eats books. He's a-

Subject: Book eater.

Model: Yes. That's right, he's a books-eater. This monster over here eats chipmunks. He must be—

Subject: A chipmunk-eater.

Model: Right. He's a chipmunks-eater. This one eats marbles—

Subject: He's a marble-eater.

Model: Yes. He's a marbles-eater. How about this one? He eats candles. He's a-

Subject: A candles-eater.

Model: Right. He's a candle-eater. This one eats spiders. What's he?

Subject: A spiders-eater.

Model: Good. He's a spider-eater. Now . . .

The discriminative control exerted by the auditory properties of the speaker's own verbal behavior as he or she speaks is a second factor that may determine the arrangement of grammar (Donahoe & Palmer, 1994). An important characteristic of verbal behavior under normal conditions is that it is vocal. Since many children are skilled listeners before they become fluent speakers, they need not rely on feedback from others. Rather, with vocal behavior the child hears his or her own speech. Subsequently, "one's own speech is not only a response, it is a stimulus, comparable, as a stimulus, to the speech of others" (p. 318). Therefore, children may be provided immediate feedback about the conformity of their speech relative to the verbal community. A child's utterances can then shape and maintain his or her behavior because he or she has achieved *parity* with the practices of the verbal community. Parity is "a particular kind of response, a recognition that one has conformed" (Palmer, 1996, p. 290).

Horne and Lowe (1996) attempt to explain the discriminative control that auditory feedback has over orienting behavior, remarking that this control contributes immensely towards our understanding of the acquisition of equivalence classes. They also allude to the likely reinforcing functions that such feedback can afford, under the assumption that the verbal stimuli already serve as conditioned reinforcers. Horne and Lowe observe:

> the sounds and words uttered by parents may function as potent classically conditioned stimuli that have strong emotional effects on the child so that when she hears her own replication of these vocal patterns she is affected by stimuli that have similarly strong reinforcing consequences. (p. 198)

Therefore, it is presumably reinforcing to hear one's self say *Good job* because such expressions from parents are likely to be reinforcing.

It is important to note, however, that the auditory feedback from one's own speech plays a far more important role with regard to the shaping and development of verbal behavior (Palmer, 1996). A child's utterances can shape and maintain his or her behavior because he or she has achieved parity with the practices of the verbal community, not because of the spe-

cific stimulus properties of the verbal stimuli. Thus, the ability to discriminate is a precondition to achieving parity and subsequently obtaining automatic reinforcement.

Parity occurs when a child's behavior is shaped automatically, as he or she recognizes the congruence of behavior with that of the verbal adult community. Thus, shaping of speech can be automatic. Shaping of verbal behavior occurs continuously and automatically over time (Palmer, 1996). Children do not need to rely on extrinsic reinforcement or on social approval from others.

The following experiment is an example of shaping by parity. Palmer (1998) programmed the keys on a computer keyboard to play tones of different frequencies when pressed. There was no orderly relationship between frequency and key position. A woman was asked to play *Mary Had a Little Lamb*. Although the tune was in her repertoire as a listener (in that she could complete a musical phrase if it were interrupted) the precise motor task was not. Thus, performance had to be trained. Training was accomplished solely by her motor behavior producing stimuli that corresponded to a pattern that was familiar to her. Parity was established as a reinforcer by the demands of the task and not by the tune itself.

There is a lucid discrepancy between reinforcement by the stimulus properties of a child's speech and reinforcement by achieving parity with that of the verbal community. Sundberg, Michael, Partington, and Sundberg (1996) have suggested that verbal stimuli, which develop from one's own speech, can function as reinforcers if they have been established as conditioned reinforcers as a result of being paired with other reinforcers. Hence, a child might say *Good boy!* because the phrase produces a reinforcing stimulus. Reinforcement by parity, however, is an entirely different issue. A child might imitate adult behavior by saying *Bad boy!* even though it is a conditioned punisher because achieving parity with the verbal community is automatically reinforcing. The verbal stimuli itself is not reinforcing in this case.

An instructive analogy is that automatic reinforcement is like learning how to play a familiar tune on an unfamiliar instrument. An individual trying to play a tune on an unfamiliar instrument covertly hums the tune. When a note is sounded that corresponds with the note covertly hummed, joint control (Lowenkron, 1998) occurs. As long as the notes sounded match the notes being hummed, joint control endures and the behavior is automatically reinforced. The sounding of a wrong note is punishing and joint control ends.

Likewise, when a child achieves parity with the practices of the verbal community, joint control occurs as long as response-produced stimuli match that of the verbal community. Thus, the child's verbal behavior is automatically reinforced. If children know the pattern as listeners, their own behavior as speakers will be reinforced. Their conditioned and unconditioned responses to the auditory properties of their own speech coincide when they have said it correctly. If they misspeak, they will instantly recognize that they have done so in the absence of joint control. This explanation suggests how automatic reinforcement may account for the rapid acquisition of an orderly arrangement of verbal operants in children despite the lack of explicit feedback from adults with regard to grammatical errors in their speech.

Explicit contingencies do not have to be put in place by the verbal community to ensure that the many distinctions of verbal behavior are taught. Brown and Hanlon (1970) examined the interactions of parents with their children in an attempt to evaluate the extent to which parents reinforced grammatical utterances or punished or corrected ungrammatical utterances. They determined that parents provided very little explicit feedback and tended to reinforce the content of children's utterances, not the syntax or pronunciation.

Moerk (1983), however, re-analyzed Brown and Hanlon's data and found that parents provided a high frequency of reinforcement, modeling, and correcting. Brown and Hanlon counted only instances in which a response was followed by an expression of approval or disapproval such *Good job* or *That's incorrect.* Moerk observed that other parental responses can have the same reinforcing effect. For example, the parent's simply repeating the child's utterances or orienting toward the child can function as a reinforcer. While Moerk's analysis demonstrated that a proportion of the contingencies of reinforcement in parent-child interactions are explicit, he did not oppose Brown and Hanlon's finding that many grammatical errors are implicitly as well as explicitly reinforced (Donahoe & Palmer, 1994).

As important as modeling is, it does not fully explain the acquisition of many subtleties of verbal behavior. However, it should be noted that through modeling children receive repeated exposure to verbal patterns, or intraverbal frames, which are units of listener behavior that consist of sequences of both fixed and variable elements (Palmer, 1996). Over time, these verbal frames establish intraverbal control over children's verbal behavior. When a child's behavior finds parity with the verbal community, reinforcement is automatic. Thus, from a behavioral perspective, modeling and automatic reinforcement appear to play a significant role in language acquisition, and in particular, the construction of the passive voice.

Data from numerous studies substantiate the claim that the passive construction is inadequately understood and rarely produced by the nursery school children used as participants in this area of research. For example, Lovell and Dixon (1967) found that 4.5-year-old children poorly understood and poorly produced the passive voice. In addition, there were no reported occurrences of the passive construction in over 12,000 spontaneous speech utterances collected from 5-year-old participants (Harwood, 1959). Turner and Rommetveit (1967) also found that no more than 25% of a series of passive sentences were correctly understood by a sample of nursery school children, while no more than 20% of the sample of sentences could be emitted correctly. The failure in production of the passive was further confirmed by the children's inability to repeat the passive construction even after the experimenter presented a picture and modeled the passive. Turner and Rommetveit, however, discovered substantial increases in production and comprehension of the passive by children beyond the second grade.

Hayhurst (1967) found that children of ages 5, 6, and 9 performed significantly better when they were asked to describe pictures using the passive construction when a reference was not made to an actor (e.g., the cat is being chased) than when a reference *was* made to an actor (e.g., The cat is being chased by a dog.) Hence, children performed better when they had to recall truncated passives than when they had to recall full passives. Slobin (1966, 1968b) also found that truncated passive sentences, as well as making sentences nonreversible (e.g., the food was eaten by the man), substantially lessened the difference between the syntactic complexity of the active and the passive. Nonreversibility facilitated the comprehension of the passive construction in that it became more apparent which of the two nouns was the subject and which the object.

Whitehurst, Ironsmith, and Goldfein (1974) demonstrated that even though production of the passive was not observed in baseline conditions for their participants, modeling without reinforcement was effective in producing the passive construction. Their experiment had three stages. In Stage 1, the experimenter induced the children to practice correctly labeling the animals shown in 40 pictures. In Stage 2, the 40 pictures were divided into two sets of ten pairs. Set 1 was designated *models* and Set 2 was designated *probes*. In the control condition, six of the children were shown 20 pictures from the probe set and asked to describe them. In the experimental condition, the remaining six children were shown pictures from the model and probe sets and asked to describe them. During the experimental condition, the experimenter modeled a passive construction of a sentence describing the action of one of the pictures from the model set. Reinforcement was delivered contingent on the child *not* imitating the experimenter. If the child remained silent, the experimenter showed the child a picture from the probe set and asked him or her to describe it. The experimenter did not provide reinforcement on probe trials. Model and probe trials were randomly interspersed. In Stage 3, the experimenter conducted a comprehension test and induced the participants to identify the pictures after listening to the experimenter describe the pictures in either the active or passive voice.

Silvestri, Davies-Lackey, Twyman, and Palmer (in preparation) replicated a modified version of the experimental condition of Whitehurst et al. (1974) and found evidence of the acquisition of the passive in all of their participants. Six preschool children were shown pictures of two animals interacting. The experimenter conducted alternating trials in which the experimenter modeled the passive construction on odd-numbered trials and then gave the children an opportunity to describe a different picture on even-numbered trials. The experimenter praised the children for using the active voice and provided neutral remarks when the children used the passive construction.

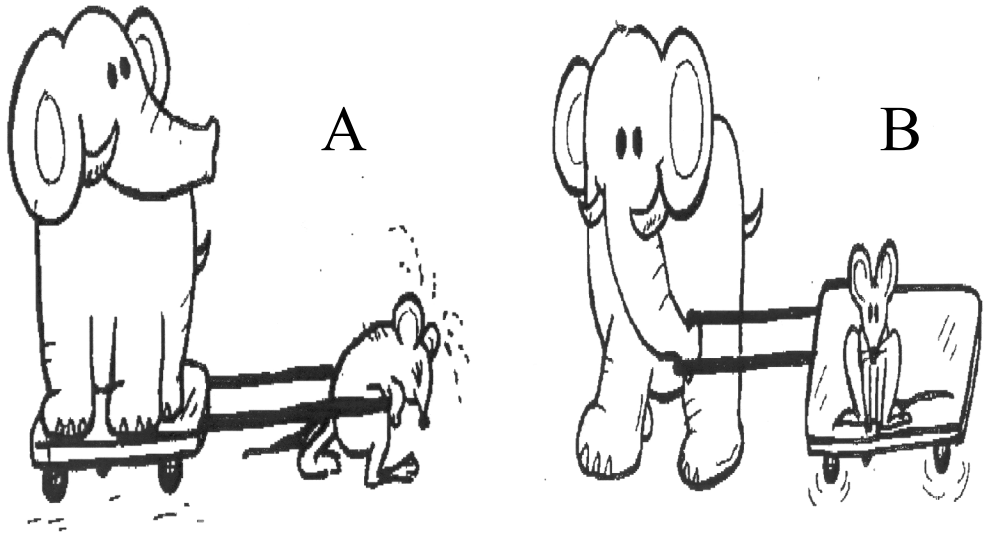

Fig. 1. A pair of pictures from the training set. The picture in panel A is described in the active voice as "The mouse is pulling the elephant." The picture in panel A is described in the passive voice as "The elephant is being pulled by the mouse." The picture in panel B is described in the active voice as "The elephant is pulling the mouse." The picture in panel B is described in the passive voice as "The mouse is being pulled by the elephant."

The results suggest that the passive construction was already in the repertoire of two of the six participants whose verbal behavior immediately came under the control of the model. This was evidenced by their production of the passive on nearly every trial. The remaining four participants produced partial or complete passive construction over the course of the experiment. The performance of the participants in this study suggests that they were able to modify their verbal behavior to conform to a rather complex model. They were not simply imitating. Rather, they were repeating an intraverbal frame in which variable terms appeared in a novel way without explicit reinforcement. In other words, the reinforcement may have derived from the parity between the child's behavior and the adults. The data can be interpreted as support for the role of automatic reinforcement in the acquisition of language.

The present study is a modification of the study conducted by Whitehurst et al. (1974) and Silvestri et al. (in preparation). The present study includes a separate baseline condition whereas Silvestri et al. used the early part of their training as a baseline. In addition, the present study also uses a generalization set by combining the pictures to mix up the actors and objects. Like Silvestri et al. (in preparation), the present study examines the effects of modeling on the production of the passive construction and supports the view that the passive voice is acquired by automatic reinforcement rather than through the supplementation of lavish extrinsic reinforcement. The study also addresses the effects of repeated exposure to training and generalized stimuli in the acquisition of the passive construction and attempts to demonstrate how repeated exposure to the intraverbal frames establishes intraverbal control over the child's verbal behavior. Additionally, the implications of joint control in the acquisition of verbal behavior are also discussed in the study.

Method

Participants

Six children, five females and one male ranging in age from 3 years 6 month to 5 years 6 months served as participants in this study. The participants were of varied ethnic background (African American, Asian, Caucasian, Hispanic). Fathers were employed as professionals, human service employees, or were in sales. Mothers were either human service employees, were in sales, or were homemakers. The participants attended day care, pre-school or

kindergarten for typically developing children in middle class communities. All of the participants appeared normal in their intellectual and physical development. To protect the anonymity of the participants, the children will be referred to by their arbitrarily assigned names throughout this paper.

Materials and Setting

The study was conducted in a room at the subject's home. A small table in the corner of the room was used during the experiment. A sheet of stickers, a 12.7 x 12.7 cm sticker chart with twenty 2.54 cm squares, and an audiotape recorder were on the table. In addition, a 25.4 cm x 29.2 cm three-ring binder was also on the table. Inside the binder was a stack of 40 black and white 10.16 cm x 15.24 cm drawings used as stimuli. The 40 drawings consisted of 20 pairs of pictures.

One set of 10 pairs was used for *training* and one was used for *testing*. Each pair showed the same two animals interacting. One picture depicted animal A doing something to animal B. The alternate picture in the pair depicted animal B doing the same thing to animal A (see Figure 1).

In addition, there were 17 black-and-white 10.16 cm x 15.24 cm drawings used as the *switch set.* These drawings were similar to the training pictures except that animal A or animal B was replaced by another animal from a different pair in the training set (see Fig. 2).

Procedure

At the start of the session, the child was told that he/she was going to play a game in which stickers could be earned, and there was also an additional prize for playing with the experimenter. The child was then shown a bag of prizes containing various toys and allowed to select a single preferred item. The experimenter then sat down next to the child at the table and placed the selected item on the table, where it remained in sight throughout the session. In order to motivate the child to maintain his/her performance during the session, the experimenter gave the child stickers that were placed on the sticker chart. The stickers were given on a VR 4 schedule contingent on the child's sitting well and describing the pictures using the active voice. When the child earned 20 stickers, the prize was presented. When present, a reliability observer sat behind the child. One adult female served as the experimenter. The data for each child was collected in a single session that lasted no more than 40 min.

Phase 1: Baseline. When the experiment began, the child was given the following instructions: "We're going to play a game and you will get to tell me about these pictures. Sometimes it will be my turn to talk about the pictures and sometimes it will be your turn to talk about the pictures. When it is your turn, I will tell you it is your turn." (If the child did not repeat the instructions, the experimenter repeated them until the child seemed to understand.)

The child was then shown 10 pictures from the testing stimuli and asked to describe them.

Phase 2: Modeled passive and assessed for passive construction using the training set. The experimenter showed the child one item from a pair and described it using the passive voice. For example, the experimenter showed the child a picture of an elephant pulling a mouse and said, "The mouse is being pulled by the elephant" (see Figure 1). After the experimenter described one item from a pair using the passive construction, the experimenter showed the child the alternate item from the pair on the next trial. Hence, the child was shown the alternate picture from the pair and instructed, "It's your turn, tell me about this picture." For example, the experimenter showed the child a picture of a mouse pulling an elephant and said, "It's your turn, tell me about this picture."

The experimenter always nodded or said, "Good" or some equivalent social praise when the child used the active voice to describe the picture. The experimenter never praised the child for using the passive voice or otherwise indicated that the passive construction was the desired response. In other words, reinforcement was withheld when the child used the passive construction.

Phase 3: Tested the production of the passive construction using the switch set. The child was shown 17 pictures from the switch stimuli and asked to describe them.

Phase 4: Modeled passive and assessed for passive construction using the training set. The procedure used in Phase 2 was used to test the production of the passive construction.

Phase 5: Tested the production of the passive construction using the switch set. The pro-

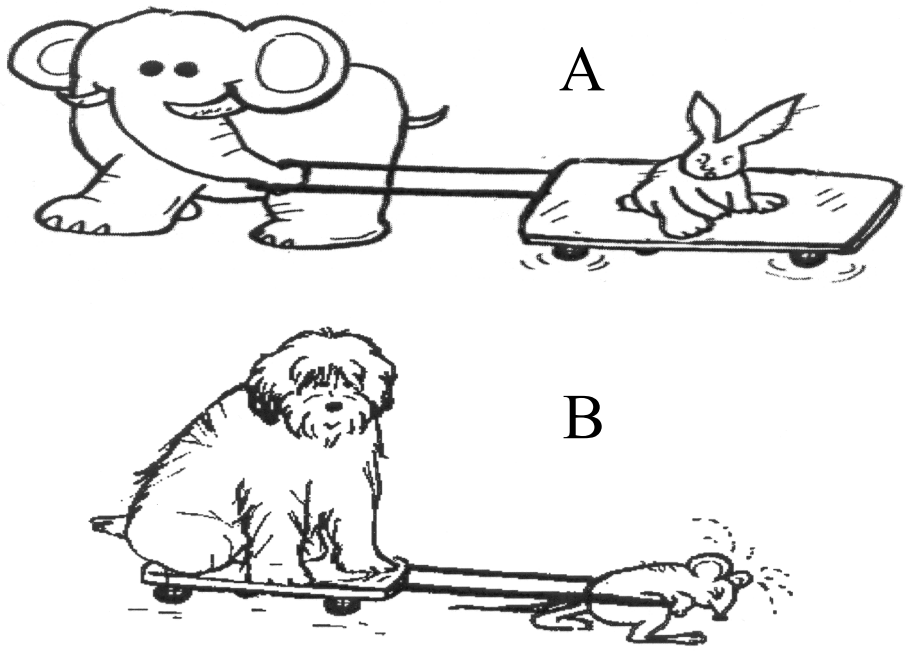

Figure 2. Two pictures from the switch set. These drawings are similar to the drawings from panel A and B in Figure 1, except that a rabbit replaced the mouse in panel A and a dog replaced the elephant in panel B.

cedure used in Phase 3 was used to test the production of the passive construction.

Phase 6: Tested the production of the passive construction using the testing set. The procedure used in Phase 1 was used to test the production of the passive construction (with the exception that stickers were given for responding to the pictures using the active voice during this phase) using the set of 10 pairs from the testing stimuli.

Measurement

In Phases 1, 3, 5 and 6, the pictures were held up in front of the child and the instruction "Tell me about this picture" was given. The experimenter waited 10 s for the child to respond. If a response was made, the experimenter recorded the complete response verbatim. The picture was removed and after a 2 s pause, the next picture was presented and the experimenter repeated the instruction, "Tell me about this picture."

In Phases 2 and 4, the experimenter showed one item from a pair and described it using the passive voice. The experimenter then waited for 10 s. If the child did not imitate the experimenter, the experimenter said, "Good waiting for your turn." The picture was then removed and the next trial followed in 2 s. If the child tried to imitate the passive construction, the experimenter stated, "Don't say anything until I tell you it's your turn," and started the trial over again. Thus, reinforcement was delivered contingent upon the absence of imitation during training trials.

Interobserver agreement data was taken during two sessions. Both the experimenter and the second observer recorded all responses verbatim and had access to the audiotape recordings during both sessions. Interobserver agreement was 100% during these sessions.

Four categories of utterances were scored as passive constructions for the data described in Figure 3. Each of these categories was scored as a successful production of the passive voice. They were as follows: (1) utterances which contained the passive construction and described the subject and object in the correct position as portrayed in the picture;[1] (2) utterances which contained a passive structure but in which the actor and object were reversed from the roles depicted in the pictured being

[1] The dog is being brushed by the cat.

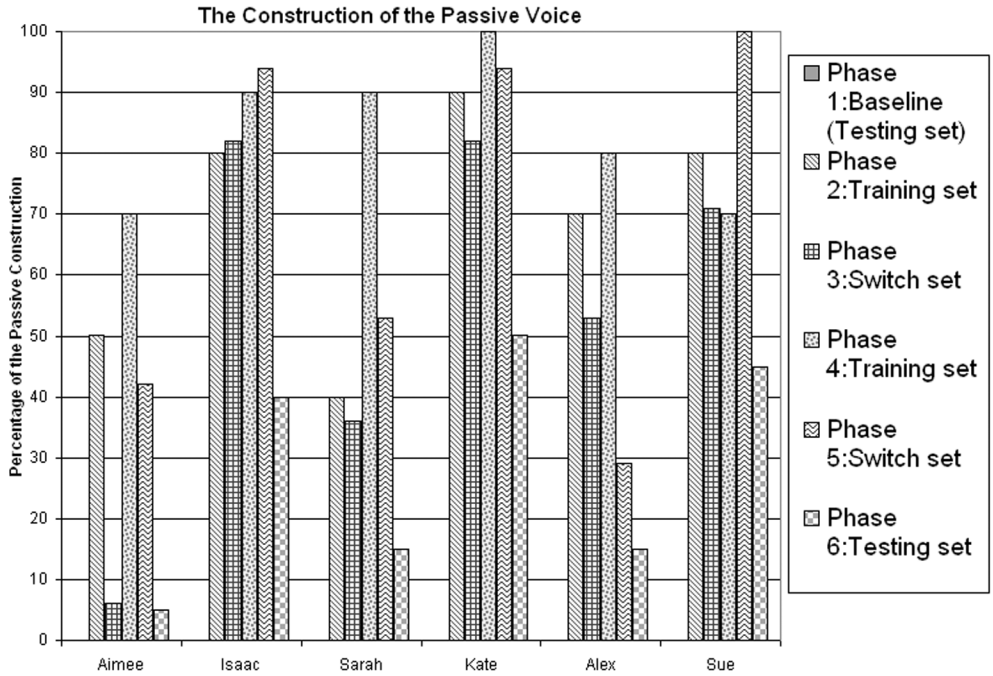

Fig. 3. Percentage of trials resulting in complete or partial passive construction across all six phases. Each subject scored 0% in Phase 1. The training set was used in Phases 2 and 4, the switch set was used in Phases 3 and 5, and the testing set was used in Phases 1 and 6.

described;[2] (3) utterances which contained a passive construction but in which the same animal was labeled in both the subject and object role,[3] and (4) utterances that were truncated passive constructions which had no expressed actor.[4] The first category is an example of a complete passive. The last three categories are scored as partial passives. Occasionally, the children would mislabel the animal in a picture. For example, a zebra might be labeled a horse. Such responses were treated as semantically appropriate since these animals are similar in appearance.

Results

The graph in Figure 3 depicts the percentage of production of the passive construction across participants, aggregating the three forms of partial passives with complete passive constructions. Figures 4–9 decompose the data and depict the percentage of each of the four categories of passive constructions during each phase for each participant, respectively. The numerical results expressed in Figures 4–9 are summarized below.

Sixty percent of Sue's utterances in Phase 2, 59% in Phase 3, 60% in Phase 4, 76% in Phase 5, and 15% in Phase 6 were complete passives. She produced a passive construction in which the same animal was labeled in both the subject and object role in 10% of her utterances in Phase 2. She produced the truncated passive in 10% of her utterances in Phase 2, 6% in Phase 5, and 15% in Phase 6. She also produced the reverse passive in 12% of her utterances in Phase 3, 10% in Phase 4, 18% in Phase 5, and 15% in Phase 6.

For Isaac, 60% of all of his utterances in Phase 2, 76% in Phase 3, 90% in Phase 4, 88% in Phase 5, and 35% in Phase 6 were complete passives. He also produced the truncated passive in 6% of his utterances in Phase 5 and the reverse passive in 20% of his utterances in Phase 2 and 5% in Phase 6.

For Sarah, 18% of all her utterances in phase 3, 30% in Phase 4, 6% in Phase 5, and 10% in Phase 6 were complete passives. She produced

[2] The cat is being brushed by the dog.
[3] The dog is being brushed by the dog.
[4] The dog is being brushed.

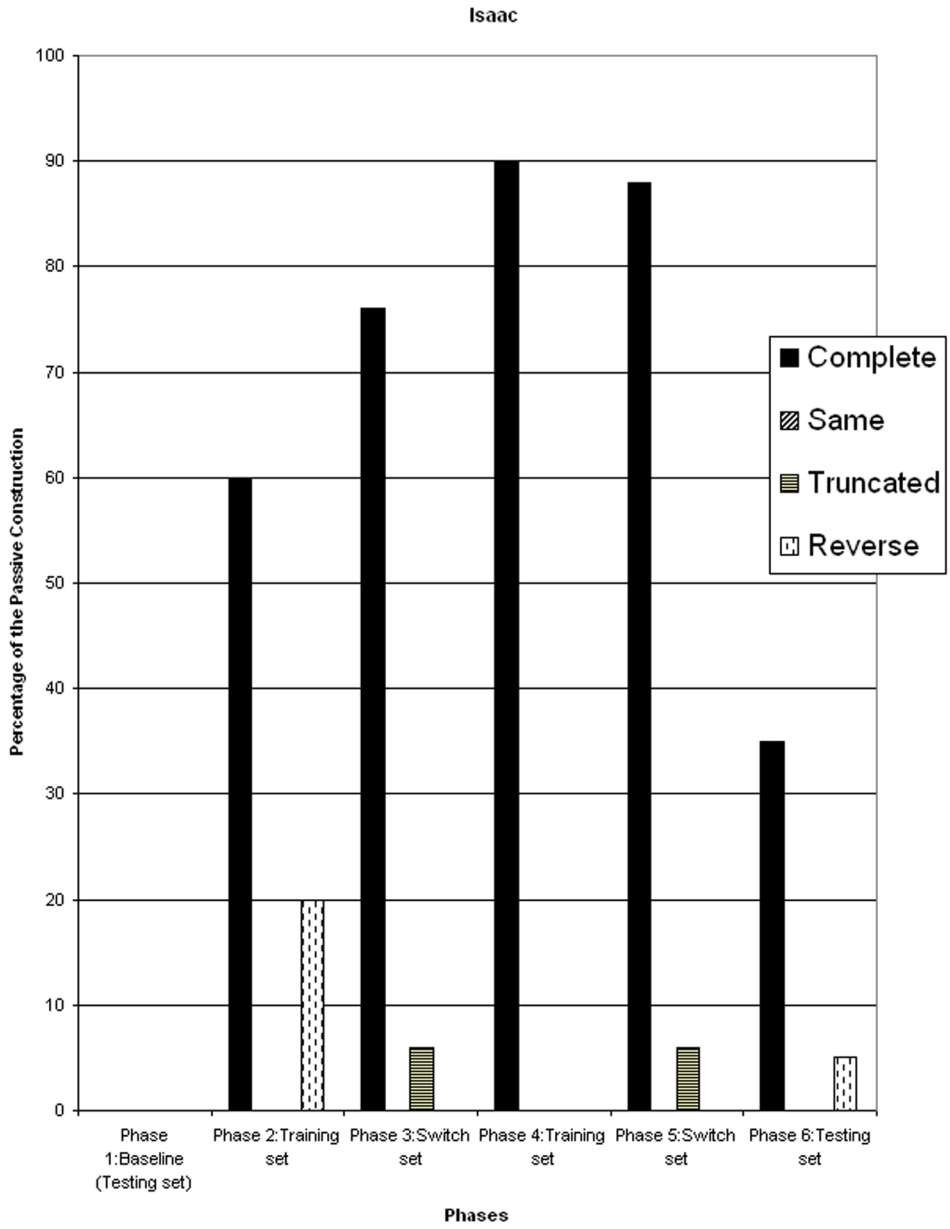

Fig. 4. Percentage of partial and complete passive constructions across each of the six phases.

partial passives in which the same animal was labeled in both the subject and object role in 6% of her utterances in Phase 3. She also produced the reverse passive in 40% of her utterances in Phase 2, 12% in Phase 3, 60% in Phase 4, 47% in Phase 5, and 5% in Phase 6.

For Kate, 80% of all of her utterances in Phase 2, 82% in Phase 3, 100% in Phase 4, 88% in Phase 5, and 50% in Phase 6 were complete passives. She also produced the truncated passive in 6% of utterances in Phase 5 and the reverse passive in 10% of her utterances in Phase 2.

For Alex, 50% of all of her utterances in Phase 2, 53% in Phase 3, 70% in Phase 4, 29% in Phase 5, and 10% in Phase 6 were complete passives. She also produced the truncated passive in 5% of her utterances in Phase 6 and the

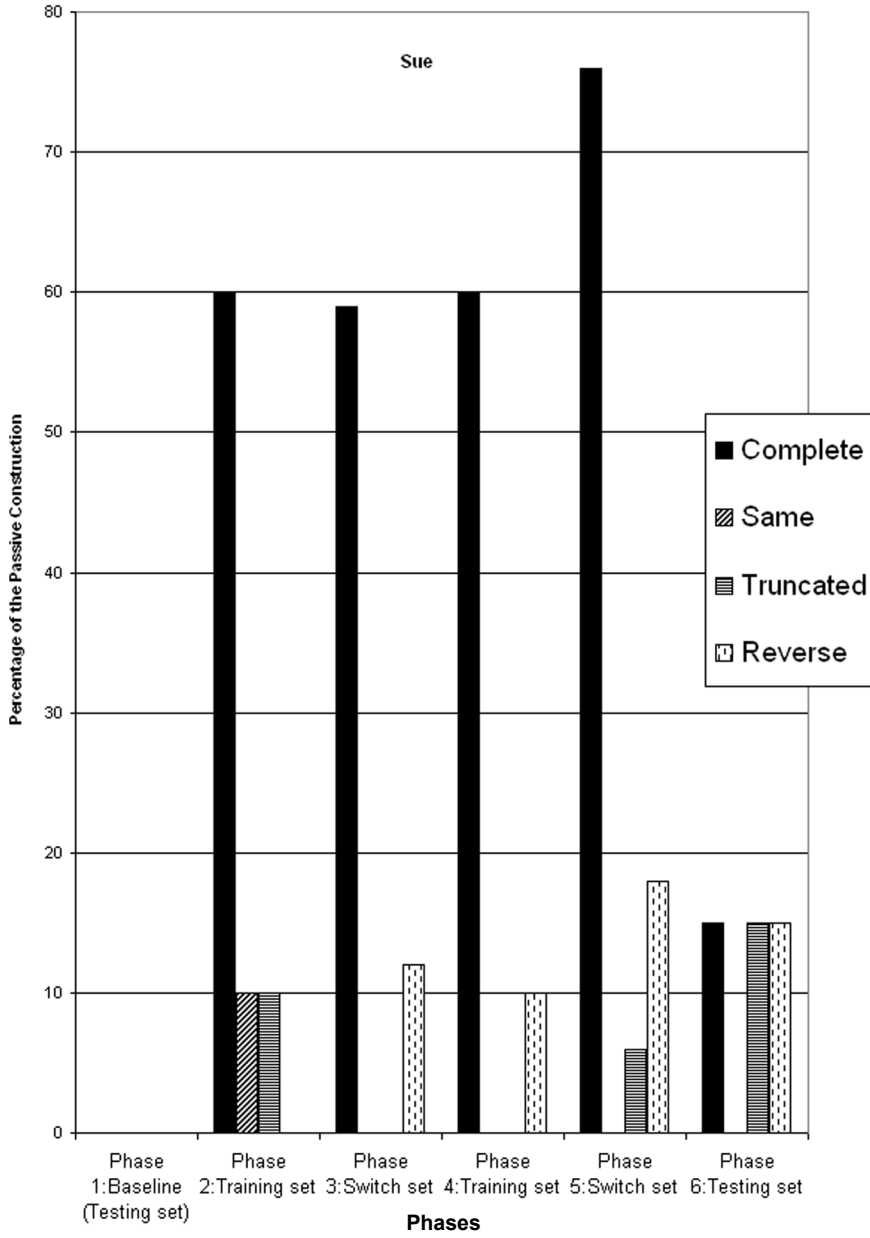

Fig. 5. Percentage of partial and complete passive constructions across each of the six phases.

reverse passive in 20% of her utterances in Phase 2 and 10% in Phase 4.

For Aimee, 10% of all of her utterances in Phase 2, 10% in Phase 4, 24% in Phase 5, and 6% in Phase 6 were complete passives. She also produced the reverse passive in 40% of her utterances in Phase 2, 6% in Phase 3, 60% in phase 4, and 18% in Phase 5.

Discussion

None of the children used the passive construction to describe the pictures in Phase 1. They either labeled the animals in the pictures or described the pictures using the active voice. The results in this study support previous findings that in the absence of modeling, nursery

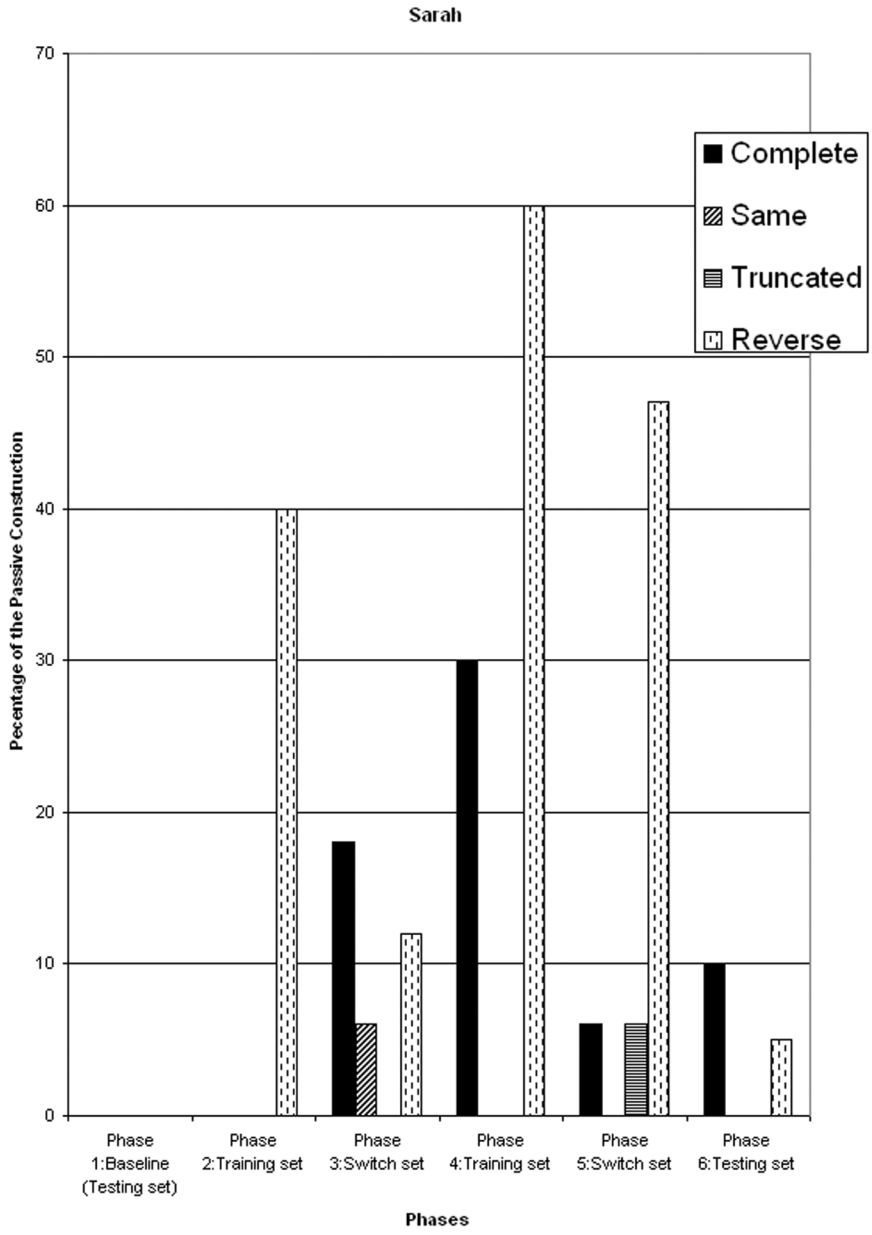

Fig. 6. Percentage of partial and complete passive constructions across each of the six phases.

school children rarely produce the passive voice (Lovell & Dixon, 1967; Harwood, 1959; Turner & Rommetveit, 1967a). All of the children began using either the partial and/or complete passive construction only after the experimenter modeled the passive sentences. Repeated exposure to the training set in Phase 2 and Phase 4 and the switch set in Phase 3 and Phase 5 generally increased production of the passive voice across participants. All participants uniformly exceeded baseline levels of passive production without modeling in Phase 6 when presented with the testing stimuli.

The results from the present study support the findings of Whitehurst et al. (1974) and Silvestri et al. (in preparation) with regard to the impact of modeling on the acquisition of the passive voice. Through modeling, the children received repeated exposure to the experimenter's verbal behavior. Subsequently,

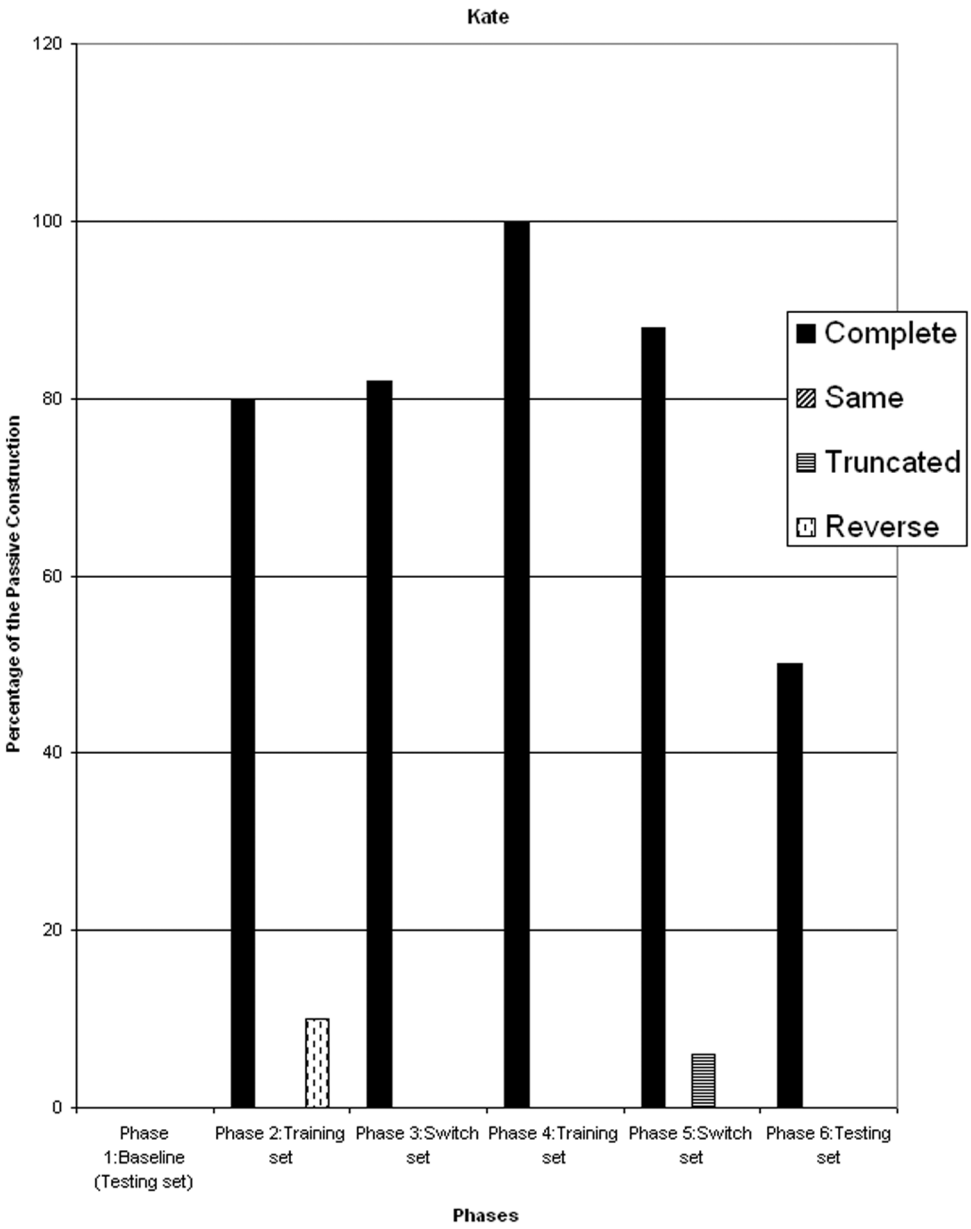

Fig. 7. Percentage of partial and complete passive constructions across each of the six phases.

repeated exposure to examples of the passive construction such as "The elephant is being pushed by the mouse" and "The fish is being kissed by the bird," established the intraverbal frame, *the Z is being Y-ed by the X,* in the child's repertoire as a listener. Furthermore, repeated exposure to these examples appeared to strengthen the rate of occurrence of the intraverbal frame, and over time established intraverbal control over the children's verbal behavior (Palmer, 1998). The child was then able to conform to the experimenter's verbal patterns and produce either the partial or complete passive constructions from Phase 2 to

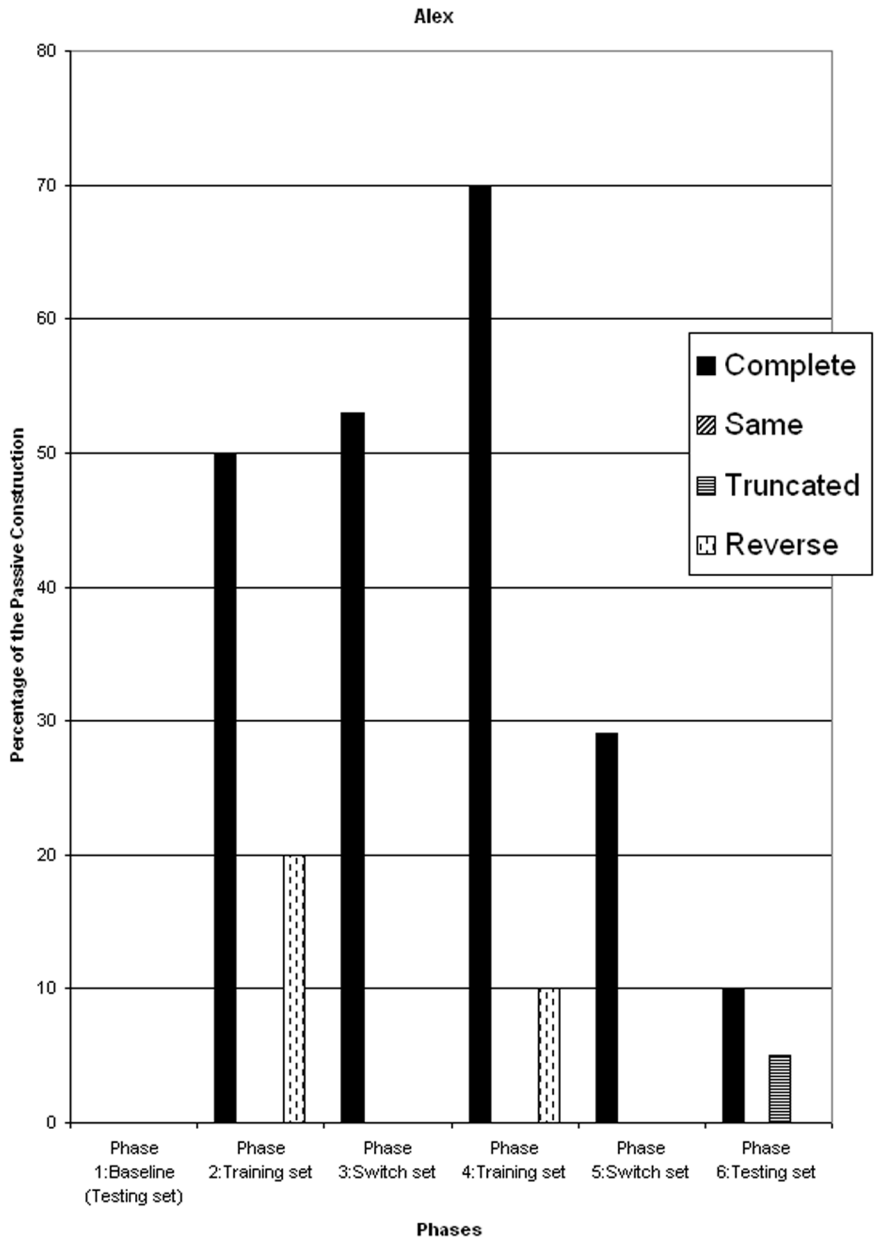

Fig. 8. Percentage of partial and complete passive constructions across each of the six phases.

Phase 6. Thus, repeated exposure to an intraverbal frame can lead to appropriate control that extends over variable or novel elements.

In general, the children's description of the pictures conformed to the structure of the intraverbal frame, *The Z is being Y-ed by the X,* by changing the Z and X elements accordingly across examples and adding "ed" to the Y element or regular past-tense verb. These response patterns demonstrate how the prosodic, temporal, and semantic properties of the X, Y, and Z elements of the frame govern the transition from one element of the frame to the next.

The prosodic and temporal properties of the variable elements are stimulus properties that have physical dimensions whereas the semantic properties are derived from an individual's

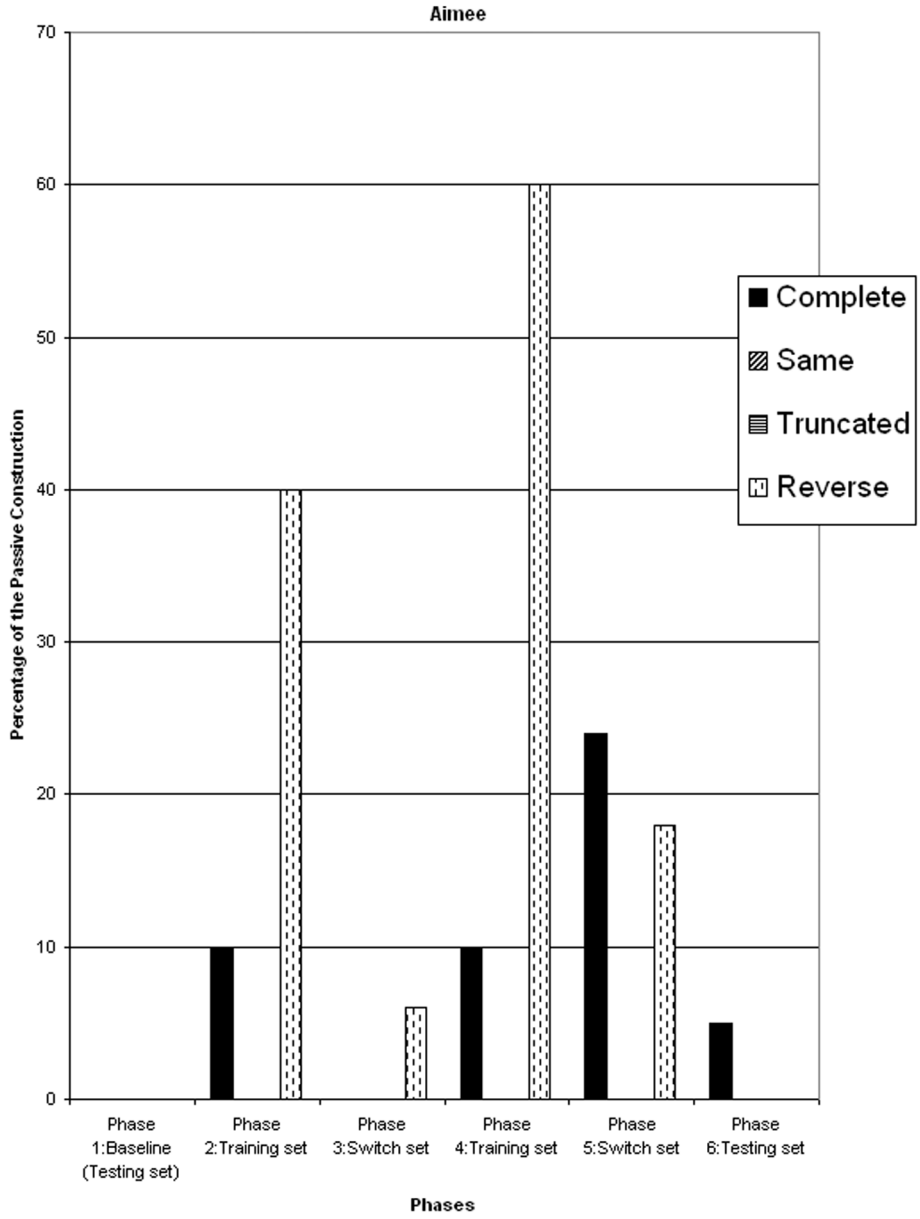

Fig. 9. Percentage of partial and complete passive constructions across each of the six phases.

own history of contingencies. With regard to prosodic properties, notice for example, that "The elephant is being pulled by the mouse" is said with the same pattern of intonation as "The fish is being kissed by the bird." It is said with the same pattern of intonation that is independent of the phonemes.

As for temporal properties, the element *by the* is indirectly controlled by another verbal stimulus, *is being,* with a certain pattern of emphasis and duration. Therefore, *Y* cannot be indefinitely long or intraverbal control of *by the X* will be lost. For example, if a long clause were inserted, such as "The elephant is being very slowly and cautiously pulled by the mouse" intraverbal control would be lost. The Z element also cannot be indefinitely long or the intraverbal control of *is being Y'ed* will be lost. If a clause of great length were inserted, such as "The elephant that is hungry and mad

because he has not eaten all morning is being pulled by the mouse" intraverbal control will be degraded. Indeed here, *all* intraverbal control over the object being acted upon is lost. As for semantic properties, Z must be something that is being acted upon while X must be something that is performing the action expressed by the verb.

For example, some of the children described the picture of a dog brushing a cat as "The cat is being brushed by the dog." However, some children were not able to identify the action, and substituted that verb with one that could be semantically correct in the context of that picture. For example, one child's response to the picture of the dog brushing the cat was, "The cat is being scratched by the dog." Despite using the incorrect verb, the prosodic and temporal properties created a certain pattern or rhythm that enabled the child to adhere to the intraverbal frame.

Some of the children used regular past tense verbs when novel stimuli were presented that contained irregular past-tense verbs. For example, one child described a picture of a squirrel catching a frog as "The frog is getting pushed by the squirrel." For the same picture, another child said, "The frog is being stopped by the squirrel." None of the children described the picture as "The frog is being caught by the squirrel." In another example, one child described a picture of a camel throwing a snail as "The snail is being pushed by the camel." In each of these examples the children switched from the irregular past-tense verb to a regular past-tense verb to conform to the intraverbal frame and used verbs that were semantically appropriate to the context of the picture.

The experimenter observed that Sarah and Aimee only gradually conformed, while Kate, Isaac, Sue, and Alex immediately conformed to the experimenter's verbal behavior by using the complete passive construction after modeling occurred. For example, after the experimenter modeled the response, "The tiger is being sprayed by the giraffe" during Phase 2 and asked Sarah to describe the alternate picture from the same pair, she responded, "The lion being watered by a giraffe." However, when the experimenter presented Sarah the identical picture in Phase 4, she described the picture as "The tiger is being sprayed by a giraffe," which is a reverse passive. Interestingly, the two participants who exhibited gradual conformity also produced the largest percentage of reverse passives. As evidenced in Figures 6 and 9, Sarah and Aimee produced an increasing percentage of reverse passives with repeated exposure to the training stimuli in Phases 2 and 4, and with the switch stimuli in Phases 3 and 5.

One possible explanation for the phenomenon of gradual conformity is related to auditory discrimination with regard to one's own verbal behavior. After listening to modeled responses from the experimenter, some of the children who initially produced only partial passive constructions began to produce complete passive sentences. The presumptive inference is that a child who is uttering part of the passive finds that it coincides with the intraverbal pattern that has been set up by the experimenter over the course of repeated utterances, that child begins to emit patterns of relevant intraverbal responses. As a skilled listener, the child is able to detect when he or she has conformed or deviated from the experimenter's verbal behavior. Thus, with vocal behavior, children are discriminating listeners long before they become fluent speakers (Fraser et al., 1963; Mann & Baer, 1971; Gesell & Thompson, 1934; Whitehurst & Novak, 1973; Palmer, 1996). The feedback from one's own speech serves a different reinforcing function that appears to play a role in the shaping and development of verbal behavior. Under most circumstances, people find parity of speech with that of others to be reinforcing and deviations from parity to be punishing. To the competent listener, a deviation from parity is instantly detected (Palmer, 1996).

Countless contingencies of reinforcement are implicit in the acts of speaking and hearing oneself conform to the practices of the verbal community. Nearly every occurrence of verbal behavior is provided with reinforcement of some sort. By contrast, very little reinforcement is explicitly arranged (e.g., parents simply repeating child's utterances or parents orienting to the child and responding appropriately in some way).

The subtle aspects of our verbal repertoire may well be shaped by the contingencies of automatic reinforcement. The process might be as follows. The children were eventually affected by the intraverbal pattern as listeners and were possibly rehearsing it covertly throughout the experiment. When the pictures evoked

a tact that coincided with the current intraverbal response, automatic reinforcement would have occurred for a passive-voice response. Thus, the auditory stimulus that the child as a speaker produced and the child as a listener heard exerted joint control over responses conditioned to the earlier elements of the intraverbal frame. Based on this analysis, the occurrence of the passive voice would have maintained and/or increased even though explicit reinforcement was received only for responses in the active voice. The implication is that the reinforcer in modeling is not primarily explicit but rather automatic. That is, the subject is reinforced directly by the similarity between his or her behavior and that of the model; direct social approval is not always necessary (Palmer, 1996). As Skinner (1957) pointed out:

> When a sound pattern has been associated with reinforcing events, it becomes a conditioned reinforcer . . . . The young child alone in the nursery may automatically reinforce his own exploratory vocal behavior when he produces sounds, which he has heard in the speech of others. The self-reinforcing property may be merely an intonation or some other idiosyncrasy of a given speaker or of speakers in general .... The process is important in shaping up standard forms of response. (p. 58)

The reinforcement is immediate, automatic, and mediated largely by the repertoires of a child-as-speaker and a child-as-listener. When children first learn to speak they can be affected by the tempo and orderly arrangement of complex verbal operants as stimuli, but cannot produce them. However, when they succeed in doing so, they do not need to be explicitly reinforced by the adult verbal community; the stimulus aspects of the achievement itself are reinforcing (Palmer, 1998).

In summary, the speaker-as-listener evokes behavior in himself/herself as well as in others. This process would seem to be important in the acquisition of verbal behavior. Modeling provides repeated exposure to verbal patterns and consequently establishes intraverbal frames, which constitute a form of intraverbal control over the child's verbal behavior. The resemblance of the auditory feedback a child receives from his/her own verbal behavior to the stimuli provided by the verbal community can function as reinforcement for acquiring the community's verbal practices. Achieving parity with the community can function as reinforcement for further imitation of adult verbal behavior. More specifically, this study provides some support for the view that modeling and automatic reinforcement offer a molecular yet parsimonious model for understanding the acquisition of the passive construction. On a larger scale, it also provides a potential mechanism to explain some aspects of the acquisition of language in general.

One limitation of the study arises from the difficulty of assessing whether or not the children possessed the passive construction in their repertoires prior to the experiment. This limitation may impact future studies because it is unlikely that any child's complete history of speech will ever be known. This research, however, bolsters findings from previous studies that support the notion that language in general, and in particular the passive voice, can be acquired through modeling and automatic reinforcement; explicit reinforcement is not required. Thus, to ensure appropriate language acquisition and development, parents and educators need to be aware of how the practices of the verbal community shape a child's verbal repertoire. It is not because of the stimulus properties of the speech patterns but presumably because of a long history of contingencies in which behaving as adults behave (conforming to a model) has been automatically reinforced.

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