Research

Evaluation of a Deductive Procedure to Teach Grammatical Inflections to Children With Language Impairment

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Purpose: To evaluate the learning effects of a deductive language-teaching procedure when teaching a novel gender agreement verb inflection to children with language impairment.
Method: Thirty-two 6–8-year-old children with language impairment were randomly assigned to either a deductive (N = 16) or an inductive (N = 16) treatment group. In the deductive treatment, the examiner presented a rule guiding the novel inflection to be learned as well as models of the inflection. In the inductive treatment, only models of the verb inflection were presented. Learning was assessed in 3 different production contexts during each of 4 treatment sessions.
Results: Significantly more participants in the deductive group than the inductive group acquired the novel morpheme based on a teaching probe (10 vs. 3), generalization probe (10 vs. 3), and maintenance probe (7 vs. 2). Task performance was not significantly influenced by language ability or nonverbal intelligence.
Conclusions: The deductive teaching procedure was found to be efficacious when teaching a novel grammatical inflection. However, this effect was limited because treatment gains varied across participants, testing contexts, and sessions. Future studies should continue to examine the efficacy of deductive procedures when integrated into traditional implicit approaches for children with language impairment.

Key Words: child language intervention, language impairment, school-age children

One special language weakness for English-speaking children with language impairment (LI) is the use of grammatical morphology. Compared to children with typical language development, English-speaking children with LI are more likely to omit tense and agreement grammatical forms such as third person singular present tense *–s,* regular past tense *–ed,* copula and auxiliary forms of *be,* and auxiliary *do* (Bedore & Leonard, 1998; Leonard, Eyer, Bedore, & Grela, 1997; Rice, Tomblin, Hoffman, Richman, & Marquis, 2004; Rice & Wexler, 1996; Rice, Wexler, & Hershberger, 1998). Therefore, language interventions for children with LI typically include a focus on syntax and morphology (Fey, Long, & Finestack, 2003). Despite a need for efficient and effective interventions for children with LI focusing on these language weaknesses, the most rigorously conducted treatment studies have yielded variable outcomes (see Law, Garrett, & Nye, 2003), and most commonly, treatment gains are only evident after very long treatment periods (e.g., Leonard, Camarata, Brown, & Camarata, 2004; Leonard, Camarata, Pawlowska, Brown, & Camarata, 2006). Thus, there remains a need for more efficient and effective grammatical interventions.

Most current grammar interventions for children with LI require the learner to induce patterns or rules from positive examples, but they do not encourage the learner to think or talk about the process or products of learning. For example, in many general stimulation (Cole, Maddox, & Lim, 2006) and many focused stimulation (Weismer & Robertson, 2006) approaches, interventions take place in naturally occurring play and book-reading contexts such that the child is never aware that grammar is a teaching target. In these approaches in which the clinician does not attempt to make the child consciously aware of the teaching target, learning of grammatical patterns occurs through *inductive* processes.

One way to enhance the effects of inductive grammar facilitation, especially for older children, may be to engage the children's metacognitive abilities in the learning process. In such approaches to grammar facilitation, the clinician helps the child to become conscious of the teaching target and may even explicitly inform the child of the principles or patterns underlying the target form. Rules can then be deduced from specific examples presented by the clinician or other intervention agent. Thus, these are referred to as *deductive* approaches.

The current investigation is an early evaluation of the clinical hypothesis that deductive teaching procedures can speed the development of grammatical abilities among children with LI. In the procedure we test in this study, the clinician explicitly describes the pattern underlying the target grammatical construction and then provides examples of the pattern and opportunities for the child to practice it.

Our motivation to test a deductive approach for grammar facilitation stems from two major sources. First, there is a rich literature of studies comparing the efficacy of deductive and inductive instructional procedures when teaching grammatical structures to adults learning a second language (see Norris & Ortega, 2000). For example, Doughty (1991) examined the effects of deductive and inductive instructional procedures when teaching English relativization (e.g., "A woman *who is a professional architect* suggested the playground design") to adult learners of English as a second language. Doughty provided participants in the deductive instruction group with explicit rule statements via computer along with on-screen sentence manipulations that created relative clauses. In contrast, participants who were assigned to the inductive learning group were presented only sentences containing relative clauses without overt rule statements or on-screen sentence manipulations. Although both treatment groups made gains, the learners who received deductive instruction made significantly greater gains on immediate posttests than those who were in the inductive learning group. In line with these findings, extensive research efforts in second language learning reveal that deductive teaching techniques generally are superior to inductive techniques in helping participants to acquire and produce target grammatical constructions within limited contexts (see Norris & Ortega, 2000).

Evidence of the deductive teaching advantage in second language instruction is largely based on studies involving high school students and adult learners. However, there are numerous examples within speech-language pathology in which this level of intervention awareness and deductive instruction has been adopted as an important, if not necessary, component of efficacious communication interventions for young children. One such example is the teaching of speech sounds. In most approaches to speech sound therapy, children are made explicitly aware of the specific treatment targets (e.g., [s] and [r]), which are then rehearsed explicitly in therapy in different phonetic contexts in small sets of training words. Social and other extrinsic reinforcements are often provided contingent on the child's accurate efforts to achieve explicit sound production targets that are consistent with acceptable phonemic boundaries. Another example comes from phonological awareness instruction (Justice & Kaderavek, 2004; Kaderavek & Justice, 2004). Although many children acquire phonological awareness skills implicitly, there is substantial evidence that, to learn phonological awareness skills efficiently, many children need direct, deductive interventions in which they are made explicitly aware of the instructional goals (see Bus & van Ijzendoorn, 1999). The following examples from Gillon (2004) illustrate the use of deductive procedures within a phonological awareness intervention targeting rhyming skills.

> Do pie boat rhyme?… No, they don't end the same. They don't rhyme. Do pie tie rhyme?… Yes, they sound the same at the end p..ie, t..ie [segmenting the onset-rime units]. They both end in *ie.* Pie and tie are rhyming words. (p. 141)

In interactions such as these, the clinician not only helps the child to be consciously aware of the target, she also uses overt descriptions of what rhyming is and how rhyming words relate to one another as a means of helping the child acquire the concept of rhyming. A clinician who uses metalanguage along with specific examples of the linguistic form being taught to help the child acquire underlying patterns and principles is using deductive teaching procedures in her instructional approach.

Several investigators of child language interventions have proposed incorporating deductive pattern-focused teaching procedures into intervention programs to further enhance learning (e.g., Connell, 1982; Spekman & Roth, 1982). To our knowledge, the only efficacy study of a fully deductive grammatical intervention with young children with LI was reported by Swisher, Restrepo, Plante, and Lowell (1995). In this study, the investigators attempted to teach 4–6-year-old children with typical language development ($N = 25$) and children with LI ($N = 25$) two novel nouns plus a novel morpheme. Examiners presented and manipulated clay figures during a story presentation to stress the contrast between the marked and unmarked nouns. For participants assigned to the explicit, deductive teaching condition, during training sessions, examiners presented explicit information delineating the pattern or rule underlying the use of the novel morpheme (i.e., "For the small one you say *gack,* but for the big one, you have to say [u], *gacku*"). Thus, children were required to deduce the rule having been told its basic form. For participants assigned to the implicit, inductive condition, examiners provided a filler statement (i.e., "The gacku was sad because he lost his favorite magical object"). Thus, this approach required the children to induce the pattern from positive examples. The children were never told the rule or required to think about language patterns.

All study results were based on generalization production probes. Results revealed that the task was especially difficult for children in both groups. In the explicit condition, however, significantly more of the children with typical language development demonstrated generalization on the posttest (8 participants) than did children with LI (2 participants). In the implicit condition, there was not a significant difference between the children with typical language who generalized (7 participants) and the children with LI who generalized (4 participants). Thus, the children with LI appeared not to gain as much from explicit cues as did the typical learners.

There are several study factors that may have limited the effects of the explicit intervention in the Swisher et al. (1995) study. First, the participants in the Swisher study may have been too young to make use of the explicit instructions provided in the intervention (see, e.g., Hesketh, Dima, & Nelson, 2007). The participants were as young as 4 years and may not have had sufficient language comprehension and cognitive processing skills to apply the provided rules. Second, the children in the Swisher study were required to learn both novel nouns and a novel morpheme that limited the noun's meaning. It may be that grammatical morphemes are likely to be learned most readily when the morphological target itself is the only new aspect of the models provided (Kuczaj, 1982). Therefore, the learning task in the Swisher et al. study may have been unnecessarily complex, especially for learners with LI. The approach adopted for the present investigation maintains the deductive components of the Swisher et al. approach while limiting its complexity and applying it to older children with LI.

Current Study

The current study is a tightly controlled, early efficacy study (Fey & Finestack, 2009) designed to test the efficacy of a deductive language procedure when teaching a novel grammatical inflection to children with LI. The purpose of early efficacy studies is to establish a cause-and-effect relationship between a treatment variable and an outcome measure. In this case, we sought to determine whether a deductive grammatical procedure leads to improved performance on production probes. This type of evidence should indicate whether deductive techniques warrant further examination in other early efficacy studies or even in later efficacy or effectiveness studies, which involve more generalizable and naturalistic conditions. We chose to compare (a) learning of the novel inflection using a deductive procedure with (b) learning using a more commonly employed inductive modeling procedure. The modeling approach used in this study has been shown to be an effective strategy for teaching language forms to young children (Courtwright & Courtwright, 1979; Ellis Weismer & Murray Branch, 1989; Wilcox & Leonard, 1978).

Participants' use of the novel inflection was measured in three contexts reflecting successive levels of generalization and maintenance. The study addressed three primary questions, with predictions based on findings from second language learning and phonological awareness teaching that demonstrate an advantage for deductive procedures:

1. Is a deductive intervention efficacious in teaching children with LI to *produce* a grammatical verb inflection? *Prediction:* On a 10-item production probe that took place immediately after teaching trials and involved the same sentence subjects and verbs as those used in training, it was anticipated that more children who received the deductive intervention would produce the novel gender inflection correctly than would children who received the control inductive intervention.
2. Is a deductive intervention efficacious in teaching children with LI to *generalize* a grammatical pattern to sentences containing unfamiliar subjects and/or verbs? *Prediction:* On a 30-item generalization production probe that took place after the teaching trials and involved sentence subjects and verbs different from those used in training, it was anticipated that more children who received the deductive intervention would demonstrate appropriate use of the novel gender inflection than would children who received the control inductive intervention.
3. Do children with LI *retain* grammatical forms if taught using a deductive language intervention? *Prediction:* On a 20-item maintenance production probe that took place at least 1 day after teaching, it was anticipated that more children who received the deductive intervention would demonstrate appropriate use of the novel gender inflection than would children who received the control inductive intervention.

Method

Participants

Thirty-four 6-, 7-, and 8-year-old children with LI were recruited primarily from a large, urban school district with minority students representing well over half of the population. Prior to the children completing any study testing or experimental sessions, parents signed consents to participate that were approved by the University of Kansas Medical Center Human Subjects Committee. All participants met four primary criteria: (a) They were currently receiving speech-language and/or reading services or were on a watch list for language-learning problems, based on school evaluations; (b) they had Spoken Language Quotients of 80 or below (–1.33 *SD*s) on the Test of Language Development—Primary, Third Edition (TOLD–P:3; Newcomer & Hammill, 1997); (c) they received a standard score of 70 or above (–2 *SD*s) on the Matrices nonverbal scale of the Kaufman Brief Intelligence Test, Second Edition (KBIT–2; Kaufman & Kaufman, 2004); and (d) English was the dominant language in the home. Children were excluded from the study if they met any of the following conditions: (a) a history of frank neurological disorders, such as stroke, traumatic brain injury, seizure disorders, or cerebral palsy, as reported by their parents; (b) a failed hearing screening at the time of identification or a history of receiving services for hearing impairment; or (c) a standard score of 80 or below (–1.33 *SD*s) on the Goldman Fristoe Test of Articulation—Second Edition (Goldman & Fristoe, 2000). Table 1 presents the study groups' characteristics based on the inclusionary and exclusionary entry criteria and other demographic information.

Our criterion for LI was based largely on the work of Tomblin and colleagues (Tomblin et al., 1997; Tomblin, Records, & Zhang, 1996). These investigators defined LI in kindergarten as performance below –1.25 *SD*s on two or more of five composites (vocabulary, grammar, narration, comprehension, and production). They also found that for a single composite score, such as the Spoken Language Quotient from the Test of Language Development—Primary, Second Edition, a cutoff of –1.14 *SD*s yields the highest degrees of sensitivity and specificity (.86 and .99, respectively). Given that a large percentage of our recruitment population included African American children, it was important for us to reduce the chance of false positives; therefore, we maintained the lower cutoff that was suggested by Tomblin et al. (i.e., –1.33 *SD*s). Most children fell well below this criterion with Spoken Language Quotient means below –1.66 *SD*s for each ethnicity across both treatment conditions (see Table 2). The LI status of the participants across ethnic groups was further substantiated by parental report of speech-language

TABLE 1. Participant group characteristics.

Preexperimental variable	Deductive Group	Inductive Group	*p*	*d*(95% CI)
Female:male ratio	0.78:1 (7/9)	0.60:1 (6/10)	1.00	0.06 (–0.64–0.75)
White:African American/Hispanic ratio	0.33:1 (4/12)	0.33:1 (4/12)	1.00	0.00 (–0.69–0.69)
Age (months)				
M	87.94	88.31	.90	–0.05 (–0.74–0.65)
SD	7.71	8.32		
Min–max	74–103	72–102		
Caregiver education (years)				
M	12.81	13.38	.53	–0.23 (–0.92–0.47)
SD	2.69	2.36		
Min–max	9–20	9–18		
Spoken Language Quotient[a]				
M	67.50	69.56	.49	–0.25 (–0.95–0.45)
SD	8.03	8.47		
Min–max	56–80	48–80		
Speaking Composite[a]				
M	68.69	68.88	.96	–0.02 (–0.71–0.67)
SD	10.56	10.50		
Min–max	52–85	49–82		
Listening Composite[a]				
M	78.81	80.13	.64	–0.17 (–0.86–0.53)
SD	8.08	7.66		
Min–max	64–91	64–94		
Syntax Composite[a]				
M	69.81	68.81	.81	0.09 (–0.61–0.78)
SD	11.12	11.66		
Min–max	53–96	51–89		
Nonverbal intelligence[b]				
M	82.31	82.63	.91	–0.04 (–0.73–0.65)
SD	7.90	7.83		
Min–max	73–105	73–99		
Time to complete treatment (days)				
M	9.19	9.31	.93	–0.03 (–0.72–0.66)
SD	3.53	4.39		
Min–max	4–16	4–16		

Note. Min–max = minimum–maximum; CI = confidence interval.

[a]Standard score with $M = 100$, $SD = 15$, based on the Test of Language Development—Primary, Third Edition (TOLD–P:3; Newcomer & Hammill, 1997).
[b]Standard score with $M = 100$, $SD = 15$, based on the Kaufman Brief Intelligence Test, Second Edition (KBIT–2; Kaufman & Kaufman, 2004).

and/or reading services being received at the time of the study participation (see Table 2). Across all groups, the vast majority were receiving such services.

Finally, 17 of our 23 African American participants were serving as participants in a larger intervention study (Fey, Finestack, Gajewski, Popescu, & Lewine, in press). As part of that study, these 17 children received the nonword repetition test (Dollaghan & Campbell, 1998). Process-dependent nonword repetition tests have been shown to exhibit less test bias that may be associated with ethnicity, such as dialectal differences and economic status (Campbell, Dollaghan, Needleman, & Janosky, 1997). Oetting, Cleveland, and Cope (2008) determined that, when combined with a low score on a standardized language test, a percentage phonemes correct score of 71% or lower was the best point for identifying African American children with LI. This is similar to the 70% criterion identified by Dollaghan and Campbell (1998). Fourteen of the 17 participants who took the nonword repetition test received scores below these cutoffs (see Table 2).

Our nonverbal intelligence criterion of 70 or above is lower than that adopted by Tomblin et al. (1996, 1997) in their definition of specific language impairment (SLI; i.e., 85 or above). Fifteen of our participants had nonverbal standard scores in this range and thus could qualify as having SLI. Nineteen of our participants fell within the range of 73 to 84. Tomblin and his colleagues have referred to these children as having nonspecific language impairment (NLI). Thus, we view our sample of children with LI as comprising both children with SLI and NLI. The cognitive variability in the sample allowed us to include more children like those on the caseloads of cooperating speech-language pathologists and special educators, and led us to examine carefully the

TABLE 2. Participant nonverbal IQ and language characteristics according to ethnicity.

Variable	Deductive Group: African American (n = 11)	Deductive Group: Hispanic (n = 1)	Deductive Group: White (n = 4)	Inductive Group: African American (n = 12)	Inductive Group: White (n = 4)
Spoken Language Quotient[a]					
M	68.00	62.00	67.50	68.67	72.25
SD	8.06		9.75	9.41	4.57
Min–max	56–80		56–77	48–80	69–79
Nonverbal intelligence[b]					
M	81.18	76.00	87.00	81.50	86.00
SD	5.53		12.75	6.87	10.65
Min–max	73–91		75–105	73–96	73–99
Speech-language services					
Yes	9	0	4	9	4
No	2	1	0	3	0
Nonword repetition task[c]					
M	65.77[d]			66.15[e]	
SD	7.59			5.49	
Min–max	55.21–76.04			54.17–73.96	

[a]Standard score with M = 100, SD = 15, based on the TOLD–P:3.
[b]Standard score with M = 100, SD = 15, based on the KBIT–2.
[c]Total percentage of phonemes correct based on Dollaghan and Campbell's (1998) nonword repetition task.
[d]n = 7.
[e]n = 10.

relationship between IQ and performance on the experimental task.

Thirty-four children who met the study entry criteria were randomly assigned to a treatment group: the Deductive Group or the Inductive Group. The group assignment order was determined prior to the recruitment and identification of study participants. The investigator was kept unaware of a participant's potential group assignment until the participant completed the entry testing. After a subject was identified, the randomized list was consulted to determine the assignment. After randomization, 1 child could not be contacted for study task sessions. Another child only completed one study task session. These 2 participants were withdrawn from the study. Their data are not included in any of the study analyses. Thus, there was a total of 16 participants in the Deductive Group (mean age = 7.38 years) and 16 participants in the Inductive Group (mean age = 7.36 years).

The randomized treatment groups were compared on a total of nine preexperimental variables, as well as on the total number of days required to complete the four treatment sessions (see Table 1). No significant differences were identified between the two treatment groups on any of these preexperimental measures (all p values > .49).

Novel Grammatical Marking

The novel inflection targeted in this study was the same as that used by Anderson (2001) in her study of inflectional morpheme learning by Spanish children with SLI. This inflection marks the gender of the sentence subject (agent) on the sentence verb (action) in a manner that occurs naturally in other languages, such as Hebrew (Dromi, Leonard, Adam, & Zadunaisky-Ehrlich, 1999). Inflectional morphological gender markers are not used in English; however, because English marks aspect and tense as well as person and number, the gender marking used in this study does not conflict with universal language parameters (Bybee, 1985). In this study, the endings *–pa* and *–po* were used to mark the sentence verb for either a female or male sentence subject. The marking was counterbalanced so that for half of the participants, the *–pa* ending marked a female subject (e.g., "Sara can run*pa*"), and for the other half, the ending was used to mark a male subject (e.g., "Mike can run*pa*"). Using an inflection that does not occur in English ensured that the children's performance in the study was not influenced by previous or concurrent experience with the form being taught.

It was anticipated that this inflection would be especially difficult for children with LI to learn for four reasons. First, in this task, the novel verb gender morpheme served as a verb inflection. Grammatical inflections are members of a morpheme that has been shown to be difficult for children with LI to acquire (Bishop, 1994; Eadie, Fey, Douglas, & Parsons, 2002; Rice & Oetting, 1993; Rice et al., 1998, 2004; Rice & Wexler, 1996). Second, the novel marking in this study involves subject-verb agreement. Although present in English, subject-verb agreement markings are sparsely represented, and they are limited to markings of the third person singular and forms of *be*. These later developing grammatical markings have been shown to be especially difficult for children with LI to acquire (Rice & Oetting, 1993). Third, gender marking in English is restricted to a subset of its pronouns. English-speaking children have less experience and familiarity with gender marking, especially when marked on verbs. Thus, gender inflections are likely to be challenging for children with LI. Fourth, in Anderson's (2001) study of language learning in Spanish-speaking children with SLI using a direct but inductive modeling or a modeling plus imitation procedure, participants with LI had greater difficulty learning the novel inflection compared to participants with typical language development. Because the children in this study had difficulty learning this inflection, it seemed a good marker to use to rigorously test our deductive procedure with children with LI.

Stimulus Presentation

The teaching task and all of the probes were presented via a laptop computer. Computer presentation ensured that in each treatment group, each child received identical presentations of the learning and test stimuli. Participants sat at a table or desk with the computer monitor not more than 3 feet from their eyes. Auditory stimuli were presented through two external speakers. The examiner adjusted the speaker volume to a level confirmed as comfortable by the participants. All study teaching tasks and probe trials were presented using DirectRT (Jarvis, 2003), software designed to present audio and video stimuli via computer.

Teaching Sessions

Each study participant completed four teaching sessions. These sessions were intended to occur within a 2-week period. The mean number of days between individual treatment sessions for both groups combined was 2.75 (range = 1–11; Deductive: M = 2.73, range = 1–11; Inductive: M = 2.77, range = 1–7). The mean number of days required to complete all four treatment sessions for both groups was 9.25 (range = 4–16 days; Deductive: M = 9.19, range = 4–16; Inductive: M = 9.31, range = 4–16). All sessions took place in the children's homes, day cares, or schools in the quietest space available. Each teaching session consisted of a maintenance probe, a teaching task, a teaching probe, and a generalization probe. The exception to this is that the first teaching session did not include a maintenance probe. The probes assessed participants' ability to produce the novel inflection in three different contexts.

Teaching Task

Modeling teaching task. At Times 1 and 2, participants were taught the novel grammatical morpheme using a modeling technique similar to that of Wilcox and Leonard (1978). At the beginning of the task, a narrator informed the participants that "Tiki, a creature from outer space, just came to Earth. Tiki uses many of the same words we do, but there is something different about the way Tiki talks." The narrator instructed the participants to try to figure out Tiki's language so that they could talk just like her. Thus, in both the Deductive and Inductive conditions, the children were made aware of something special to be learned from Tiki's way of talking. The participants were required to watch and listen to each model; the examiner did not instruct the participants to imitate the models.

Next, participants viewed 20 colored graphics depicting characters completing various actions. These drawings included four different characters performing five different actions. Simultaneously, the participants heard the creature from outer space describe the situation using her language (e.g., "Mike can walkpo"). These descriptions served as models of the target grammatical morpheme. After every fifth model, the narrator provided an auditory prompt. The prompt provided depended on the teaching condition (i.e., Deductive or Inductive). The rule-based prompt for the Deductive Group was "When it's a boy, you add *–po* (*–pa*) to the end. When it's a girl, you add *–pa* (*–po*) to the end." The filler prompt for the Inductive Group was "Listen carefully so you can talk just like Tiki." Thus, the key distinction between the two conditions was that the deductive procedure informed the child of the specific details of the target morpheme's pattern of occurrence but the inductive procedure did not.

Recast teaching task. At Times 3 and 4, the teaching task changed. The recast teaching task required the participants to attempt to produce the novel grammatical form when presented with a stimulus comprising a graphic of a character carrying out an action combined with an auditory prompt of the character's name plus the modal *can* (e.g., "Sara can"). Just as in the modeling teaching task, at the beginning of the recast teaching task, a narrator instructed the participants to try to figure out Tiki's language so that they could talk just like her. Next, the narrator instructed the participants to complete each sentence just as Tiki would. The participants viewed 20 graphics identical to the graphics in the modeling teaching task. Simultaneously, the participants heard Tiki begin to describe the situation using her language (e.g., "Mike can…"). If the participants produced the verb with the appropriate gender marking (i.e., *–pa* or *–po*; "Sara can readpa"), the examiner prompted the computer to present the next stimulus. If the participant omitted the gender marking or produced the incorrect marking, the examiner signaled the computer to provide a recast of the child's attempt (e.g., "Sara can readpa"). Just as in the modeling teaching task, after every fifth model, the narrator provided an auditory prompt specific to the participants' group assignment (i.e., Deductive or Inductive).

Teaching task stimuli. Teaching task stimuli, including the sentence subjects and verbs, were selected based on data indicating that children were likely to be familiar with the items. The four sentence subjects that were included in the teaching task were *Sara, Mike, Lori,* and *Jake*. These proper names were selected from the Social Security Administration's database of baby names (Social Security Administration, 2005). These names were all listed in the top 35 most popular names for the 1990s and 2000–2004 databases. Again, this criterion helped ensure that the participants had some familiarity with the names. There were five verbs included in the teaching sentences: *laugh, run, write, dance,* and *drink*. All but one of these verbs (*laugh*) are items on the MacArthur Communicative Development Inventories Words and Gestures form (CDI:WG; Fenson et al., 1993). The CDI:WG was designed for use with children 8 to 16 months old. Thus, the selected verbs should have been in the productive vocabularies of the children in this study.

Teaching Probe

After each teaching task, participants completed a teaching probe that required them to produce the targeted novel inflection. The probe contained 10 items that were randomly selected from the 20 teaching items and presented in a random order. The narrator instructed the participants to complete the sentences just as Tiki would. This presentation format was the same as that used in the recast teaching task.

Generalization Probe

The generalization probe's task and stimulus presentation were identical to the teaching probe. The only differences were in the number of items and the type of items. The generalization probe contained 30 items that were different than those used in the teaching tasks and teaching probe. There were three types of generalization items: a familiar subject paired with a new verb, a new subject paired with a familiar verb, and a new subject paired with a new verb. The familiar subjects and verbs used in this task included the same four subjects and five verbs used in the teaching tasks and teaching probe. The four new subjects (*Ashley, Jenny, Nick,* and *John*) and five new verbs (*cry, walk, read, swim,* and *eat*) met the same selection criteria that were used for the teaching task items. Of the possible 20 stimulus items for each type of generalization item, 10 items of each type were selected at random to be included in the generalization probe. Within the probe, the different types of generalization items were presented randomly.

Maintenance Probe

At Times 2, 3, and 4, participants completed a maintenance probe at the beginning of the session to assess their ability to recall and apply the target inflection form after at least 1 day since instruction. The maintenance probe's task and stimulus presentation were identical to the teaching and generalization probes. The only difference was in the number of items. The maintenance probe contained a total of 20 items. These items comprised the same 10 items as the teaching probe administered during the previous session plus 10 randomly selected generalization probe items from the previous day. The learning and generalization items were randomly presented together.

Reliability of Data

Teaching sessions were audio-recorded using a portable digital recorder with an internal microphone (Marantz PMD660). After each session, using these recordings, the investigator rescored the participants' responses as correct or incorrect. Additionally, the investigator coded the participants' incorrect responses. Responses were considered correct if they contained a verb plus the appropriate *–pa*/*–po* marking. However, some leniency was applied when scoring items given the limited number of learning opportunities. Generally, it was important for the scoring system to recognize all children who clearly contrasted masculine and feminine subjects with a verb suffix that was in at least some ways related phonologically to the target. Therefore, responses in which the consonant /p/ was omitted or replaced by another consonant were scored as correct if the correct vowel was present. Vowel substitutions were allowed as long as there were clear and consistent distinctions between the two target vowels. Such scoring leniency had to be applied for only 2 of the 32 participants. Responses that were judged as incorrect were given one of three error codes: opposite marking, bare stem marking, or "other." Responses were coded as the opposite marking if the participant produced one of the novel forms but matched it to the wrong gender; that is, if the participant's response to an individual item was /pa/ when the correct response was /pou/ (or vice versa). Responses were coded as the bare marking if the participant only produced the verb, omitting the gender marking—for example, if the participant responded, "laugh," when the correct response was "laughpo." Responses were coded as "other" if the marking produced was unclear, ambiguous, or inaudible.

To determine the reliability of the investigator's scoring and coding of the probes, a second coder, blinded to the treatment group assignments of the participants and the primary judge's codes, rescored and recoded 25% of the data. The mean scores for the probes scored by both judges were extremely close: 53% (Judge 1) and 51% (Judge 2) on the teaching probe, 51% (Judge 1) and 50% (Judge 2) on the generalization probe, and 35% (Judge 1) and 39% (Judge 2) on the maintenance probe. Applying the absolute agreement definition, the intraclass correlation coefficients (ICCs) for each probe were all very high (.98, 1.00, and .90, respectively). The ICCs provide a measure of reliability between the judges, indicating the proportion of variance in the scores that is related to the participants' performance rather than that of the judges (Berk, 1979; Suen & Ary, 1989). Our high values indicate that the judges contributed only a very small part of the variance in the children's scores.

To ensure that data entry mistakes were minimized, a research assistant independently reentered all data into a secondary spreadsheet. The investigator's and research assistant's spreadsheets were compared for differences. Discrepancies were resolved by reexamining the original data files.

Fidelity of Treatment

The presentation of the modeling teaching task stimuli for the first two sessions was preprogrammed into the stimulus presentation software. Therefore, for all groups, the delivery of the teaching task was computer controlled. At Times 3 and 4, the recast teaching task required the participants to produce the novel marking. Depending on the participants' responses, the examiner prompted the computer to present a recast of incorrect attempts or to deliver the next stimulus. To ensure that the examiner provided this treatment appropriately, the investigator scored whether the examiner correctly presented each teaching item.

Of the 20 teaching task items presented, the mean percentage of items presented correctly by the examiner at Time 3 was 93.93% (SD = 10.13). The mean percentage of items presented correctly at Time 4 was 93.75% (SD = 12.76). To test whether there were differences in the accuracy of the treatments provided in the Deductive and Inductive Groups, t tests were completed comparing the mean percentages of items presented correctly for each group at Times 3 and 4. Neither analysis revealed differences between treatment groups, Time 3: $t(26) = 0.17$, $p = .81$; Time 4: $t(30) = 0.78$, $p = .93$.

To ensure the precision of the scoring of the treatment accuracy, the examiner's delivery of the treatment was rescored by a research assistant blinded to the treatment group assignments of the participants and the primary judge's codes. The assistant rescored a total of 25% of the Time 3 and 4 recast teaching tasks. The mean percentage of correctly administered trials was 94 for Judge 1 and 92 for Judge 2. Reliability of the scoring was computed using the consistency definition for ICCs based on the arcsine transformed values of the percentage of trials administered correctly. This test yielded an ICC value of .85, indicating that 85% of the variance in subject scores was due to systematic differences between the participants rather than to differences between judges and other sources of error.

Statistical Design

To determine whether more children with LI acquired the novel language pattern when taught using a deductive than an inductive procedure, the nonparametric Fisher's Exact probability test for 2 × 2 tables was completed for each study question. This nonparametric test was selected for the analyses because the percentage accuracy scores obtained for each study question do not reflect a continuous interval scale. Instead, these scores were categorically distributed into three distinct response patterns, defined as follows:

1. "Pattern Users" had accuracy scores at or near 100%. This reflects acquisition of the inflection. The participant correctly marked gender using the appropriate *–pa*/*–po* inflection with no or very few errors.
2. "Undifferentiated Users" had accuracy scores near 50%. This reflects incomplete acquisition of the inflection. The participant either produced the same inflection for all items (e.g., [pa]) or produced both inflections in a rather random fashion).
3. "Bare Stem Users" had accuracy scores near 0%. This reflects no acquisition of the inflection. The participant produced the uninflected English verb form (e.g., "run").

The number of participants in each treatment group who were classified as Pattern Users served as the dependent variable for each analysis. To determine categorization of the response patterns defined above, criteria were established for each response category. Using the traditional conservative value of 90% correct as an indication of mastery of a grammatical form, participants who scored at a level not significantly lower than 90% correct (Brown, 1973; Miller, 1981) on one or more treatment days were classified as Pattern Users. The significance level was determined by calculating the binomial p value, based on the corresponding z score. All scores with cumulative probabilities less than .05 were considered to be significantly lower than 90%. Thus, on the generalization probe, scores less than 24 (i.e., 80%) were considered to be significantly below the 90% criterion level; participants with scores equal to or greater than 24 (80%) were classified as Pattern Users. The cutoff levels for Pattern, Undifferentiated, and Bare Stem Users for each probe were calculated in this same fashion (see Table 3 for individual cutoff values). Phi (Φ) served as indication of effect size for the Fisher's Exact test. Phi values range from 0 to 1; the closer values are to 1, the stronger the relationship between the variables involved. Traditionally, investigators have interpreted phi values of .10, .30, and .50 to be small, medium, and large effect sizes, respectively (Green & Salkind, 2003, p. 353).

TABLE 3. Participant response categorization for the teaching, generalization, and maintenance probes.

Probe	Cutoff criteria (number correct)	Time 1	Time 2	Time 3	Time 4
Teaching (10 items)					
Deductive					
Pattern User	≥7	1	9	8	10
Undifferentiated User	≥3 and ≤6	6	5	3	3
Bare Stem User	≤2	9	2	5	3
Inductive					
Pattern User	≥7	0	2	3	3
Undifferentiated User	≥3 and ≤6	9	12	10	10
Bare Stem User	≤2	7	2	3	3
Generalization[a] (30 items)					
Deductive					
Pattern User	≥24	2	8	6	10
Undifferentiated User	≥11 and ≤19	6	6	5	4
Bare Stem User	≤5	8	2	2	2
Inductive					
Pattern User	≥24	0	0	1	3
Undifferentiated User	≥11 and ≤19	10	13	10	10
Bare Stem User	≤5	6	2	3	3
Maintenance[b] (20 items)					
Deductive					
Pattern User	≥16		3	5	7
Undifferentiated User	≥6 and ≤13		5	5	4
Bare Stem User	≤4		7	6	4
Inductive					
Pattern User	≥16		0	0	2
Undifferentiated User	≥6 and ≤13		8	11	9
Bare Stem User	≤4		8	5	4

[a]One participant in the Inductive Group did not meet any of the response group criteria (score = 10). Three participants in the Deductive Group and 2 participants in the Inductive Group did not meet any of the response group criteria (Deductive scores = 20, 20, and 23; Inductive scores = 10 and 21).
[b]One participant in the Deductive Group did not meet any of the response group criteria (score = 15). One participant in the Deductive Group and 1 participant in the Inductive Group did not meet any of the response group criteria (both scores = 15).

Results

Teaching Probe

To answer Study Question 1, which refers to use of the target morpheme in the same contexts as were presented in the teaching task, participants' performances on the 10-item teaching probe were analyzed. Using the criterion of 7 or more items correct during at least one time period, 12 children in the Deductive Group and 5 children in the Inductive Group were classified as Pattern Users. The nonparametric Fisher's Exact test revealed a statistically significant difference between the groups (p = .03), with a moderate to strong association between group membership and inflection use (Φ = .44).

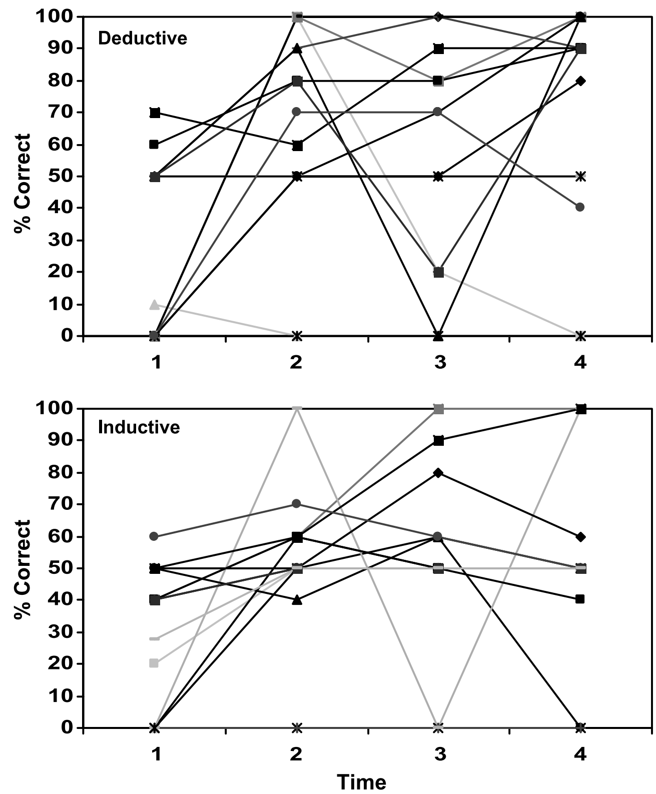
Examination of Table 3 provides insight into the groups' response patterns over time. In the Deductive Group, only 1 participant was a Pattern User at Time 1. At Time 2, over half of the Deductive participants shifted from being Non-pattern Users to Pattern Users, and most participants maintained this level at Times 3 and 4. For the Inductive Group, at Time 1, none of the participants were Pattern Users. At Times 2, 3, and 4, the majority of the Inductive Group participants were Undifferentiated Users. A comparison of the Deductive and Inductive Groups' performance indicates that the majority of Deductive Group participants were Pattern Users; the majority of Inductive Group participants were Undifferentiated Users.

Generalization Probe

To answer Study Question 2 concerning the productive use of the target in new contexts never modeled in the teaching task, participants' uses of the novel *–pa* and *–po* markings on the 30-item generalization probe were analyzed. Using the criterion of 24 or more items correct during at least one time period, 10 participants in the Deductive Group and 3 participants in the Inductive Group were classified as Pattern Users. The Fisher's Exact test revealed a statistically significant difference between the groups (p = .03), with a moderate to strong association between group membership and inflection use (Φ = .45).

Examination of response group categorizations and the individual participants' data in Table 3 and Figure 1 reveals distinct response patterns over time based on the treatment received. In the Deductive Group, at Time 1, 2 participants were Pattern Users. After Time 1, the number of Pattern Users increased dramatically, with 10 Pattern Users at Time 4. The majority of participants in the Inductive Group were Undifferentiated Users. There were no Pattern Users until Times 3 and 4, when 3 participants shifted out of the nonuser categories. A comparison of the two treatment groups indicates that more participants in the Deductive Group were Pattern Users compared with the Inductive Group. For the Deductive Group, the majority of participants became Pattern Users at Time 2; for the Inductive Group, Pattern Users did not emerge until Time 4.

FIGURE 1. Generalization probe individual participant data across teaching sessions for the Deductive Group (top panel) and Inductive Group (bottom panel).



Maintenance Probe

To answer Study Question 3 concerning retention of the ability to use the novel marking over time, participants' performances on the 20-item maintenance probe were analyzed. Using the criterion of 16 or more items correct during at least one of the three sessions, 8 children in the Deductive Group and 2 children in the Inductive Group were classified as Pattern Users who maintained the novel pattern across sessions. The Fisher's Exact test revealed a significant difference between the intervention groups (p = .05), with a moderate to strong association between group membership and inflection use (Φ = .41).

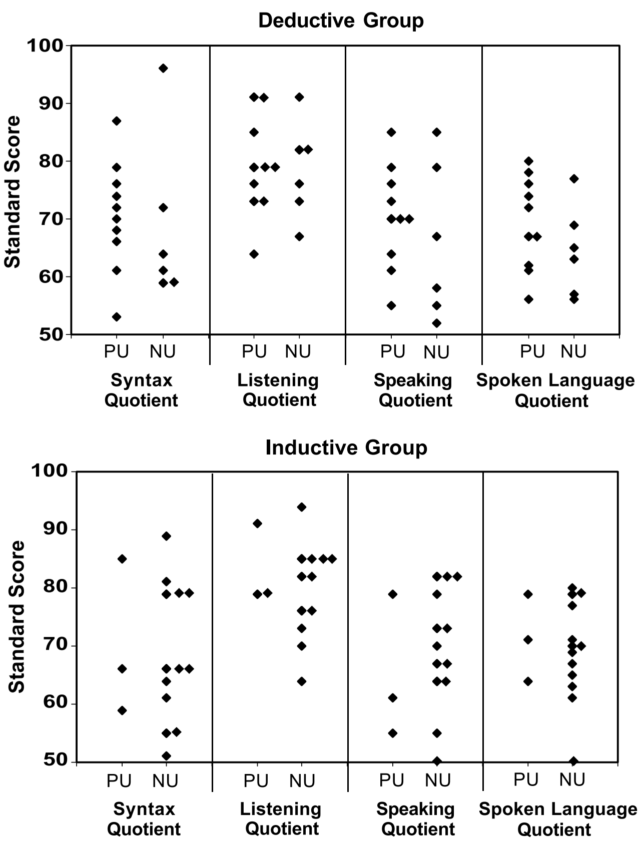
Examination of Table 3 indicates that the majority of the Deductive Group participants were Nonpattern Users at each of the three time points. However, there was a gradual shift in the number of Pattern Users over time, with the most Deductive Group Pattern Users (7) at Time 4. There were no Pattern Users in the Inductive Group until Time 4, when 2 Pattern Users emerged. In sum, compared with the Inductive Group, there were more Pattern Users in the Deductive Group on the maintenance probe.

Post Hoc Analyses

Post hoc analyses were conducted to determine whether the participants' abilities to generalize a grammatical pattern acquired via our deductive procedure were moderated by their language and nonverbal cognitive abilities.

Language ability. To examine the influence of language ability on task performance, dot plots were created demonstrating the range of language scores for participants who met the criteria for Pattern User and those who did not based on the generalization probe (see Figure 2). Four composite scores from the TOLD–P:3 were used as indices of language ability. These indices were Syntax Quotient, Listening Quotient, Speaking Quotient, and Spoken Language Quotient. Examination of Figure 2 reveals that for participants in both the Deductive and Inductive Groups, language ability was not closely related to task performance. In the Deductive Group (see top panel of Figure 2), for each

FIGURE 2. Language abilities of the Pattern Users (PU) and Nonpattern Users (NU) in the Deductive and Inductive Groups.



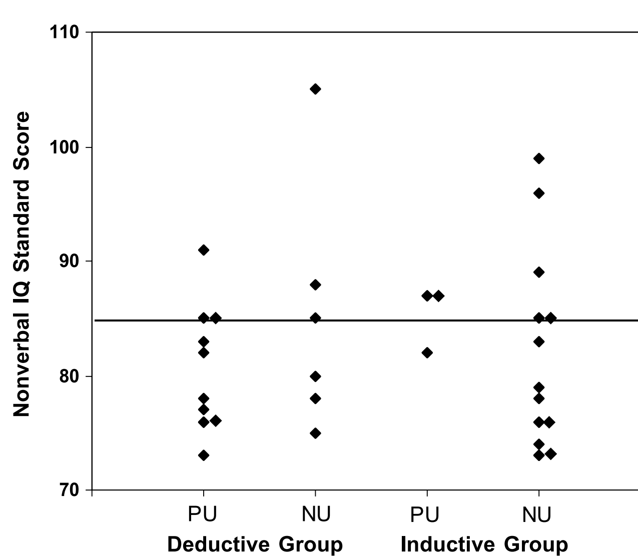
language measure, the 3 participants with the highest language scores included both Pattern Users and Nonpattern Users. Likewise, on each of these measures, the 3 participants with the lowest language scores included both Pattern Users and Nonpattern Users. This same pattern held true for participants in the Inductive Group (see bottom panel of Figure 2) with one exception. The participants with the lowest scores on the Listening Quotients were all Nonpattern Users; however, the participant with the highest Listening Quotient was also a Nonpattern User. The pattern revealed in the dot plot indicates that across treatment groups and language measures, there was a lack of association between language performance and task performance.

Nonverbal intelligence. Our participant exclusionary criteria allowed for children with below average nonverbal intelligence scores to be included in the study, as long as they had nonverbal IQs above 70 and no previously identified developmental disabilities. Ten participants in the Deductive Group and 9 in the Inductive Group had borderline nonverbal intelligence scores (i.e., nonverbal IQ scores between 73 and 84) and could be viewed as having NLI (Tomblin, Zhang, Buckwalter, & O'Brien, 2003). To examine the influence of nonverbal intelligence and consequently diagnosis (i.e., SLI vs. NLI) on task performance, dot plots were created demonstrating the range of KBIT–2 nonverbal intelligence standard scores for participants who met the criteria for Pattern User and those who did not based on the generalization probe (see Figure 3). Examination of Figure 3 reveals that for participants in both the Deductive and Inductive Groups, intelligence was not closely related to task performance. In the Deductive Group, the 5 participants with the highest IQ scores included both Pattern Users and Nonpattern Users. Likewise, the 5 participants with the lowest language scores included both Pattern Users and Nonpattern Users. In the Inductive Group, there were only 3 participants who were Pattern Users. These participants' nonverbal IQ scores fell in the middle of the distribution, while participants in the Inductive Group who were Nonpattern Users included participants at the extreme high and low ends of the distribution. Moreover, a comparison of participants with SLI (dots above the horizontal in Figure 3) and those with NLI (dots below the horizontal line) indicates that neither diagnostic group was more likely to include Pattern Users or Nonpattern Users. Overall, the pattern revealed in the dot plot indicates that across treatment groups, there was a lack of association between nonverbal intelligence and task performance.

Discussion

The purpose of this study was to evaluate the efficacy and effects of an intervention procedure that supplies early school-age children with LI with an explicit grammatical rule and opportunities for rule deduction. On the whole, the results of this study revealed a clear advantage for the deductive procedure over a direct but inductive intervention procedure.

FIGURE 3. Nonverbal intelligence scores based on the Kaufman Brief Intelligence Test, Second Edition (Kaufman & Kaufman, 2004) of the PU and NU in the Deductive and Inductive Groups. The horizontal line marks the standard score cutoff of 85 differentiating participants with specific language impairment (85 and above) and those with nonspecific language impairment (below 85).



Similar to second language learners, it appears that 6- to 8-year-old children with LI can make use of the metalinguistic presentation of a grammatical pattern when learning an inflectional language form.

At first, it does not seem surprising that children who are informed explicitly of a language pattern would outperform children for whom the pattern was implicitly presented in the target exemplars. Several studies in which children with LI have been trained to produce novel grammatical patterns using inductive techniques have shown that learning of these forms is often slow and overall performance is often weak (Anderson, 2001; Connell & Stone, 1992; Johnston, Blatchley, & Olness, 1990). Nevertheless, the only previous study that has tested a similarly deductive procedure was not successful, even over the short term. Specifically, the finding of a significant learning advantage for the deductive procedure in the present study runs counter to the results of the Swisher et al. (1995) study, which also examined the efficacy of a deductive teaching procedure with children with LI.

There are several differences between the present study and that of Swisher et al. (1995) that might account for the differences in study outcomes. First, the participants in the Swisher et al. study were, on average, 3 years younger than the participants in the present study. The youngest participant in the Swisher et al. study was 4 years old; the youngest child in the present study was 6 years old. Recent research in phonological intervention suggests that there are significant age-based limitations in the extent to which children with communication problems can utilize metalanguage to develop speech and phonological awareness targets (see, e.g., Hesketh et al., 2007). There are likely to be similar constraints on grammar facilitation approaches. Furthermore, factors that align closely with age such as language and cognitive abilities may have negatively affected learning of the participants in the Swisher et al. study. Although the language and cognitive abilities of the participants in the current study did not appear to be related to task performance, the participants in the Swisher et al. study may not have possessed enough linguistic exposure or knowledge to have the necessary metalinguistic awareness to apply the explicit rules presented to them.

Second, as noted above, participants in the Swisher et al. (1995) study had the additional task of learning the novel nouns to which the novel bound morpheme was affixed. This additional learning task may have made the complexity of the morphology-based language target too difficult for the participants, especially given their young age. The structure taught in our study was a suffix attached to well-known English verbs.

Third, the teaching contexts differed greatly between the Swisher et al. (1995) study and the current study. In the Swisher et al. study, the novel nouns and the novel morpheme were presented to the participants in a story context. In the present study, the novel morphemes were presented in isolated sentences with identical syntactical structures. Swisher et al. acknowledged that processing of the narrative text plus the processing of the explicit rule may have interfered with the acquisition of the novel lexical morpheme. In the present study, limiting the context of the target form presentation to isolated sentences with identical syntactic constructions may have eased the processing demands required of the participants and allowed the participants to make greater use of the explicit rule presented. We do not know if participants in the present study who received deductive and direct instruction would have demonstrated a learning advantage under more naturalistic teaching conditions such as those used in the Swisher et al. study.

Last, the rule presented in the Swisher et al. study may not have been as explicit as the rule presented in the present study. The Swisher et al. study did not include information regarding the overarching pattern to be learned by the children such as "For the small one you just say the name; for the big one you have to add [u] to the end." Thus, the participants may have been attempting to memorize the specific forms instead of learning a generalizable pattern. The rule presented in the present study may have been better at facilitating the learning of a pattern that could be generalized across exemplars.

It is unclear which, if any, of these factors are critical to the success of the deductive language intervention procedure. However, at the very least, the disparity in findings of these two studies motivates further examination of the efficacy of deductive procedures when teaching children with LI.

Limitations of Observed Effects

Despite the finding that the deductive procedure in the current study was more efficacious than the control inductive procedure in teaching a novel morpheme, this advantage must be qualified in several ways. First, although the participants taught with the deductive procedure learned the gender agreement inflection most readily, it is important to note that not all participants who received the deductive intervention demonstrated acquisition of the novel marking. Several possible factors that might have contributed to learning difficulties, such as language ability and cognitive ability, can be ruled out as likely explanatory variables. Despite the variability in the language scores across participants in both treatment groups, there was no indication that participants with the lowest standardized language scores were at a disadvantage for learning the novel grammatical marking with deductive instruction. However, we did not record the participants' abilities to comprehend or produce specific English inflections. These skills may have influenced the learning of the novel inflection in ways that were not captured by the gross language measures analyzed. As was the case for language ability, there were no differences between participants who did and did not acquire the novel marking based on level of nonverbal intelligence. Thus, participants with below average nonverbal intelligence abilities (i.e., NLI) did not show different learning patterns from those with average nonverbal intelligence abilities (i.e., SLI).

It is also possible that the novel gender agreement morpheme was especially difficult for the English-speaking participants of this study. The novel form targeted in the present study was selected because it had been previously used in a study of language learning (Anderson, 2001). The participants in Anderson's study were acquiring Spanish, a language that is morphologically complex with inflections marking person, tense, aspect, and mood. English makes relatively sparse use of verb inflections. Despite the sparseness of English inflections, it is important to note that for both Spanish and English, agreement markings such as those used in the current study are consistent with the morphological typologies of both languages (see Bybee, 1985). Because English is a sparsely inflected language, with nouns and verbs frequently appearing as bare stems, English-speaking children may be less likely to pay special attention to the ends of words (Dromi, Leonard, & Shteiman, 1993). Thus, in the current study, such cognitive biases may have rendered the participants less likely to attend to the ends of verbs to identify these forms.

The performance of the children in Anderson's (2001) study indicates that cognitive biases most likely cannot account for the learning difficulties of the children in the current study. The Spanish-speaking children in Anderson's study should have had a learning advantage for the novel marking over the English-speaking children in the present study because Spanish is a language that is rich in verb inflections. Thus, these children should have been favorably disposed to acquire and use the target morpheme. However, the nearly complete inability of Anderson's participants with LI to produce the inflections using inductive teaching procedures suggests that a stronger attentional bias toward the ends of words or toward gender agreement would not have rendered the form significantly more learnable for the children in our study. To eliminate these potential confounds, future studies should examine the acquisition of true grammatical morphemes or at least novel morphemes that are more consistent with English morphological inflections (e.g., first and second person present tense). Additionally, to learn more about the language-learning mechanisms of children with LI, follow-up studies should also compare the learning of children with LI to children with typical language development.

A second qualification of our outcomes is that each of the study probes measured language learning in constrained contexts. The contextual constraints are evident on multiple levels. For example, all of the probe items required the participants to produce only the verb corresponding to the action depicted in the graphic presented plus the appropriate gender marking. Furthermore, participants were not required to generate entire sentences. Thus, the complexity of the task was significantly reduced. Probes that required sentence generation or even sentence imitation may have resulted in less substantial gains. Another contextual constraint was that in the teaching tasks, the novel inflection was modeled in the same single syntactic construction, and participants were required to produce the novel inflection in only this construction (i.e., subject + modal *can* + verb). Finally, the probing contexts did not require participants to produce the targeted morpheme in connected language such as conversation or story generation contexts serving a meaningful communicative function. For all of these reasons, the findings of this study may not generalize to contexts in which learners are required to generate and/or produce all sentence elements. This, of course, was one of the primary concerns many clinicians and investigators had with virtually all direct first language methods for teaching language forms; it ultimately led to the fairly exclusive use of implicit approaches to teaching (Fey & Proctor Williams, 2000; Nelson, 1989).

A third qualification of our outcomes is that language learning was only assessed in the expressive domain. Participants' comprehension of the novel form was not measured in this study. In the Anderson (2001) study, both production and comprehension of the novel form were assessed. Although in Anderson's study there was no evidence of learning based on the production probe, both participants with SLI and typical language development demonstrated some learning on the comprehension probe. It is unknown whether the advantage for the deductive procedure found in the current study would also be found in the receptive domain.

A final study qualification is that this study was designed specifically to analyze the impact of the application of a deductive procedure on language learning. Thus, the study procedures were implemented in a rigorous manner to maintain internal validity. It is unknown whether the study outcomes would have been different if both the deductive and inductive procedures had been implemented in a more naturalistic context, such as a focused stimulation format (Fey, Cleave, Long, & Hughes, 1993; Leonard et al., 2004, 2006; Tyler, Lewis, Haskill, & Tolbert, 2003) or as in milieu teaching (Hart & Risley, 1975). Moreover, it may be the case that the most effective treatment strategy may very well be one that supplements naturalistic approaches with deductive procedures (Ellis, 1993). However, it remains unknown whether such an integrated technique would demonstrate the same or a higher degree of efficacy as the deductive procedure evaluated in the present investigation.

Clinical Implications

As noted above, it is most likely the case that the most effective intervention approaches for school-age children with deficits in grammar are those that supplement less direct, naturalistic approaches with deductive teaching procedures. Such an integrated approach has been suggested and even developed by investigators of second language learning and phonological awareness instructions. For example, within second language learning, it has been argued that deductive instruction does not lead to automization of targeted language rules and that it may be necessary to combine deductive and inductive instructional procedures to successfully teach language targets (DeKeyser, 1997; Ellis, 1993). To this same point, Justice and Kaderavek (2004; Kaderavek & Justice, 2004) developed the embedded-explicit approach for emergent literacy intervention in which deductive and inductive instructional techniques are integrated into a single intervention to maximize treatment gains. Thus, the most efficient and effective grammatical interventions for children with LI are also most likely those that blend deductive and inductive instructional techniques. Such an approach may be especially beneficial for early-school-age children with persistent grammatical difficulties that negatively affect both their spoken and written language. However, the efficacy of an integrated approach under these, or any circumstances, is unsubstantiated. Further empirical evaluations of deductive procedures when applied in isolation and when combined with other techniques that involve a variety of language learners are much needed.

The current study was intentionally designed as an early efficacy study (Fey & Finestack, 2009) to examine the effects and efficacy of a deductive intervention procedure. Early efficacy studies are based on short-term interventions in highly controlled laboratory contexts. The results of the current study indicate that there was a significant cause-and-effect relationship between the deductive treatment and the acquisition of a grammatical marker. Given this finding, essential next steps are to replicate the finding in other early efficacy studies with other grammatical targets and to complete later efficacy studies (Fey & Finestack, 2009) that will allow for greater generalization of study findings. To extend the findings from the current investigation, there are a number of factors that will need to be resolved in follow-up efficacy studies. Specifically, future studies must examine (a) the applicability of deductive procedures when targeting true English morphemes that are problematic for children with LI; (b) the generalization of language acquired from deductive procedures to different, less contrived, and more communicative contexts; (c) the achievement of long-term effects of language-learning gains made from interventions incorporating deductive procedures; and (d) the optimal blend between deductive and inductive procedures to include in an intervention program.

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