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Research Article

Evaluation of a Combined Explicit–Implicit Approach to Teach Grammatical Forms to Children With Grammatical Weaknesses

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Purpose: Many children with developmental disorders experience difficulty mastering grammatical forms, including children with developmental language disorder and a subset of children with autism spectrum disorder (ASD). One of the key language features in both of these populations is a weakness in the expressive use of grammatical forms. There is a paucity of studies that evaluate the effectiveness of interventions targeting grammatical forms for populations other than developmental language disorder. The current study evaluated a combined explicit–implicit intervention approach to teach grammatical forms to children with ASD symptomology.
Method: Researchers used a single-subject, nonconcurrent multiple baseline, A-B-C study design. Three children with characteristics of ASD (2 with formal diagnoses) between the ages of 5 and 9 years participated in treatment targeting a weak grammatical structure. After baseline, each participant completed a series of treatment sessions that comprised implicit instruction, followed by a series of treatment sessions that incorporated explicit instruction. Accuracy of use was assessed during each session across baseline, implicit-only, and explicit–implicit conditions as well as 1 week, 1 month, and 2 months posttreatment.
Results: All participants produced target forms with low accuracy across baseline and implicit-only treatment sessions. Within three explicit–implicit treatment sessions, all participants demonstrated a marked increase in level and upward trend in their production accuracy. Gains in accuracy were maintained 2 months posttreatment for 2 of the 3 participants.
Conclusions: The current study provides preliminary evidence to support the use of explicit approaches to teach grammatical forms to children with ASD symptomology and motivates further investigation in this area.

Grammatical weaknesses have been identified and proposed to be a clinical marker for diagnosis of children with developmental language disorder (DLD), which includes children traditionally referred to as children with specific language impairment (Leonard, Miller, & Gerber, 1999; Rice & Wexler, 1996; Rice, Wexler, & Cleave, 1995; Rice, Wexler, & Hershberger, 1998; Tager-Flusberg & Cooper, 1999). Children with DLD omit grammatical morphemes, including verb tense and agreement markers (e.g., past tense *–ed,* third-person singular *–s*) in obligatory contexts for much longer than age-matched peers based on elicitation tasks (Rice et al., 1995) and natural language samples (Bedore & Leonard, 1998; Leonard et al., 1999; Rice et al., 1998).

Researchers have found similar patterns of grammatical weaknesses in other populations. For example, Eadie, Fey, Douglas, and Parsons (2002) found similarities in grammatical deficits between children with DLD and Down syndrome in use of tense (e.g., third-person singular *–s*) and nontense (e.g., omission of articles and *–ing*) morphology. Several studies have also reported deficits in grammatical development in children with fragile X syndrome beyond what would be expected based on mental age, which suggests an impairment similar to DLD (Estigarribia, Martin, et al., 2011; Estigarribia, Roberts, Sideris, & Price, 2011; Finestack & Abbeduto, 2010; Sterling, Rice, & Warren, 2012). Additionally, although language skills vary widely in children with autism spectrum disorder (ASD), there is evidence of a subgroup of children with ASD who exhibit impaired production of grammatical morphemes and complex sentences similar to children with DLD (Eigsti, Bennetto, & Dadlani, 2007; Kjelgaard & Tager-Flusberg,

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2001; Rapin & Dunn, 2003; Roberts, Rice, & Tager-Flusberg, 2004).

Despite a broad range of affected populations, there are relatively few studies that have examined grammatical interventions for children who have a language disorder associated with a neurodevelopmental disorder. Moreover, existing studies suggest that traditional interventions for children with DLD that target grammatical weaknesses yield only moderate outcomes. Traditional grammatical interventions primarily rely on the use of implicit approaches to facilitate grammar, such as modeling, focused stimulation, recasting, and imitation. These approaches aim to increase the frequency children encounter target forms and provide children opportunities to practice target forms they typically omit. However, the most rigorous treatment studies relying exclusively on these implicit approaches indicate that children require many treatment sessions to achieve modest gains (e.g., Fey, Cleave, Long, & Hughes, 1993; Leonard, Camarata, Brown, & Camarata, 2004; Leonard, Camarata, Pawlowska, Brown, & Camarata, 2006).

An alternative approach to grammatical intervention that may be more efficacious is one that incorporates explicit instruction. Explicit or metalinguistic approaches are based on the perspective that children with language weaknesses have difficulty learning grammar implicitly and benefit from explicit teaching of the patterns guiding the use of grammatical forms (Ebbels, 2014). With explicit instruction, the child is given direct instruction of the rules guiding the use of difficult morphosyntactic structures (e.g., teaching a child that when we talk about something that happened in the past, a /t/ or /d/ sound comes at the end of the verb). The number of studies evaluating the efficacy of explicit approaches is much less in comparison to implicit approaches, but there is preliminary evidence to suggest that explicit approaches are effective when teaching grammatical forms to school-age children who experience weaknesses in grammatical language (Bolderson, Dosanjh, Milligan, Pring, & Chiat, 2011; Finestack, 2018; Finestack & Fey, 2009; Kulkarni, Pring, & Ebbels, 2014; Smith-Lock, Leitão, Lambert, & Nickels, 2013; Tobin & Ebbels, 2019). Thus, the current study aims to examine the effectiveness of incorporating an explicit instructional approach with traditional implicit approaches to teach grammatical forms to early school-age children with ASD.

Implicit Grammatical Intervention Approaches

Efficacy of implicit instructional approaches has been most widely investigated for children with DLD, which includes children traditionally identified as having specific language impairment. Although implicit instructional approaches are often utilized in grammatical intervention, the most rigorous treatment studies indicate only modest outcomes (i.e., children often do not reach mastery) after as many as 96 treatment sessions spanning as long as 6 months (Law, Garrett, & Nye, 2004; Leonard et al., 2004, 2006; Leonard, Camarata, Pawlowska, Brown, & Camarata, 2008). Results of a meta-analysis reported by Law et al. (2004) suggest that traditional grammar intervention for children is inadequate. The analysis included 13 speech-language interventions for preschool to school-age children with DLD. Investigators reported mixed evidence to support the effectiveness of expressive grammar interventions, especially if children with severe receptive language deficits were included. Studies included in the meta-analysis (e.g., Fey et al., 1993; Gibbard, 1994) typically employed implicit instructional procedures such as focused stimulation, modeling, and recasting carried out by a clinician or a parent. Researchers found no significant effect for language intervention compared to no therapy when effect size was measured by assessments of overall syntactic ability, mean length of utterances (MLUs), total number of utterances, and parental report of phrase complexity.

Further evidence to support the need for more efficacious grammar intervention comes from Leonard and colleagues (Leonard et al., 2004, 2006). Leonard et al. (2004) provided grammatical intervention to 31 children with DLD aged 3–4 years. Treatment comprised implicit instructional approaches such as focused stimulation (concentrated exposure to target embedded in a story) and conversational recasting (12 recasts per session) to target third-person singular *–s* or auxiliary verbs is/are/was. After a total of 48 interventions sessions over 12 weeks (four sessions per week) and 1,152 exposures to the grammatical target, researchers reported significantly greater gains on target forms in comparison to unrelated target forms. However, mean accuracy for both target forms remained below 50%. The mean accuracy for children whose target was third-person singular was approximately 35% (highest percentage for any child was 82%), and the mean accuracy for children in the auxiliary group was approximately 24% (highest percentage for any child was 65%). Leonard et al. (2006) extended the treatment study by 48 sessions to total 96 sessions over a 6-month period. Again, although children made significant progress in comparison to unrelated nontreated forms, few children reached mastery level with the mean accuracy at 53% for the third-person singular group and 49% for the auxiliary group.

Plante et al. (2014) also reported moderately significant outcomes following treatment using implicit instructional approaches, specifically recasting. In this study, 18 children with DLD aged 4–5 years were randomly assigned to one of two conversational recast treatment conditions (i.e., high-verb variability or low-verb variability) to improve use of various grammatical morphemes. Participants received twenty to twenty-five 30-min sessions over a 6-week period. Researchers found that the children in the high-verb variability group demonstrated significantly stronger performance on probes that tested generalization of the morpheme to new verbs. However, it is important to note that few children exceeded 50% production accuracy on the probes in either condition.

Overall, studies evaluating the effectiveness of grammatical interventions relying exclusively on implicit instruction report equivocal findings and are especially sparse for

children of populations other than DLD. Thus, there remains a need to develop more efficient and effective grammatical intervention that can be applied to various populations.

Combined Explicit–Implicit Grammatical Intervention Approaches

Research indicates that combining implicit language teaching approaches with explicit approaches is beneficial when teaching grammatical forms to children with significant weaknesses in language (Bolderson et al., 2011; Calder, Claessen, & Leitão, 2018; Kulkarni et al., 2014; Smith-Lock et al., 2013). In contrast to implicit approaches, explicit instructional approaches aim to make the child conscious of the target and the underlying pattern or rule that guides the language structure. This is done by directly teaching the child the linguistic context in which a target structure is obligatory, for example, explaining that when we talk about what a person or a thing does all the time, we put a /z/ at the end of the verb (e.g., "He run**s**.").

One type of explicit instruction that investigators have examined is the SHAPE CODING system (Ebbels, 2007), which involves visual cues (Kulkarni et al., 2014). The SHAPE CODING system uses a variety of shapes, colors, and arrows to indicate parts of speech and morphology. In a single-case study, Kulkarni et al. (2014) provided treatment to two children aged 8 and 9 years. Participant A had a diagnosis of DLD, and Participant B had a diagnosis of ASD with language as his main area of need. Treatment targeted verb tense. Interventionists engaged in explicit discussion of grammatical rules, in addition to visually representing target structures using color, shapes, and arrows (e.g., verbs underlined in blue, verb tense highlighted using placement of a down arrow). After ten 30-min therapy sessions, both children demonstrated significant improvement on the Regular Past Tense subtest of the Test of Early Grammatical Impairment (TEGI; Rice & Wexler, 2001). Participant A improved from 0% accuracy to 100% accuracy, and Participant B improved from 15% accuracy to 45% accuracy. However, gains did not generalize to a semistructured conversation task for Participant A until after additional generalization therapy was provided (pregeneralization therapy = 5%, postgeneralization therapy = 55%).

Using a group design study, Smith-Lock et al. (2013) also showed a significant effect of direct explicit teaching combined with implicit grammar facilitation techniques for 5-year-old children with DLD. Treatment targets included increasing production of subject pronouns, possessive *–s*, or past tense *–ed*. The 34 study participants were assigned to one of two intervention groups: grammatical treatment program (experimental group) or the general classroom program (control group). Two grammatical targets were identified for each child in the treatment group, one to be treated and one untreated. Groups met weekly for 1 hr over an 8-week period. The general classroom program focused on following directions and provided comprehension assistance. The grammatical treatment program provided repeated modeling of grammatical targets followed by opportunities for children to produce targets, receive feedback, and have opportunities to correct himself or herself during play-based activities (e.g., playing with Play-Doh). In addition to focused stimulation, recasting, and imitation techniques, children in the treatment group received direct teaching of a grammatical target (e.g., "When we talk about boys, we say *he* and when we talk about girls we say *she*."). There was a significant difference ($d = 1.24$) in grammatical performance on pre- and posttreatment outcome measures between groups. Children in the experimental group demonstrated significantly more progress on treated targets (increased from 22% to 45%) than untreated targets (increased from 28% to 29%) over the intervention period. Researchers recognized that grammar targets did not reach mastery levels.

More recently, Calder et al. (2018) conducted a multiple baseline single-case experimental design study. The study included three 6- to 7-year-old children with language impairment. The treatment target for all three children was the regular past tense *–ed* form. Over the span of 5 weeks, participants completed ten 45-min treatment sessions. Prior to intervention, participants completed three baseline assessment sessions. Postintervention, participants completed two assessment sessions. The SHAPE CODING system was used to teach the targeted form with different shapes representing the sentence subject, verb, and object. An arrow pointing left and down was used to indicate past tense. In the context of completing various play activities, the general treatment steps comprised the clinician explicitly stating the action, modeling a sentence using the corresponding shapes, commenting on the action using the third-person singular form, then asking the child to describe what happened. The clinician and child repeated this sequence an average of 49 times in each 45-min session. Participants 1 and 2 (P1 and P2) demonstrated significant gains on the target form. P1's accuracy of past tense *–ed* production increased from 33% at the end of baseline to 80% posttreatment. However, accuracy on a maintenance assessment 5 weeks posttreatment dropped to 60%. P2's baseline accuracy was 0%, which increased to 20% immediately posttreatment and 53% 5 weeks posttreatment. Participant 3 (P3) demonstrated minimal gains with baseline, immediate posttreatment, and 5 weeks posttreatment accuracy levels of 0%, 7%, and 17%, respectively. Calder et al. concluded that their findings support the use of an intervention approach that combines implicit and explicit techniques, while acknowledging that none of the participants met mastery levels on the target form. The authors suggest that, with more sessions, the gains may have been more robust.

Results from these studies suggest that a combined explicit–implicit treatment approach may be beneficial for children aged 5–9 years with weaknesses in grammatical language, including children with ASD. Generally, the findings indicate that, with relatively few sessions (e.g., 10 sessions), children are able to achieve high levels of accuracy.

However, across studies, relatively few children met mastery levels and long-term treatment effects were not robust. Additionally, given the study designs, it is unclear if the children would have benefitted equally from an implicit-only intervention approach.

Comparison of Explicit and Implicit Approaches

There are a few studies that have directly compared the efficacy of interventions that rely on implicit approaches and those that incorporate explicit instruction (Bangert, Halverson, & Finestack, 2019; Finestack, 2018; Finestack & Fey, 2009; Motsch & Riehemann, 2008). These studies provide preliminary evidence that treatment approaches that include explicit instruction are more advantageous than those that rely solely on implicit techniques when targeting the grammatical weaknesses of children with DLD or ASD.

For example, Motsch and Riehemann (2008) compared implicit-only and combined explicit–implicit intervention approaches to teach German dative and accusative case inflections. Participants included 126 German-speaking children aged 8–10 years primarily diagnosed with DLD. Children in the implicit-only group were in classrooms in which teachers used traditional modeling, while children in the explicit–implicit group were in classrooms in which teachers used "context optimization" techniques, which combine implicit modeling and corrective feedback approaches with metalinguistic approaches to make the target structure and its underlying grammatical rule explicitly known to the child. Researchers reported use of reading, writing, and visual capacities to support this metalinguistic awareness. Children in the experimental group received intervention for an average of 17 min four times a week over a period of 6 weeks for accusative case, 4 weeks for dative case, plus 2 weeks during which the two forms were contrasted. It is unclear how often children in the implicit-only group received intervention for each case marking, although the authors reported that the children in the implicit-only group received specific training on each case marking at the same time that the explicit–implicit group received the context optimization instruction.

Study results revealed that the children in the explicit–implicit group had significantly greater pre- to posttreatment gains than the implicit-only group for only the dative form (explicit–implicit: pretreatment accuracy = 21%, posttreatment = 36%; implicit-only: pretreatment accuracy = 22%, posttreatment = 21%). However, there were no significant group differences in pre- to posttreatment gains for the accusative form (explicit–implicit: pretreatment accuracy = 47%, posttreatment = 71%; implicit-only: pretreatment accuracy = 43%, posttreatment = 67%), although both groups made significant gains. Researchers recognized that only three participants reached accuracy of over 80% for the dative case with this relatively short intervention (12 hr). The study results provide preliminary evidence of an advantage of explicit–implicit instruction over implicit-only instruction; however, groups were not randomly assigned, and the procedures implemented by teachers in the implicit-only group were underspecified.

In three separate studies, Bangert et al. (2019), Finestack (2018), and Finestack and Fey (2009) compared children's acquisition of novel grammatical forms using explicit–implicit and implicit-only instructions. Results from all studies indicated that children who received explicit–implicit instruction outperformed those who received implicit-only instruction. Participants in the Finestack (2018) and Finestack and Fey (2009) studies included children with DLD between the ages of 5 and 8 years; participants in the Bangert et al. (2019) study included seventeen 5- to 10-year-old children with ASD. Using a space-themed learning game, participants were asked to learn to talk like a creature from outer space who "uses a lot of the same words we do, but talks a little bit differently." Across studies, participants were taught one to three novel inflectional forms, including gender, aspect, and/or person markers, in a randomized sequence. Modeling and recasting were used to teach the novel forms for participants when taught with explicit–implicit or implicit-only instruction. Additionally, participants in the explicit–implicit group received direct instruction regarding the pattern or rule guiding the targeted novel form (e.g., "If it is a boy, you have to add *–pa* to the end. If it is a girl, you have to add *–po* to the end").

To assess acquisition, at the end of each of the four to five 20-min treatment sessions, participants viewed pictures of characters engaging in common actions and completed sentences describing the picture using the novel targeted form. In all studies, significantly more children who received explicit–implicit instruction met criteria to be considered a "pattern user" (accuracy scores at or greater than 80%) by the end of the instruction period than children who received implicit-only instruction. Although these results show an advantage of explicit instruction when teaching novel grammatical markers to children with DLD or ASD, researchers cannot conclude that the same outcomes would be observed when teaching true grammatical markers.

In summary, findings from available literature support further development of effective and efficient grammatical interventions for children with DLD as well as other populations of children with grammatical weaknesses. To date, studies have primarily focused on children identified with DLD and have evaluated instructional approaches that rely on implicit techniques. Reported gains associated with implicit-only instructional approaches are often modest even after an extensive amount of treatment sessions. Preliminary evidence suggests that an alternative, explicit instructional approach may be more advantageous than implicit-only approaches when teaching children with grammatical deficits. Thus, in the current study, we examined the use of a combined explicit and implicit approach to teach grammatical forms to children with ASD symptomology experiencing weaknesses in grammatical development.

Current Study

Using a single-subject, multiple baseline nonconcurrent A-B-C design, we evaluated the effects of an exclusively implicit intervention and an integrated explicit and implicit intervention. For each of the three 5- to 9-year-old participants with ASD symptomology, investigators identified a weak morphosyntactic structure and provided implicit instruction for a series of treatment sessions, followed by the addition of explicit instruction for a series of treatment sessions. Accuracy in producing the target structure was measured throughout each condition to determine if the addition of explicit instruction significantly improved accurate production of the target. Additionally, accuracy was assessed across three short-term maintenance sessions, conducted 1 week after the last explicit session, and three long-term maintenance sessions, conducted 1 week, 1 month, and 2 months following the final short-term maintenance session. We anticipated that the explicit–implicit intervention would result in greater accuracy and a faster rate of acquisition compared to the implicit-only intervention. The specific study questions were as follows:

1. Do children produce a grammatical target with greater accuracy and demonstrate a faster rate of acquisition when taught with a combined explicit and implicit approach than an implicit approach alone?
2. Do children demonstrate maintenance of accuracy when provided a combination of explicit and implicit instruction?

The current study extends the work of Bangert et al. (2019), Finestack (2018), and Finestack and Fey (2009) by comparing the effectiveness of implicit-only and explicit–implicit approaches when teaching true grammatical forms in contrast to novel markings. The current study also used more naturalistic activities (i.e., story and play activities) than previously used in the Finestack studies. In contrast to the SHAPE CODING system, clinicians only used verbal cues when explicitly presenting the pattern or rules guiding target forms.

Method

Participant Recruitment

To recruit participants, researchers contacted service providers likely to be working with children eligible for the study, including private clinics and schools. Researchers asked the service providers to share study information with families whom they believed would be appropriate for the study. Parents who were interested in the study consented for the research team to contact them. Researchers also contacted parents of children involved in a previous study on expressive language development in individuals with ASD who consented to be contacted for future research opportunities. Informed written consent was obtained prior to the first assessment.

All study participants were required to meet the following criteria: (a) be between the ages of 5 and 9 years; (b) be a native speaker of mainstream English; (c) have parent concern regarding their child's language development; (d) obtain a standard score on the Structured Photographic Expressive Language Test–Third Edition (SPELT-3; Dawson, Stout, & Eyer, 2003) below 95 or score below screening criterion on the Rice/Wexler TEGI (Rice & Wexler, 2001) to ensure significant weaknesses in grammatical language; (e) have mean correct responses on at least one form assessed by the TEGI below age criterion; (f) have no history or indication of neurological disorders other than ASD, such as stroke, traumatic brain injury, seizure disorder, or cerebral palsy, as reported by the participants' parents; and (g) pass a standard hearing screening.

Descriptive Measures

Trained research assistants administered the following assessments to confirm study eligibility and to characterize participants' language development, cognitive level, and behavioral profile: (a) Rice/Wexler TEGI (Rice & Wexler, 2001), (b) SPELT-3 (Dawson et al., 2003), (c) Test for Auditory Comprehension of Language–Third Edition (TACL-3; Carrow-Woolfolk, 1999), (d) conversational language sample, (e) Conners' Parent Rating Scale–Revised: Long Form (CPRS-R:L; Conners, 1997), (f) Leiter International Performance Scale–Revised (Leiter-R; Roid & Miller, 1997), (g) hearing screening, (h) Child Autism Rating Scale–Second Edition (CARS-2; Schopler, Reichler, & Rochen Rennner, 2010), and (i) developmental and current service questionnaires.

Rice/Wexler TEGI

The TEGI (Rice & Wexler, 2001) is a criterion-referenced standardized test designed to evaluate grammatical deficits in children between the ages of 3 and 9 years. Participants completed the three core TEGI probes, including the third-person singular probe, past tense probe, and Be/Do probe. The TEGI has an average of .91 sensitivity (range: .86–.94) and .82 specificity (range: .80–.84) at the specified screening criteria levels. Criteria levels or "cut-points" represent performance levels that separate the normal group from the language disorder group. The TEGI was used to help determine study eligibility and to identify treatment targets.

SPELT-3

The SPELT-3 (Dawson et al., 2003) includes 54 full-color photographs of everyday situations and objects paired with simple verbal questions and statements to elicit specific morphological and syntactic structures. The SPELT-3 has .90 sensitivity and 1.0 specificity, with a standard score of 95 as a cutoff for 4- and 5- year-old children with language impairment (Perona, Plante, & Vance, 2005). The SPELT-3 yields a standard score with a mean of 100 and an *SD* of 15. The SPELT-3 was also used to help determine study eligibility.

TACL-3

The TACL-3 (Carrow-Woolfolk, 1999) consists of 142 items divided into three subtests that assess a child's ability to understand English vocabulary, grammatical forms, and elaborated phrases and sentences. It is appropriate for children 3 through 9 years of age. The assessment yields a TACL Quotient score with a mean of 100 and an *SD* of 15 as well as standard scores for each subtest with a mean of 10 and an *SD* of 3. The TACL-3 was used to characterize receptive language ability.

Language Sample

The research assistant obtained a conversational language sample from each participant that was approximately 30 min in length. The assistant elicited the language sample during play and reading activities as well as via direct conversational prompts (e.g., Tell me about what you did at school today.). Two trained research assistants transcribed the language samples using Systematic Analysis of Language Transcripts (SALT) conventions (Miller & Iglesias, 2010). We used SALT to calculate the MLU in morphemes. We report the participants' MLU to help characterize their expressive language ability.

CPRS-R:L

The CPRS-R:L (Conners, 1997) is a parent report instrument that assesses symptoms of attention-deficit/hyperactivity disorder and other behaviors in children between the ages of 3 and 17 years. The CPRS-R:L yields standard scores for each subscale related to inattentive symptoms and hyperactive–impulsive symptoms, with a mean of 50 and an *SD* of 10. A standard score greater than 65 is usually understood to indicate a clinically significant problem. The CPRS-R:L was used to help characterize participants' attention abilities and establish a behavioral profile.

Leiter-R

The Leiter-R (Roid & Miller, 1997) is a nonverbal IQ test appropriate for individuals 2–21 years of age. The test specifically measures visualization and spatial reasoning. Instructions for all test items are given using nonverbal cues (e.g., pointing, thumbs up, thumbs down). The Leiter-R yields a Brief IQ composite score with a mean of 100 and an *SD* of 15 that is based on four subtests. This test was used to describe nonverbal cognitive ability.

Hearing Screening

The hearing screening procedures followed the guidelines suggested by the American Speech-Language-Hearing Assessment Panel (American Speech-Language-Hearing Association 1996 Audiologic Assessment Panel, 1997). To pass the screening, participants had to detect 500-, 1000-, 2000-, and 4000-Hz pure tones presented at 25 dB HL in each ear.

CARS-2

Research assistants administered the CARS-2 (Schopler et al., 2010) to characterize the symptom severity of autism behaviors. The CARS-2 comprises two 15-item rating scales that address areas specific to ASD, including verbal and nonverbal communication, relating to people, repetitive behaviors, rituals and routines, and presence of hyper-/hyposensitivity. These quantifiable ratings are based on direct observation, with higher raw scores indicating the presence of autism and greater symptom severity. The standard version (CARS-ST) rating scale is for children between the ages of 2 and 6 years or children age 2 years or older with significantly impaired communication and/or cognitive abilities. Scores of 37 and greater represent severe symptoms of ASD. All three participants were administered the standard version.

Questionnaires

Parents responded to approximately 33 questions regarding age, ethnicity, parent education and employment, child developmental milestones, and special services that the child was receiving. Additionally, with parental consent, researchers contacted the child's speech-language pathologist. The speech-language pathologist responded to approximately 10 questions regarding speech-language services that the participant was currently receiving, including current goals and treatment dosage.

Participants

Participants included three children identified with developmental language delays who presented with ASD symptomology. Table 1 includes a summary of each participant's developmental profile.

P1 was 6 years 7 months at the start of the study. His parent identified him as a White, European American boy. He lived at home in a two-parent household. Both parents were college educated, with one parent holding a master's degree and one parent holding a bachelor's degree. The parent endorsed a preliminary diagnosis of mild–moderate range ASD obtained from the family developmental pediatrician. His score on the CARS-2 (Schopler et al., 2010) indicated severe symptoms of ASD. P1 had been receiving speech-language services for approximately 5 years in addition to occupational and physical therapy. During the study, he was receiving private speech-language intervention two times per week for 60-min sessions. Therapy focused on naming members in a category, answering "why" questions, following directions containing comparative location concepts, and retelling two to three details about remote events.

P2 was 5 years 2 months at the start of the study. His parent identified him as an Asian/Pacific Islander boy. The only language spoken in the home and by the child was English. P2 lived at home in a two-parent household. Both parents obtained graduate degrees and held professional employment. One parent worked full time, while the other worked less than 30 hr per week. The parents reported no history of seizure, behavior disorder, attention-deficit/hyperactivity disorder, or other developmental or acquired disorder. Although P2 had no formal diagnosis, clinically, he displayed symptoms characteristic of ASD and was

Table 1. Participant characteristics.

Variable	Participant		
	P1	P2	P3
Age			
Year;month	6;8	5;6	9;1
TEGI[a]			
Third-person singular	71%; Below criterion	50%; Below criterion	0%; Below criterion
Past tense	100%; Above criterion	69%; Above criterion	0%; Below criterion
Do	0%; Below criterion	80%; Below criterion	0%; Below criterion
Be	100%; Above criterion	76%; Above criterion	0.08%; Below criterion
SPELT-3[b]			
Standard score[c]	86	102	< 4
TACL-3[d]			
TACL Quotient[c]	89	94	49
Vocabulary[e]	6	8	4
Grammatical Morphemes[e]	9	8	1
Elaborated Sentences[e]	10	11	1
Language sample			
Total no. of utterances	270	324	337
MLUm[f]	4.79	3.64	2.52
Conners' Parent Rating Scale–Revised: Long Form[g]			
Oppositional	47	44	71
Inattention	68	56	70
Hyperactivity	68	39	89
Social Problems	78	70	69
ADHD Index	74	54	69
Emotional Lability	56	39	67
Conners' Global Scale	72	44	78
Leiter International Performance Scale–Revised			
IQ Composite	67	70	70
Child Autism Rating Scale–Second Edition			
Raw score	51	38.5	51
T score	64	50	66

Note. ADHD = attention-deficit/hyperactivity disorder.

[a]Rice/Wexler Test of Early Grammatical Impairment (Rice & Wexler, 2001). [b]Structured Photographic Expressive Language Test–Third Edition (Dawson et al., 2003). [c]Standard score: $M = 100$ and $SD = 15$. [d]Test for Auditory Comprehension of Language–Third Edition (Carrow-Woolfolk, 1999). [e]Standard score: $M = 10$ and $SD = 3$. [f]Mean length of utterance in morphemes. [g]*T* scores: $M = 50$ and $SD = 10$.

receiving speech-language services to address areas of social communication at a private clinic. P2 had been receiving speech-language services for approximately 6 months, one time per week for 90 min. The focus of speech-language treatment was to increase the use of question forms to make basic requests, such as "Can I have…?" and "Can you help me…?"; increase ability to follow two-step directions; increase vocal intensity; and increase ability to independently initiate interaction with a peer and engage in joint play. His CARS-2 score indicated severe symptoms of ASD.

P3 was 9 years 0 months at the start of the study. His parent identified him as a White, European American boy. The only language spoken in the home and by the child was English. P3 lived in a two-parent household. One parent held a bachelor's degree, and the other had completed some college. Both parents were professionally employed; one worked full time, while the other worked less than 30 hr per week. Parents reported a formal diagnosis of ASD obtained by a developmental pediatrician and a diagnosis of generalized anxiety disorder. His CARS-2 score indicated severe symptoms of ASD. At the time of the study, P3 had been receiving speech-language services for 6 years, as well as occupational therapy. He received services both through his school and privately. He received school services four times a week for 60 min to address peer interaction and coping skills and three times a week to address expressive and receptive language. He received private services two to four times a week for 45 min. Speech-language goals involved decreasing challenging, attention-seeking, and task-escape behaviors (e.g., using strategies to get attention and self-regulate, asking to take a break); increasing the ability to follow a group plan (e.g., staying in the group, engaging in the group activity); answering a variety of "who," "what," "when," "where," and "why" questions; creating sentences using appropriate pronouns (e.g., I, you, he, she, they, we); using complete messages when commenting, sharing, directing, protesting, or asking for assistance; using three to five descriptive words/traits; and making requests.

Treatment Targets

Upon meeting inclusionary criteria, the research team identified a grammatical target form for each

participant by reviewing performance on the TEGI. The team selected forms that were produced with less than 30% accuracy as targets. P1's treatment target was singular and plural "do" questions (e.g., "Does Mary feed the lamb?" "Do ducks swim in the water?"), which had pretreatment accuracy of 0% (0/10). P2's target was singular and plural "be" copula questions (e.g., "Is the sand hot?" "Are the suitcases heavy?"), which had pretreatment accuracy of 0% (0/5). P3's treatment target was past tense *–ed* forms, which had pretreatment accuracy of 0% (0/10).

Experimental Design

The study utilized a single-subject, multiple baseline nonconcurrent A-B-C design, which included baseline, implicit-only intervention, and explicit–implicit intervention. The independent variable was the following type of treatment: implicit-only or explicit–implicit. The dependent variable was the proportion of accurate productions (spontaneous or elicited) of the participant's target form.

Sessions were typically scheduled two times per week, depending on the family's availability. Each participant completed three to seven baseline sessions during which the researchers ensured that accuracy of the target form remained below 30% prior to the start of treatment. Baseline session lengths for P1 and P3 ranged from 7 to 10 min; sessions for P2 were longer, ranging from 12 to 23 min due to frequent redirections. Following baseline sessions, participants completed a minimum of five implicit-only intervention sessions (P1 and P3: 7–12 min, P2: 12–25 min). If accuracy remained relatively stable after five implicit-only sessions, participants then moved to explicit–implicit intervention for a minimum of five sessions (P1 and P3: 8–16 min, P2: 7–27 min). Explicit–implicit intervention was discontinued after the participant demonstrated 80% accuracy or higher across three consecutive sessions. Immediately after treatment, participants completed three short-term maintenance sessions in which baseline conditions were resumed. Participants also completed three long-term maintenance sessions at 1 week, 1 month, and 2 months posttreatment. Maintenance session lengths ranged from 6 to 11 min for all participants.

Procedure

Three trained interventionists conducted all sessions. Two interventionists were graduate students in speech-language pathology; the other was an American Speech-Hearing-Language Association–certified (CCC-SLP) graduate student. The same general procedures were used for baseline, implicit-only, explicit–implicit, and maintenance sessions. Figure 1 outlines the procedures used in each condition. Across all conditions, each session included a focused stimulation activity followed by an instructional play activity. For the focused stimulation activity, the interventionist read aloud a story that contained eight to 12 models of the target form. This was followed by a play activity in which the interventionist created opportunities for the participant to produce the target form using characters and themes from the story.

Focused Stimulation Model Story Activity

Research assistants who were undergraduate students in speech-language pathology created 17 thematic stories that contained eight to 12 models of the target form. In each story, each target model was applied to a unique verb from the MacArthur–Bates Communicative Developmental Inventories (Fenson et al., 2007). This was done because evidence exists that children acquire forms faster when applied to a variety of verbs (Plante et al., 2014). For P1, each story included six to eight models of the target plural "do" questions (e.g., "Do pigs sleep?" "Do roosters crow?") and four to six models of contrastive singular "do" questions (e.g., "Does the bunny hop?" "Does the barn have doors?"). Researchers chose to provide models of the singular form as a contrast to the plural form to facilitate learning; however, it was not the target of intervention, which is why fewer models were included in the story. For P2, each story included six models of singular copula "be" questions (e.g., "Is the t-rex mean?" "Is the triceratops thirsty?") and six models of plural copula "be" questions (e.g., "Are dinosaurs big?" "Are dinosaurs' teeth sharp?"). For P3, each story included 12 models of past tense *–ed* forms (e.g., "They kissed." "He pushed.").

Researchers purchased toys related to each story theme. See the Appendix for a sample story. Each story was approximately 150–200 words in length with an MLU of 8–10. During the story activity, the interventionist maintained the child's attention by acting out the story with related toys, using exaggerated voice/action, modifying the environment to reduce distractions, and directly requesting the participant's attention (e.g., "Listen to me").

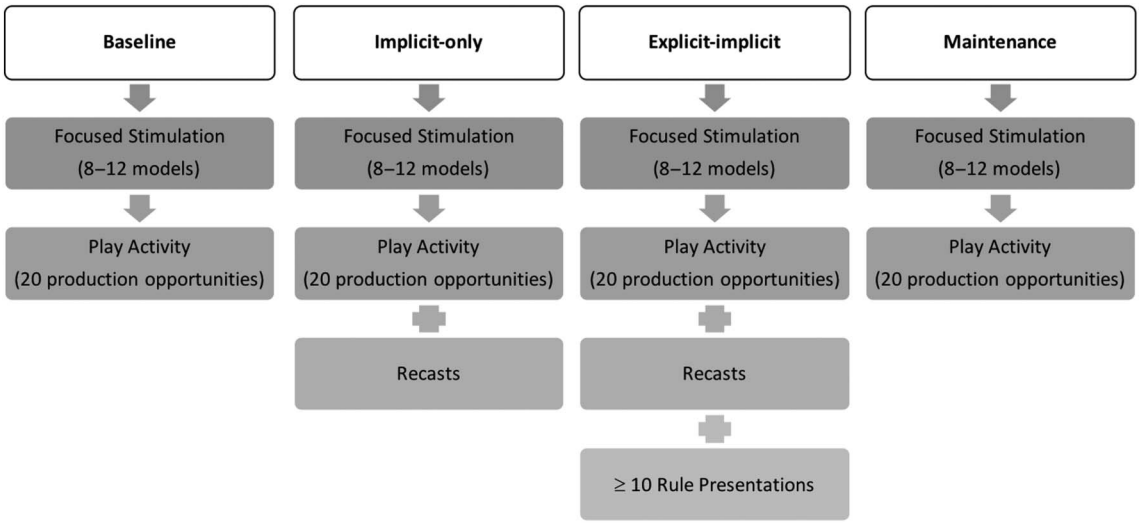
Instructional Play Activity

After the focused stimulation activity, the interventionist gave the participant the opportunity to play with the same toys used by the interventionist in the story. The goal of the activity was to provide the child with at least 20 opportunities to use the target form. These were usually prompted opportunities in which the interventionist elicited the target form with a directive or question (e.g., "Ask if the garage door closes." "She is jumping. Now she's all done jumping. What did she do, she ___?"). Spontaneous attempts or productions by the child to produce the target form also counted as opportunities. The instructional play activity was the only activity that was modified across the baseline/maintenance, implicit-only, and explicit–implicit conditions.

During baseline and maintenance sessions, the interventionist read aloud a model story and facilitated a structured play activity as described above. In contrast to the treatment sessions, the interventionist did not provide any recasts or explicit instruction during the play activity.

During the implicit-only treatment sessions, if the child made an erroneous attempt of the target form during the play activity, the interventionist provided a recast that

Figure 1. Procedures used in each study condition.



emphasized, with vocal stress, use of the correct target form in a complete sentence. The child was not directly told if the production was correct or incorrect, and the interventionist did not explicitly point out the child's error.

During the explicit–implicit treatment sessions, if the child made an erroneous attempt to produce the target form, the interventionist provided explicit feedback in addition to a recast during the play activity. Explicit feedback consisted of verbal instruction such as directly referencing the child's error (e.g., "Uhoh, you started with "does") and explaining the grammatical rule guiding the target form (e.g., "When we ask a question about more than one person or thing, we say 'do' instead of 'does'; when asking about one person or thing, we start with 'is,' and when asking about more than one person or thing, we start with 'are'; when something has already happened, we add a /t/ sound or a /d/ sound to the end of the word.").

Transcription and Coding

The interventionists recorded each session using the internal microphone of a portable audio recorder (Marantz PMD661 or Marantz PMD620). The interventionists' and children's utterances during the instructional play activity were transcribed by trained research assistants, blinded to session number and session type (e.g., baseline, training, or generalization), following conventions of SALT (Miller & Iglesias, 2010). For each recording, after one transcriptionist completed an initial transcription, a second transcriptionist reviewed it and identified discrepancies between the initial transcription and the audio recording. The first transcriptionist then reviewed the discrepancies and made final judgments whether to accept or decline the changes.

Two trained coders, also blind to session number and session type, coded the children's productions of target forms during the instructional play activity. A response was correct if the child produced the appropriate grammatical target spontaneously in a sentence or as a single word in response to a clinician probe. The coders scored all other responses as incorrect, including when the child refused to respond. Because no response or a refusal to respond could indicate avoidance to respond due to lack of ability to produce the target, to be conservative, we considered these responses as incorrect. The average number of refusals for P1, P2, and P3, respectively, across sessions were as follows: baseline: 1.33, 5.25, 3; implicit-only: 0.20, 4.80, 1.60; explicit–implicit: 0.40, 2.18, 0.14; short-term maintenance: 0.00, 2.33, 0.33; long-term maintenance: 0.33, 1.33, 0.67. A response received a separate code if the utterance was inaudible or unintelligible. The coders totaled the number of accurate spontaneous and/or prompted target productions and the total number of opportunities to yield a percentage of correct responses for each session.

Fidelity of Treatment

To determine fidelity of treatment, the coders coded the interventionists' instructions and feedback provided to the participants during the instructional play activity. Codes indicated when the interventionist provided an opportunity to produce the target form (e.g., "What did the boy do?"), a recast (occurring after the child production), and an explanation of the pattern guiding use of the target form. As participants progressed through the explicit–implicit intervention sessions, the interventionists tended to provide shortened explanations of the pattern guiding the target form (e.g., "There is only one person so we would say…[is]"); thus, coders also indicated when the interventionists provided partial explanations. Each child's session transcript was reviewed according to session type: baseline, implicit-only, explicit–implicit instruction, short-term

maintenance, and long-term maintenance. Fidelity measurements, presented in Table 2, included average number of each clinician code by session type.

As expected, in the baseline sessions, the interventionists provided no recasts or presentations of rule/partial rule. In the implicit-only sessions, participants received an average of 12–20 recasts per session. The interventionists did not provide rules or partial rules in any of the implicit-only sessions. In the explicit–implicit sessions, P1 received an average of 1.4 recasts per session, P2 received five recasts, and P3 received 13.7 recasts per session. We note that the interventionist for P3 consistently recasted all child attempts at the target, regardless of accuracy. In the explicit–implicit sessions, the interventionists presented the rule or partial rule at least 10 times per session, on average, for each participant. In the short-term maintenance sessions, the interventionists provided very few recasts to P1 and P2. P3's interventionist continued to recast every child's attempt, providing an average of 20.7 recasts. The interventionist provided few rule or partial rule presentations to P1 and P2 and none to P3. In the long-term maintenance sessions, the interventionists provided an average of 0.3 times per session of recasts to P1 and 7.6 times per session to P3. P2 did not receive any recasts in long-term maintenance sessions. The interventionists did not present the rule or partial rule in long-term maintenance sessions for any of the participants.

Reliability of Child and Interventionist Codes

To assess reliability of the child and interventionist codes, research assistants double-scored approximately 25% of the sessions, randomly selected. Interrater reliability for the child codes was 84%, 93%, and 96% for P1, P2, and P3, respectively. Interrater reliability for the interventionist codes was 88%, 91%, and 94% for each participant.

Data Analysis

Visual inspection of the data was used to examine differences in use of target forms based on treatment condition. The participants' accuracy in producing the target grammatical form was visually analyzed in terms of level, trend, and variability across baseline, treatment, and maintenance phases.

We calculated the percent of nonoverlapping data (PND; Scruggs & Mastropieri, 2001; Scruggs, Mastropieri, & Casto, 1987), a measure commonly used to describe treatment effectiveness in single-subject design studies. The PND method identifies the highest data point in baseline and then calculates the percentage of intervention phase data points that exceed it. We interpreted PND calculations using the following guidelines suggested by Scruggs and colleagues: Scores above 90% represent very effective treatment, scores from 70% to 90% represent effective treatment, scores from 50% to 70% represent questionable treatment, and scores below 50% are ineffective.

Additionally, we calculated effect sizes using Tau-*U* (Parker, Vannest, Davis, & Sauber, 2011). Using an online calculator (Vannest, Parker, Gonen, & Adiguzel, 2016), we calculated two omnibus Tau-*U* scores across all participants: baseline versus implicit-only and implicit-only versus explicit–implicit. We interpreted Tau-*U* scores of < .65 as demonstrating weak or small effects, .66–.92 as demonstrating medium to high effects, and .93–1.0 as demonstrating strong effects (Parker et al., 2011). For each analysis, we used the .40 level to indicate presence of trend in the baseline and implicit-only conditions, respectively, and controlled for trends as necessary (Parker et al., 2011).

Table 2. Fidelity of treatment: average number interventionist-provided opportunities, recasts, and feedback.

Session type by participant	Opportunities	Recasts	Rule presentations	Partial rule presentations
Baseline				
P1	14.3	0	0	0
P2	23.8	0	0	0
P3	21.4	0	0	0
Implicit-only				
P1	14.6	12.2	0	0
P2	24.8	18.8	0	0
P3	14.7	20	0	0
Explicit–implicit				
P1	22.4	1.4	14.6	1.2
P2	19.8	5	3.2	6.6
P3	20.6	13.7	10.9	7.7
Short-term maintenance				
P1	11.7	0	0.2	0
P2	22.7	1.33	0.7	1
P3	21	20.7	0	0
Long-term maintenance				
P1	10.3	0.3	0	0
P2	23.3	0	0	0
P3	22	7.6	0	0

Note. P1 = Participant 1; P2 = Participant 2; P3 = Participant 3.

Results

P1

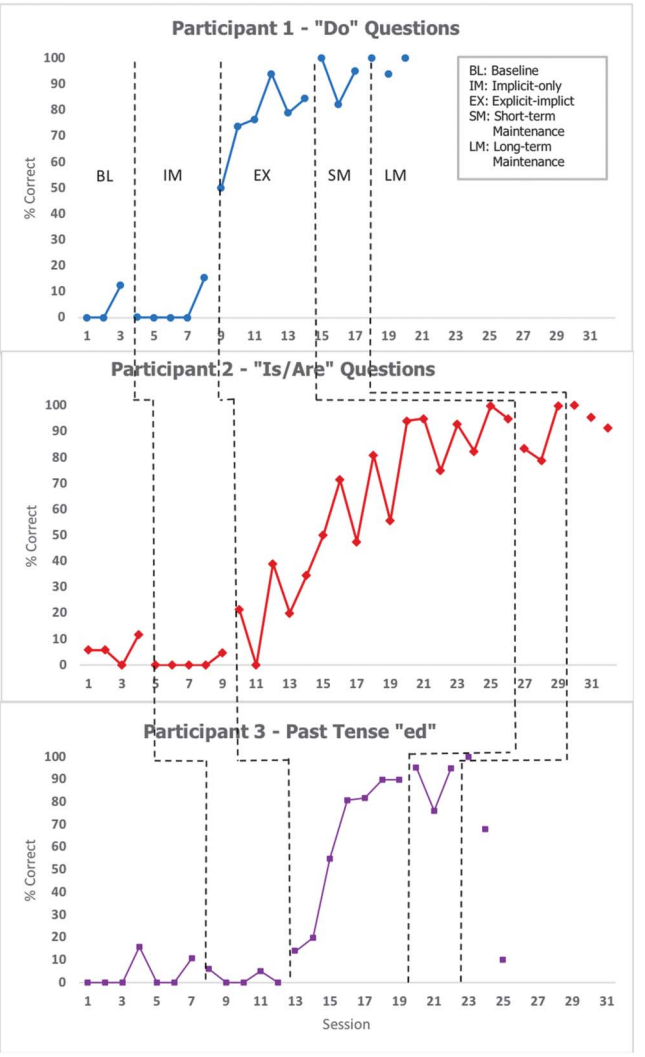
The top panel of Figure 2 displays P1's percent accuracy for producing present tense auxiliary "do" questions. Over the 2-week baseline period, which included three sessions, P1 produced "do" questions with 0%–13% accuracy and "does" questions with 83%–100% accuracy. The interventionist proceeded with treatment targeting "do" questions because his performance on this form was stable and close to 0%. He was above 80% accurate producing "does" questions, prompting the researchers to monitor rather than teach this form. The interventionist continued to probe "does" questions four to six times during each treatment session to evaluate the necessity of teaching this form.

P1 completed five implicit-only treatment sessions over a 2-week period during which his accuracy on "do" questions remained at 0% for the first four sessions and increased to 16% (2/13) at the fifth session. Visual inspection of data in the implicit-only phase reveals stable performance with a slight upward trend between the last two sessions. The interventionist proceeded to explicit–implicit treatment because the increase in accuracy was negligible and well below mastery level (i.e., 80% accuracy) across these five sessions. Without instruction, P1's accuracy on "does" questions was between 67% and 100%.

After switching to explicit–implicit treatment, there was an immediate change in accuracy level and an upward trend across the first three sessions. Accuracy producing "do" questions across these sessions was 50%, 74%, and 76%, respectively. Because P1's performance continued to rise across three consecutive sessions, the interventionist began fading the frequency of explicit feedback. For the remaining explicit–implicit sessions, feedback was only provided after erroneous attempts, but at least three times intermittently throughout the session. During the fourth through sixth explicit–implicit sessions, P1's performance on the target form was 94%, 79%, and 85%, respectively. He achieved a mean accuracy of 86% across the six explicit–implicit treatment sessions over a 1-month period. The interventionist withdrew treatment to assess maintenance because P1 performed near or above 80% accuracy across three consecutive sessions. Without instruction, P1's accuracy on "does" questions remained to be between 67% and 100% in this phase.

P1 completed three short-term maintenance sessions over a 1-week period in which baseline conditions were resumed. He performed at 100%, 82%, and 95% accuracy across these sessions with a mean accuracy of 92%. P1 showed stable performance that remained above 80% accuracy for all short-term maintenance sessions. P1 also participated in three sessions to assess long-term maintenance of the target form at 1 week, 1 month, and 2 months post the last short-term maintenance session. He performed at 100%, 94%, and 100%, respectively, with a mean accuracy of 98%. P1 continued to show stable performance that remained above 90% accuracy for all long-term maintenance sessions. P1's accuracy on "does" questions was between 50% and 100% in both the short- and long-term maintenance phases.

Figure 2. Percent accuracy on target forms across baseline, implicit-only, explicit-implicit, immediate maintenance, and long-term maintenance phases.



P1's PND between baseline and implicit-only phases was 20%. This minimal change indicates that implicit-only instruction was an ineffective treatment. In contrast, P1's PND between the implicit-only and explicit–implicit phases was 100%, indicating a significant shift in performance.

P2

The middle panel of Figure 2 displays P2's percent accuracy for producing present tense copula "be" questions. P2 established a stable baseline with four sessions that occurred over a 1-month period. The extended baseline

period was due to holidays and scheduling conflicts. P2's baseline performance ranged from 0% to 12% accuracy. Due to his low and stable performance across these baseline sessions, the interventionist proceeded to the implicit-only treatment phase.

P2 completed five implicit-only treatment sessions over the course of approximately 3 weeks. He remained at 0% accuracy across the first four sessions. His accuracy increased to 5% in the fifth sessions. Throughout the implicit-only treatment period, P2's performance was stable and remained well below the mastery level. Thus, the explicit–implicit treatment phase commenced after the fifth implicit-only session.

P2 completed 17 explicit–implicit treatment sessions over a 2-month period. Figure 2 reveals that there was a small magnitude of immediate change in level from 5% to 21% between the last implicit-only session and the first explicit–implicit session. Nevertheless, the entire explicit–implicit phase presented an upward trend from 21% to 95% accuracy. With explicit–implicit instruction, P2 was able to implement the rule by starting plural copula questions with "are" and singular copula questions with "is." However, he struggled with plural questions because he produced "are" two times in the questions (e.g., "Are the monkeys are hungry?"). This error pattern caused limited progress in the first four sessions with accuracy between 0% and 39%. Beginning with the fifth session, the interventionist provided additional explicit instruction that highlighted the child's erroneous production to draw attention to his mistake (e.g., "Uhoh, you said, 'Are monkeys ARE hungry?'") and explicit description of the error with a rule (e.g., "You said ARE two times. We only say it one time at the beginning.").

Following the additional explicit instruction, an upward trend was observed between the fifth to seventh sessions, with accuracy increasing from 35% to 71%. Performance levels fluctuated between 48% and 100% accuracy for the remaining 10 sessions. Variability in performance may be explained by P2's level of cooperation during the sessions. Specifically, during the 10th explicit–implicit session, the interventionist was able to elicit only nine attempts of the target. Despite variability in performance levels, Figure 2 reveals a steady increase in performance with explicit–implicit instruction.

P2 completed three short-term maintenance sessions over a 1-week period in which baseline conditions were resumed. He performed at 83%, 78%, and 100% accuracy across these sessions. P2 showed stable performance that remained near or above 80% accuracy for all short-term maintenance sessions. P2's percent accuracy during the 1-week, 1-month, and 2-month long-term maintenance sessions was 100%, 96%, and 91%, respectively. P2 continued to show stable performance that remained above 90% accuracy for all long-term maintenance sessions.

For P2, PND between baseline and implicit-only phases was 0%, indicating that implicit instruction had no effect on improving performance. In contrast, PND between implicit-only and explicit–implicit phases was 92%, indicating that explicit instruction was highly effective compared to implicit instruction.

P3

The bottom panel of Figure 2 displays P3's percent accuracy for producing regular past tense *–ed* forms. Over the course of seven sessions within a 1-month period, P3 established a stable baseline. Baseline performance ranged from 0% to 16% accuracy on the target form. Due to his low and stable performance across the baseline sessions, the interventionist proceeded to the implicit-only treatment phase.

P3 completed five implicit-only treatment sessions over 3 weeks. His accuracy ranged from 0% to 5% during this period. Because his accuracy during the implicit-only treatment sessions remained low, the explicit–implicit treatment phase commenced immediately after the fifth implicit-only session.

There was a slight change in level between the last implicit-only session and the first explicit–implicit session (0%–14%). Figure 2 reveals an upward trend in accuracy across the seven explicit–implicit sessions. P3's accuracy across Sessions 13 through 19 was 14%, 20%, 55%, 81%, 82%, 90%, and 90%, respectively. The interventionist unintentionally completed an additional explicit–implicit session after meeting the stop criteria of three consecutive sessions with performance at 80% or greater, due to error in real-time scoring during the intervention session.

P3 completed three short-term maintenance sessions over a 2-week period in which baseline conditions were resumed. He performed at 95%, 76%, and 95% accuracy, respectively. P3's performance fluctuated with a difference of 19 percentage points from session to session in this phase. P3's performance during the long-term maintenance sessions decreased from 100% at 1 week post the last short-term maintenance session to 68% at 1 month post short-term maintenance to 10% at 2 months post short-term maintenance.

For P3, PND between the baseline and implicit-only phases was 0%, suggesting implicit instruction as ineffective as no treatment due to the absence of change in performance. In contrast, PND between the implicit-only and explicit–implicit phases was 100%. This indicates that explicit instruction had a strong treatment effect compared to implicit instruction.

Tau-U Omnibus Effect Size

The analysis of the overall omnibus effect size comparing the baseline and implicit-only conditions across all participants yielded a small effect (Tau-U = 0.28, 90% confidence interval [−0.67, 0.10]). This indicates that 28% of the data showed improvement between the conditions. In contrast, the analysis of the overall effect size comparing the implicit-only and explicit-only conditions yielded a medium to high effect (Tau-U = 0.92, 90% confidence

interval [0.59, 1.0]). This indicates that 92% of the data showed improvement between the conditions.

Discussion

Three 5- to 9-year-old children with characteristics of ASD and weaknesses in grammatical language participated in a single-subject, multiple baseline nonconcurrent A-B-C designed study, which aimed to evaluate the effectiveness of incorporating an explicit instructional approach with traditional implicit approaches to teach true grammatical forms. We evaluated performance throughout implicit-only and explicit–implicit treatment conditions and examined short-term and long-term maintenance. We hypothesized that (a) children would acquire the target form at a faster rate with inclusion of an explicit approach compared to implicit instruction alone and (b) children would maintain accuracy of the target form following explicit–implicit treatment.

Each participant completed a series of implicit-only treatment sessions followed by a series of explicit–implicit treatment sessions targeting a weak grammatical form. Production accuracy of each participant's target form was measured across each treatment condition. Throughout baseline and the implicit-only treatment phase, performance levels remained relatively stable for all three participants with no clear positive trend. Controlling for possible baseline trend, the omnibus analysis comparing baseline and implicit-only conditions indicated a small effect with only 28% of data showing improvement. Upon switching to explicit–implicit treatment, participants demonstrated a substantial increase in accuracy within the first three sessions. Although a positive trend was observed for all three participants during explicit–implicit treatment, P2 demonstrated more variability in performance compared to P1 and P3. P1 reached mastery criterion (80% accuracy or higher across three consecutive treatment sessions) for "do" questions after completion of the sixth explicit–implicit session. P2 reached mastery criterion for producing present tense copular "be" questions after 17 explicit–implicit sessions, although he first achieved the 80% accuracy level during the ninth session. P3 reached mastery criterion on his regular past tense *–ed* target after seven explicit–implicit sessions. Controlling for possible baseline trend, the omnibus analysis comparing implicit-only and explicit–implicit conditions indicated a medium to large effect with 92% of data showing improvement. Study results support our hypothesis that incorporating explicit instruction into grammatical intervention leads to greater gains in production accuracy than intervention that relies on implicit approaches. PND calculations also support our hypothesis. For all participants, the PND in the implicit-only phase represented ineffective treatment, whereas the PND in the explicit–implicit phase represented highly effective treatment. Also noteworthy is that all participants maintained use of their target form immediately postintervention.

To assess long-term maintenance of the target form, participants completed sessions 1 week, 1 month, and 2 months posttreatment during which the interventionist resumed baseline conditions. Both P1 and P2 performed at or above mastery across all time points, supporting our hypothesis that children would maintain mastery of the target form following treatment. In contrast, P3 did not maintain a high level of accuracy across the long-term follow-up sessions. He performed at 100% accuracy at 1 week posttreatment but then dropped to 68% and 10% accuracy 1 and 2 months posttreatment, respectively. It appears that P3 would have benefited from booster sessions posttreatment, rather than complete cessation of treatment.

Study Implications

Empirical evidence suggests that traditional implicit approaches used to teach grammatical forms to children yield only modest outcomes after long treatment periods (Fey et al., 1993; Gibbard, 1994; Leonard et al., 2004, 2006). Thus, there remains a need to develop more efficacious and efficient interventions for children with weaknesses in grammatical language.

During the implicit-only treatment phase of our study, researchers utilized methodology similar to Leonard and colleagues (Leonard et al., 2004, 2006) including focused stimulation and recasting during structured play. Leonard et al. found that, after 96 treatment sessions and 1,152 exposures to the grammatical target (12 recasts per session), only a few of the 31 children met mastery criteria (mean accuracy approximately 50% for both targets). We found that participants did not make gains in performance with implicit-only instruction; however, once we incorporated the explicit instruction component, there was a spike in performance for each participant. In contrast to Leonard et al. (2004, 2006), our participants achieved mastery performance levels with relatively few explicit–implicit treatment sessions (i.e., six to 17). Thus, our findings provide preliminary evidence in support of incorporating explicit instruction with implicit instruction when targeting use of grammatical forms. Further investigation of explicit–implicit treatment to improve intervention efficacy is warranted.

Our results are consistent with previous research (e.g., Bolderson et al., 2011; Finestack, 2018; Finestack & Fey, 2009; Kulkarni et al., 2014; Smith-Lock et al., 2013) that found a significant advantage when explicit instruction was used to teach grammatical forms to children with DLD. The explicit approach used in the current study closely resembles the explicit approach used by Finestack and colleagues (Bangert et al., 2019; Finestack, 2018; Finestack & Fey, 2009) to teach novel grammatical forms to children with weaknesses in the use of grammatical forms. Thus, findings from the current study support further examination of explicitly presenting the rule or pattern guiding the use of grammatical forms in language intervention. Our study was a small-scale study. A large-scale randomized clinical trial is needed to rigorously evaluate the efficacy

and efficiency of the explicit approach used in the current study.

Another advantage of our study is that it begins to extend previous research on the use of explicit approaches to teach grammatical forms to a population other than DLD, specifically children with ASD or ASD symptomology. There is a paucity of studies that have examined grammatical interventions for children with ASD or other developmental disabilities (e.g., Down syndrome, fragile X syndrome). Our study contributes to the present, small body of work currently available and provides preliminary evidence in support of explicit instructional approaches to teach grammatical forms to children with symptoms characteristic of ASD.

Study Limitations

There are several limitations to this study in regard to its design. Researchers employed an alternating treatment, A-B-C design to compare acquisition of target forms with implicit-only or explicit–implicit treatment. Although reversal design is the most rigorous of the single-subject designs in terms of establishing a causal inference (Graham, Karmarkar, & Ottenbacher, 2012), it was not practical to implement reversal into our experiment, as we did not expect children to unlearn grammatical targets once acquired. Despite this, researchers were diligent in their methodology and took measures necessary to reduce risk of confounding variables (e.g., staggered baseline, standardized treatment protocol across participants) and ensure that observed effects were a result of the independent variable. Even with these precautions, there were small rises in performance at the end of each participant's baseline phase that could confound interpretation of study results. However, performance for each participant dropped in the implicit-only condition and the omnibus effect size controlling for baseline trend indicated improvement in only 28% of data between the baseline and implicit-only conditions.

Our study design was further limited by the nonrandomization of treatment phases. Because all participants received implicit-only treatment prior to explicit–implicit, treatment, the impact of treatment sequencing is unknown. It remains unknown if the explicit–implicit treatment would have been as efficacious if interventionists delivered it directly following the baseline period. We also do not know if we had extended the implicit-only sessions to six or 17 sessions if participants would have made gains similar to those made with explicit–implicit treatment. Given the near floor-level performance across implicit-only sessions, it is unlikely. Further, it may be questionable practice to continue the delivery of an ineffective treatment for an extended period of time.

Additionally, because the study only included two children with diagnoses of ASD and one participant who presented with ASD symptomology, study results cannot be generalized to the broader ASD population. Despite a small sample size, our study demonstrates value in the field as one of only a few studies to evaluate grammatical intervention for children with language impairment other than DLD (see Tobin & Ebbels, 2019) and one of the first to evaluate use of an explicit approach for children with ASD when targeting use of grammatical forms. Further research should be conducted in a more rigorous group design with a larger, heterogeneous population of children (e.g., ASD, DLD, Down syndrome) of different age levels with grammatical impairment to better understand populations for whom explicit treatment approaches may be most beneficial.

Another major limitation of this study is the narrow range of grammatical targets treated. We cannot conclude that the same outcomes would be achieved for all possible grammatical markers and syntactic elements. Although only three unique forms were targeted in this study, the complexity of explicit instruction provided was quite high. For example, for P2, verbal instruction involved a multipart rule (i.e., "Start with ARE when asking about more than one person or thing; start with IS when asking about one person or thing, and only say ARE/IS one time at the beginning"). Participants' responsiveness to multistep rules is a good indication that children would be amenable to less complex explicit rules.

Finally, our study investigated the efficacy of incorporating an explicit instructional approach in a highly structured setting and standardized manner. This allowed us to conduct a rigorously controlled experiment to reduce the risk of confounding variables and allow researchers to compare performance across participants. When receiving explicit–implicit intervention, the children were aware of the teaching target and became familiar with the routine of asking questions within the context of the structured treatment activity. In the current study, we did not assess accuracy in producing the target in other less structured contexts such as spontaneous conversation. Further research should include examination of generalization of use to conversational or narrative contexts with few prompts during which the child's attention is not directed toward the teaching target.

Conclusions

The purpose of this study was to compare an implicit intervention approach and an explicit intervention approach to teach true grammatical forms to children with language weaknesses. The results revealed a significant advantage for the explicit–implicit treatment over the implicit-only treatment such that, immediately after introducing an explicit instructional approach, a marked increase in level and upward trend was observed as well as an increase in PND compared to baseline and implicit-only phases for all participants. The current study provides preliminary evidence to support the use of explicit approaches to teach grammatical forms to children with weaknesses in language development, specifically those with ASD symptomology, and motivates further investigation in this area.

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Appendix

Sample Story

- **Target: Is/are copula questions**
- **Theme: Food**
- **Toys: Learning Resources New Sprouts My Very Own Play Food**

Tyler and Megan wanted to make their mom lunch. (10)

"Is Mom a picky eater?" Megan asked. (9)

"Not really, but she doesn't eat cheese." (8)

"Why, is she allergic to it?" she added. (9)

"Yeah that's why she never makes grilled cheese." (11)

"**Are grilled cheese sandwiches healthy?" (7)**

"They're not the best, but not the worst." (9)

"Are Dad and Ryan hungry too?" Tyler wondered. (9)

"Probably, we should make something for them." (8)

"How about hot dogs?" Megan suggested. (8)

"Good idea, are they easy to cook? (7)

"Yeah you can boil or grill them." (7)

"Let's grill them they're better that way." (9)

They grilled them and poured some milk. (9)

"Is the milk still fresh?" Tyler asked. (8)

"Yeah, it's still good for three more days." (10)

"That hot dog looks burnt, is it done?" (9)

"Yeah they all look cooked to me." Megan thought. (10)

"Are there condiments in the fridge?" they looked. (10)

"There is ketchup and mustard, perfect." (6)

"Are the hot dog buns soft?" (7)

"Yeah they are, should we add a side too?" (9)

"What about the bananas? Are they ripe yet?" (9)

"Yeah except one is brown, is it okay to eat?" (10)

"Uh probably not, you can throw that one away." (9)

Their parents and brother walked in the door. (10)

"Woah, thanks for lunch guys!" they said. (9)

"Is it tasty?" Tyler and Megan wondered. (8)

"Yeah you guys will have to start cooking more often." (12)

The family enjoyed their meal together. (7)