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Preschoolers' imitation of sentential complement sentences: Does the nature of the matrix clause matter?

Ian Morton and C. Melanie Schuele
Vanderbilt University School of Medicine, USA

Abstract
Preschoolers' earliest productions of sentential complement sentences have matrix clauses that are limited in form. Diessel proposed that matrix clauses in these early productions are propositionally empty fixed phrases that lack semantic and syntactic integration with the clausal complement. By 4 years of age, however, preschoolers produce sentential complement sentences with matrix clauses that are more varied. Diessel proposed that the matrix clauses in these later productions semantically and syntactically embed the complement clause. We refer to these matrix clauses as formulaic and true, respectively. Diessel's hypothesis about the development of sentential complement sentences was based on an analysis of spontaneous language. The purpose of this study was to evaluate Diessel's hypothesis with an experimental sentence imitation task wherein stimuli varied in the nature of the matrix clause. Thirty children with typical language development participated; 10 children in each age group (3-, 4-, and 5-year-olds) imitated 50 sentential complement sentences that included either a true or a formulaic matrix clause; the structure of the dependent clauses did not vary. Dependent variables were percent sentence imitation and percent matrix clause imitation. There was a significant main effect for matrix clause type on imitation of sentences and matrix clauses. There was also a significant main effect for age on imitation of sentences and matrix clauses. Significant matrix clause type-by-age interactions were such that percent sentence imitation and percent matrix clause imitation varied by age. Three- and 4-year-olds were less proficient than 5-year-olds on imitation of sentences with true matrix clauses and on imitations of true matrix clauses. Only 3- and 4-year-olds were less proficient imitating true matrix clauses than formulaic matrix clauses. Experimental findings support Diessel's hypothesis that there

Corresponding author:
Ian Morton, Department of Hearing and Speech Sciences, Vanderbilt University School of Medicine, 8310 MCE South Tower 1215, 21st Ave. South, Nashville, TN 37232, USA.
Email: childlanguageandliteracylab@gmail.com

is a developmental progression in the nature of preschoolers' production of sentential complement sentences.

Keywords
Complex syntax, syntax, language development, formulaic language

Introduction

The matrix clauses of sentential complement sentences serve a variety of functions. They can express likelihood (e.g. *I bet I can win*), induce action from the listener (e.g. *Tell me I can win*), or convey mental states (e.g. *She realized I can win*). According to Diessel's (2004) constructivist account of syntax development, the different functions of matrix clauses coincide with differences in how matrix clauses are stored and generated. Some sentential complement sentences have matrix clauses that are stored as a single unit. These matrix clauses are lexically specific matrix clauses that function as attention getters or expressions of likelihood, like *I bet* in *I bet I can win.* Other sentential complement sentences have matrix clauses that are generated from abstract knowledge of the syntactic structure of sentential complement sentences. These matrix clauses convey mental states, like *She realized* in *She realized I can win*. For adult speakers, sentential complement sentences with matrix clauses that are generated from abstract syntactic knowledge 'exist side by side' with sentential complement sentences with lexically specific matrix clauses (Diessel, 2004).

Diessel and other constructivists have argued that children's earliest matrix clauses in sentential complement sentences are not generated from abstract grammatical knowledge. Rather, children's earliest productions of matrix clauses in sentential complement sentences are limited to lexically specific tokens and only gradually come to include adult-like representations of matrix clauses (Diessel & Tomasello, 2001; Kidd et al., 2006). Diessel's developmental hypothesis was informed by analysis of child spontaneous language samples (Diessel, 2004; Diessel & Tomasello, 2001). Diessel observed that 3-year-olds' productions of sentential complement sentences are produced almost always with matrix clauses that consist of a first-person pronoun and an unmarked verb (e.g. *I think it's mine*; Bloom et al., 1989). These first-person pronoun/unmarked verb matrix clauses do not appear to convey propositional content; that is, the matrix clause *I think* in *I think it's mine* expresses likelihood rather than distinct propositional content (i.e. the child is not expressing thinking nor contrasting his thinking with another person's thinking). By 4 years of age, preschoolers produce sentential complement sentences with matrix clauses that consist of varied subjects and verbs overtly marked for tense and agreement, alongside the first-person pronoun/unmarked verb matrix clauses. These matrix clauses more clearly convey propositional content within each clause; *Bill knows Mary is coming to the party* involves Bill knowing as well as the action of Mary.

Diessel and colleagues concluded that the putative matrix clauses in 3-year-olds' sentential complement sentences are 'formulaic' fixed phrases, absent of propositional content, which lack semantic and syntactic integration with the complement clause (see also

Thompson, 2002). Missing from children's earliest sentential complement sentences are 'true' matrix clauses, or varied matrix clauses that are taken as evidence that the dependent clause is truly embedded within the matrix clause. Diessel's proposal, however, conflicts with other accounts of child language development, most notably with generative–nativist approaches to syntax acquisition (Poeppel & Wexler, 1993).

Generative–nativist linguists argue that from the outset of language development, children have access to abstract, adult-like representations of complex syntax (Crain & Thornton, 2000). Poeppel and Wexler (1993) argued that, as early as 2 years 6 months, children have access to the syntactic machinery that is necessary to produce sentential complement sentences. Thus, within generative–nativist frameworks, other reasons are offered to explain why children's earliest matrix clauses appear to be lexically specific but, in fact, are generated from abstract grammatical knowledge. For example, 3-year-olds may only know a few verbs that can be included in matrix clauses (e.g. *think, know*), giving the appearance that children's knowledge of sentential complement sentences is restricted to sentences with lexically specific matrix clauses (Fisher, 2002). When making their earliest mental references, preschoolers are more likely to comment on their own thoughts and observations than the thoughts or observations of others, resulting in the production of first-person pronouns (Bartsch & Wellman, 1995). In addition, children's production of sentential complement sentences could be constrained by performance factors, such as memory. According to Valian (1991), children fall short of adult grammatical representations due to limits in finding and organizing syntactic structures while remembering spoken messages of conversational partners. Critically, generativist-nativists argue that if a child had the requisite vocabulary and was not influenced by performance factors, the child would resemble adults in the grammatical proficiency of his or her sentential complement sentences.

The study reported here employed a sentence imitation task to investigate whether formulaic matrix clause proficiency precedes true matrix clause proficiency for preschool children with typical language. Before describing the experimental task, we briefly review the literature on sentential complement sentence development and describe the features proposed by Diessel and Tomasello (2001) that distinguish formulaic matrix clauses from true matrix clauses.

Development of sentential complement sentences

The most comprehensive analysis of sentential complement sentences to date has been Diessel's (2004) observational study of five children (ages 1 year 8 months to age 5 years 1 month) from the Child Language Data Exchange System (CHILDES; MacWhinney, 2000). Children produced their first sentential complement sentences in the months after their second birthday. Between 24 and 48 months, nearly all sentential complement clauses were adjoined to a matrix clause with a first-person singular pronoun (e.g. *I remember . . .*) or no overt subject in the matrix clause (e.g. *Remember . . .*). The matrix complement clause verbs were verbs that are quite frequent in ambient adult input, like *think* and *know* (i.e. epistemic verbs) or *look* and *see* (i.e. perception verbs). Furthermore, the verbs had tense features that made them unmarked on the surface. The matrix clause did not include auxiliaries, adverbs, or prepositional phrases and there were no

Table 1. Development of sentential complement clause sentences based on Diessel and Tomasello (2001).

Sentential complement clause sentence type	Approximate age of first appearance	Examples
Formulaic Sentential Complement Sentence	⩽3 years 0 months	*I think it's in here.* *I bet you missed the bus, didn't you?*
Performative Sentential Complement Sentence	3 years 0 months–4 years 0 months	*How do you know that it's going to eat supper?* *What do you mean that they'll last a long time?*
Assertive Sentential Complement Sentence	⩾4 years 0 months	*I thought it was in the house.* *He thinks that the puppy is outside.*

complementizers in the head of the complement clause. Diessel referred to these as formulaic matrix clauses.

By their fourth birthdays, children produced third-person pronouns and lexical noun phrases as matrix clause subjects and complement clause verbs were marked overtly for tense (e.g. past tense *–ed*). Some matrix clauses included auxiliaries, adverbs, or prepositional phrases and complementizers sometimes headed the complement clause. Because these matrix clauses convey their own state of affairs, Diessel called them *assertive* matrix clauses. As expected, matrix clauses like *I think* and *I know* continued to occur. The production of assertive matrix clauses was construed as evidence for complex syntax development.

Between their third and fourth birthdays, children produced a third type of matrix clause that addressed specific aspects of conversational interactions. These matrix clauses included first- or second-person pronouns, sometimes included auxiliaries in the matrix clause, and sometimes a complementizer headed the complement clause. Such matrix clauses denoted a mental state or an act of perception (e.g. Sarah at 3 years 7 months: *I didn't know . . .*) or indicated that the hearer should answer the question based on his or her beliefs (e.g. Adam at 4 years 9 months: *What do you mean that they'll last a long time?*). Diessel (2004) referred to these matrix clauses as performative.

Diessel argued that children require no abstract knowledge of sentential complement sentences to produce formulaic matrix clauses. As children hear exemplars of sentential complement sentences with assertive matrix clauses, abstract representations of sentential complement sentences emerge that allow for child productions of assertive matrix clauses. Thus, as described in Table 1, a progression in matrix clause form suggests the emergence of abstract representations of sentential complement sentences during the later preschool years.

Features of formulaic and true matrix clauses

Diessel and Tomasello (2001) posited that formulaic matrix clauses possess semantic and syntactic features that make them distinct from true matrix clauses. Figure 1 provides a decision tree to differentiate formulaic and true matrix clauses based on semantic and syntactic features. Semantically, formulaic matrix clauses act either as epistemic

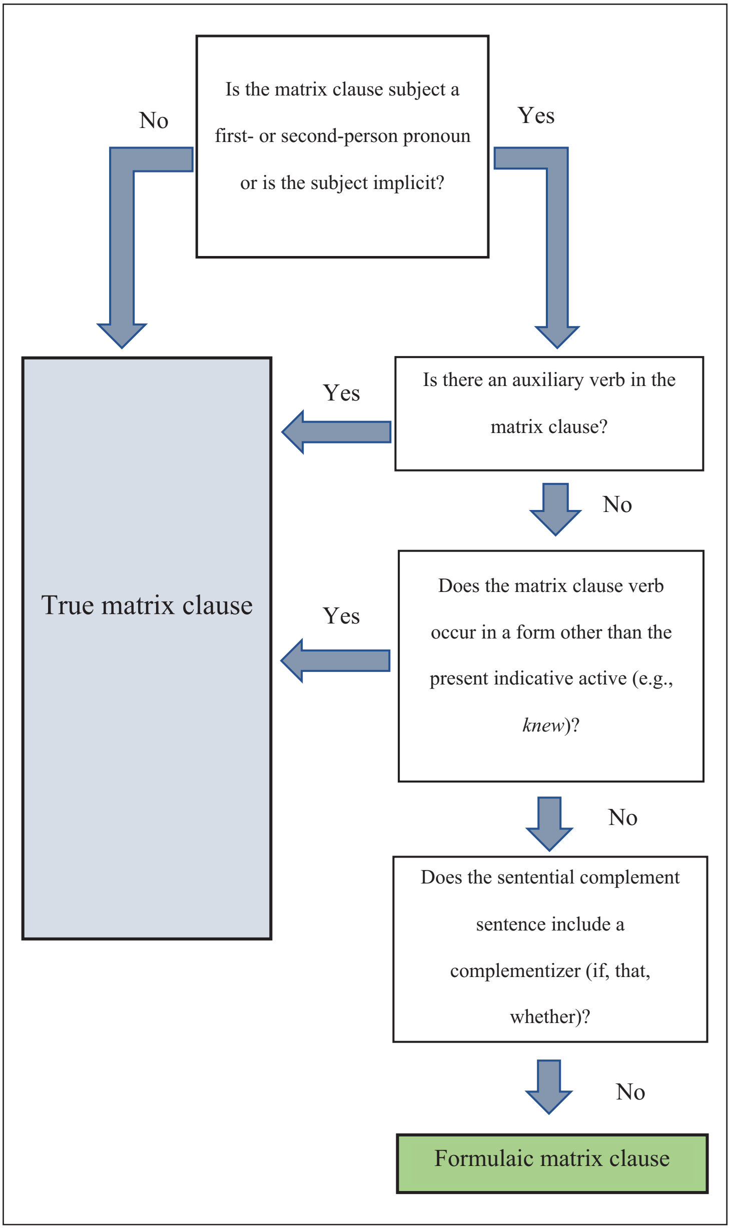

Figure 1. Decision Tree to Differentiate Sentential Complement Sentences With Formulaic Matrix Clauses From Those With True Matrix Clauses Based on Diessel and Tomasello (2001).

markers or as attention getters wherein they convey degree of certitude or likelihood, behaving much like a modal (e.g. *I think she left* is equivalent in meaning to *Maybe she left*). Diessel and Tomasello (2001) suggested that the nature of formulaic matrix clauses

Table 2. Features of formulaic and true matrix clauses based on Diessel and Tomasello (2001).

Sentential element	Formulaic features	True features
Matrix clause	'Fixed phrases' act as semi-modals or attention getters for putative sentential complement clauses	Contain propositional content separate from sentential complement clause; semantic and syntactic integration with the sentential complement clause
Matrix clause NP	Contain first-person or implicit second-person pronoun	Contain a variety of NP elements such as proper nouns, articles + lexical NP, or third-person pronouns.
Matrix clause VP	No tense markers, auxiliaries, adverbs, or prepositional phrases in the predicate	Complement clause verb may be marked for tense and have associated auxiliaries, adverbs, or prepositional phrases

NP: noun phrase; VP: verb phrase.

reflects that they are not productive clauses (i.e. do not allow for embedding of an argument; do not create a between-clause hierarchical relation) but behave as holistic units of fixed word pairings.

In contrast, Diessel and Tomasello (2001) described a true matrix clause as a construction composed of a separate noun phrase unit and verb phrase unit. As such, a true matrix clause formally embeds a clausal complement. Consider the contrast between (1) and (2).

1. She thinks that it's something to eat.
2. I think it might have to go in the other way.

In (1), the clausal complement is structurally embedded in the matrix clause; it is an argument of the matrix clause verb. There are two propositions, the first relating to a girl who is thinking and the second relating to a food item. In contrast, Diessel and Tomasello (2001) argued that in (2) the formulaic matrix clauses are only 'loosely adjoined' to the matrix clause; there is no embedding, and there are not two propositions. Table 2 lists the features of formulaic and true matrix clauses according to Diessel and Tomasello (2001).

Methodological considerations: sentence imitation tasks

The developmental account proposed by Diessel (2004; Diessel & Tomasello, 2001) was based on an analysis of preschoolers' spontaneous language. However, as with all language sample investigations, lack of production of a grammatical structure does not de facto reflect lack of skill (Bloom et al., 1974). Other explanations may account for the observed limitations. For example, a child's choice of talking about here and now topics could underlie the restricted nature of children's early matrix clauses. In conversation, speakers may primarily refer to themselves and ongoing events, resulting in sentential complement sentences with first-person pronoun/unmarked verb matrix clauses.

To address the limitations of language sample data, researchers have employed sentence imitation tasks (Ambridge & Pine, 2006). Researchers can construct experimental stimuli to include varied complexity of the construction of interest, thereby addressing the problem of insufficient evidence within spontaneous language samples (Abel et al., 2015; Ambridge & Pine, 2006; Slobin & Welsh, 1967; Smolík & Vávrů, 2014). Sentence imitation tasks have been used to address developmental questions for complex syntax, including relative clauses (Grant et al., 2002; Kidd et al., 2007; Riches et al., 2010) and sentential complement sentences (Kidd et al., 2006). Sentence imitation involves a child drawing upon lexical and syntactic representations in her long-term memory to reproduce an utterance that exceeds her short-term phonological memory (Potter & Lombardi, 1990). Thus, accurate imitation of a structure is taken as evidence of grammatical proficiency. For example, Kidd and colleagues (2006), noting the restricted complement verb variety in early sentential complement sentences, had preschoolers imitate sentential complement sentences that included complement clause verbs that rarely occur in language samples.

Research questions

We asked two research questions to ascertain whether there was experimental evidence to support Diessel's (2004) claim that preschool children's earliest sentential complement sentences are not indicative of the grammatical proficiency displayed by later-produced sentential complement sentences:

Research Question 1: Are there age- and matrix clause type-related differences in preschoolers' imitations of sentential complement sentences?

Research Question 2: Are there age- and matrix clause type-related differences in preschoolers' imitations of matrix clauses in sentential complement sentences?

We hypothesized that age-related differences would be such that 3- and 4-year-olds would imitate a greater percent of formulaic matrix clauses than true matrix clauses and a greater percent of formulaic sentential complement sentences than true sentential complement sentences. We hypothesized that there would be no such differences for 5-year-olds because by this age, children are proficient in the production of sentential complement sentences.

Method

The study methods were approved by the Vanderbilt University Internal Review Board.

Participants

Thirty preschool children (16 boys) who had typical language skills participated, 10 three-year-olds (five boys), 10 four-year-olds (five boys), and 10 five-year-olds (six

Table 3. Participant demographic characteristics by age group.

Characteristic	Age group		
	3-year-olds (n = 10)	4-year-olds (n = 10)	5-year-olds (n = 10)
Age in months			
M (*SD*)	41.90 (2.92)	51.90 (2.64)	65.30 (2.75)
Maternal education			
High school or GED	2	1	2
Bachelor's degree	4	5	5
Postbaccalaureate	4	4	3
Race/ethnicity			
White/Caucasian	9	9	10
Black/African American	1	0	0
Latino/Hispanic	0	1	0

GED: general educational development.

boys). Parents reported maternal education and race/ethnicity. See Table 3 for demographics.

We recruited preschoolers within three age bands (3 years 0 months–3 years 11 months, 4 years 0 months–4 years 11 months, 5 years 0 months–5 years 11 months) from a community preschool; age freely varied within each age band. Thirty-four children were consented. We conducted eligibility assessments with the consented children until we identified 10 eligible participants within each age band. Eligibility criteria included (a) standard score ⩾85 on the Primary Test of Nonverbal Intelligence (PTONI; Ehrler & McGhee, 2008); (b) standard score of ⩾87 on the Structured Photographic Expressive Language Test Preschool–Second Edition (SPELT-P 2; Dawson et al., 2005); (c) score at or above the chronological age criterion on the Test of Early Grammatical Impairment Screener Probes, Third Person Singular and Past Tense (TEGI; Rice & Wexler, 2001); (d) no enrollment in speech-language or other special education services; (e) per parent report no history of autism, hearing loss, or uncorrected visual impairment; and (f) imitate ⩾75% of the Control Task sentences (see Control Task below). We adopted the SPELT-P 2 empirically derived cutoff score from Greenslade and colleagues (2009) to maximize sensitivity and specificity. Four children failed to meet eligibility criteria (two 3-year-olds on the Control Task, one 4-year-old on the TEGI Past Tense Probe, one 4-year-old on the PTONI). Table 4 reports participant group means and standard deviations on eligibility measures.

Control task

The control task, a sentence imitation task, was intended to demonstrate that a participant's lack of success on the experimental task was not attributable to utterance length production constraints. The task included 20 simple sentences (six sentences included eight morphemes, four included nine morphemes, four included 10 morphemes, six

Table 4. Participant characteristics on eligibility measures by age group.

Measure	Age group		
	3-year-olds (*n* = 10)	4-year-olds (*n* = 10)	5-year-olds (*n* = 10)
	M (*SD*)	*M* (*SD*)	*M* (*SD*)
PTONI standard score	103.9 (11.63)	110.50 (5.46)	106.00 (9.56)
SPELT-P 2 standard score	106.60 (8.57)	103.30 (5.70)	102.80 (7.28)
TEGI % correct			
Third person singular probe	91.60 (10.45)	94.10 (7.58)	97.30 (5.93)
Past tense probe	80.90 (12.22)	90.20 (8.65)	95.70 (4.99)
Control sentence % correct	80.50 (4.97)	92.50 (4.86)	94.00 (5.16)

PTONI: Primary Test of Nonverbal Intelligence (Ehrler & McGhee, 2008); SPELT-P 2: Structured Photographic Expressive Language Test Preschool–Second Edition (Dawson et al., 2005); percent of scorable responses marked for finiteness, TEGI: Rice/Wexler Test of Early Grammatical Impairment (Rice & Wexler, 2001).

included 11 morphemes) that matched the experimental stimuli sentence length (nine to 10 morphemes). The control sentences followed a subject–verb–object structure; sentence length was manipulated by inclusion of adjectives that modified the sentence subject and prepositional phrases in the sentence predicate (e.g. *The slow green turtle walks on the beach*). Control sentence words were drawn from Wordbank to include only words that were used by at least 80% of 30-month-olds (http://wordbank.stanford.edu; Frank et al., 2017).

Experimental task

The experimental task was a 50-item sentence imitation task. Each experimental sentence comprised a matrix clause plus a sentential complement clause; 25 sentences were nine morphemes in length and 25 were 10 morphemes in length. Sentential complement clauses were seven morphemes in length. Sentences did not include complementizers. Each experimental sentence included one of five complement clause verbs in the matrix clause – *think, know, guess, bet, remember.* To select the complement clause verbs, we chose from verbs in Table 3 of Diessel and Tomasello (2001); the selected verbs were used in spontaneous language samples by at least five of their seven preschool participants. The complement clause verbs were distributed across experimental task sentences such that each verb appeared in 10 matrix clauses: (a) four times in a formulaic matrix clause with a first-person singular pronoun plus an unmarked verb (e.g. *I think the happy dog touched the ball*), (b) four times in a true matrix clause with a third-person singular pronoun plus a verb marked for past or present tense (e.g. *He thinks the sticky bug bites the apple*), and (c) two times in a true matrix clause with a third-person singular pronoun plus a complement clause verb and a modal auxiliary (e.g. *She will think the sad bear shared the food*). Apart from the complement clause verbs, experimental sentence words

<table>
<tr><th>Control sentence example</th><th>Experimental sentence example</th></tr>
<tr><td>Examiner says (prior to first control sentence only): Listen to my story about this picture. I want you to repeat the last part that I say. Repeat it just like I say it.

Examiner shows picture and verbally presents control item #1:
[3 sentence story] The mom and her son go to the beach. The son asks about what they see. The son asks, 'What is the turtle doing?'
[pause]
[control sentence] The slow green turtle walks on the beach.

Child imitates control sentence.</td><td>Examiner says (prior to first experimental sentence only): Listen to my story about this picture. Repeat the last part that I say. Repeat it just like I say it.

Examiner shows picture and verbally presents experimental item #1:
[3-sentence story] The mom and her son go to the park. The mom asks about what they see. The mom asks, 'What is the dog doing?'
[pause]
[experimental sentence] I think the happy dog touched the ball.

Child imitates experimental sentence.</td></tr>
</table>

Figure 2. Illustration of Administration Procedure for Control Task Sentences and Experimental Task Sentences.

were drawn from Wordbank to include only words that were used by at least 80% of 30-month-olds (http://wordbank.stanford.edu; Frank et al., 2017).

Procedure

The first author (hereafter, examiner) completed all data collection activities. Children completed two audio-recorded research sessions and all child responses were orthographically transcribed online.

In the first session, children completed, in this order, the PTONI, SPELT-P 2, TEGI, and control task. All standardized measures were administered following the manualized directions. In the second session, children completed the experimental task. Experimental task sentences were presented in one of two sequences to control for order effects. A post hoc univariate analysis of variance (ANOVA) with presentation sequence as the between-subjects factor revealed no evidence of order effects, $F(1, 28) = 0.013, p = .90$.

The control task sentences and experimental task sentences were presented in the same manner, using an adaptation of Kidd and colleagues' (2006) sentence imitation paradigm. For each sentence, the examiner presented a simple, single, color illustration and read a four-sentence story; the last story sentence was the sentence to be imitated, as illustrated in Figure 2. For the experimental stimuli, the color illustration consisted of two figures: one animal (the subject of the sentential complement clause) and one object or animal (the object of the sentential complement clause). The illustration and first three-story sentences created a meaningful context for sentence imitation. For the control task, the color illustration consisted of one figure (the subject of the sentence) and either

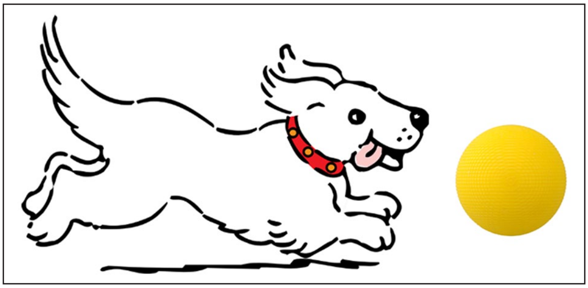

Figure 3. Corresponding Picture for the Experimental Task Item *I Think the Happy Dog Touched the Ball.*

one object (the object of the sentence) or one place (the noun phrase in a prepositional phrase). An example of the picture stimuli is provided in Figure 3.

In the control task, if the child did not attempt to repeat a sentence (i.e. imitated only one word, repeated the contextualization sentences, or gave no response), the examiner presented the sentence one additional time. In the experimental task, no repetition was provided.

Immediately prior to completing the experimental task, each child completed a training task that procedurally aligned with the experimental task. For the training task, if the child did not attempt to repeat a sentence (i.e. imitated only one word, repeated the contextualization sentences, or gave no response), the examiner re-administered the training item with successive prompting until the child attempted to imitate the sentence. First, the examiner provided verbal feedback to encourage the child to repeat the last sentence and only the last sentence: *Remember, you repeat the last part of what I said. Let's try again*. Second, the examiner provided a visual cue by pointing to his mouth at the point of the training sentence in the story. Third, the examiner modeled imitation of the sentence and the examiner then asked the child to imitate the final sentence: *What was that last part? Your turn.* Fourth, the examiner read only the training sentence and told the child to repeat the sentence, *Now, you say it*. Following the first successful prompt, the examiner re-administered the training item in the standard manner and proceeded with the next training item regardless of the child's response. The training task sentences (n = 4) were sentential complement sentences with a complement clause verb, *hope*, that was not used in the experimental task. The four training sentences varied in length (one 9-morpheme sentence, two 10-morpheme sentences, and one 11-morpheme sentence).

The examiner scored all imitations using a scoring system described in Online Appendix A. The scoring paradigm was adapted from Kidd and colleagues' (2006) sentential complement sentence imitation study.

Transcription and scoring reliability

The examiner scored all eligibility measures. A research assistant (speech-language pathology graduate student trained via coursework and clinical practice in assessment) checked 100% of the raw score and standard score calculations. Disagreements were resolved by mutual consensus.

Transcription reliability was established separately for the control and experimental tasks. To establish word-by-word transcription reliability for the control task, a research assistant (a PhD student who had extensive child language transcription experience) randomly selected two children in each age band and orthographically transcribed the selected children's control task responses from audio recordings. These transcriptions were compared with the examiner's online transcription and mean word-by-word transcription agreement was 97% (R = 95%–99%). Thus, we concluded that reliability standards were met and analysis proceeded using the examiner's online transcriptions.

To establish word-by-word transcription reliability for the experimental task, a research assistant (a PhD student who had extensive child language transcription experience) randomly selected two children in each age band and orthographically transcribed the selected children's experimental task responses from audio recordings. The mean word-by-word transcription agreement was 94% (R = 92%–98%). Again, we concluded that reliability standards were met and analysis proceeded using the examiner's online transcriptions.

Dependent variables and analysis plan

Of interest was imitation (all words and morphemes imitated) of experimental sentences by type as well as imitation of only the matrix clause portion of the experimental sentences by type. Thus, six variables were calculated for each child: (a) percent sentence imitation, (b) percent formulaic sentence imitation, (c) percent true sentence imitation, (d) percent matrix clause imitation, (e) percent formulaic matrix clause imitation, and (f) percent true matrix clause imitation.

We conducted two 3 (Age) × 2 (Matrix Clause Type) mixed-model ANOVAs with dependent variables of sentence imitation and matrix clause imitation. Age (3-, 4-, and 5-year-olds) was the between-subjects factor and Matrix Clause Type (formulaic, true) was the within-subjects factor. ANOVAs were conducted using arcsine transformations of percent data to satisfy assumptions of homogeneity of variance and approximate a normal distribution of scores. We set statistical significance for main effects at .05. For main effects and interactions yielding a statistically significant difference, effect size was calculated using eta-squared statistics. Post hoc group comparisons were conducted with a Bonferroni correction (.05/3). For post hoc group comparisons yielding a statistically significant difference, effect size was calculated using Cohen's d. As suggested by Cohen (1994), we interpreted d values of 0.8 or greater as representing a large effect size, d values less than 0.8 and larger than 0.2 as representing a medium effect size, and 0.2 or smaller as representing a small effect size. Confidence intervals (CIs) were calculated for Cohen's d and eta-squared statistics.

Results

Table 5 provides descriptive statistics (means, standard deviations) for the dependent variables by age group.

Table 5. Percent of sentence and matrix clause imitation by age group.

Variable	Age group		
	3-year-olds (n = 10)	4-year-olds (n = 10)	5-year-olds (n = 10)
	M (SD)	M (SD)	M (SD)
Sentences (n = 50)	36.40[a,b] (17.88)	54.60[a] (18.60)	67.80[b] (21.65)
Formulaic Sentences (n = 20)	53.50[a,b] (18.42)	69.50[a] (19.36)	77.50[b] (19.90)
True Sentences (n = 30)	22.67[a,b] (18.38)	43.93[a] (19.35)	60.67[b] (20.77)
Matrix Clauses (n = 50)	44.00[a,b] (19.39)	71.40[a] (11.12)	80.60[b] (15.17)
Formulaic Matrix Clauses (n = 20)	68.00[a,b] (17.51)	88.00[a] (12.52)	84.50[b] (20.20)
True Matrix Clauses (n = 30)	27.67[a,b] (21.66)	60.33[a,c] (11.38)	78.67[b,c] (16.87)

[a]Significant between-group difference for 3- and 4-year-olds. [b]Significant between-group difference for 3- and 5-year-olds. [c]Significant between-group differences for 4- and 5-year-olds.

Sentence imitation

Are there age- and matrix clause type-related differences in preschoolers' imitations of sentential complement sentences? With percent sentence imitation as the variable to address the first research question, there was a main effect for Age, $F(2, 27) = 6.93$, $p = .004$, $\eta^2 = .34$, 90% CI = [.08, .49], and Matrix Clause Type, $F(1, 27) = 144.57$, $p < .001$, $\eta^2 = .84$, 90% CI = [.73, .89]. There was also a significant Age × Matrix Clause Type interaction, $F(2, 27) = 4.17$, $p = .03$, $\eta^2 = .24$, 90% CI = [.02, .40]. Formulaic matrix clause sentences were imitated at higher accuracy than true matrix clause sentences ($d = 1.02$, a large effect size, 90% CI = [0.20, 1.77]).

Planned post hoc between-group comparisons for age revealed a significant between-group difference for 3- and 4-year-olds, $t(18) = -2.61$, $p = .02$, with a large effect size, $d = 0.83$, 90% CI = [0.04, 1.59], as well as for 3- and 5-year-olds, $t(18) = -4.35$, $p < .001$, with a large effect size, $d = 1.42$, 90% CI = [0.48, 2.02], but not for 4- and 5-year-olds, $t(18) = -1.78$, $p = .09$.

To explore the interaction effect, planned post hoc comparisons revealed statistically significant within-group differences in each age group. Formulaic matrix clause sentences were imitated with greater proficiency compared with true matrix clause sentences for 3-year-olds, $t(9) = 10.17$, $p < .001$; 4-year-olds, $t(9) = 8.41$, $p < .001$; and for 5-year-olds, $t(9) = 4.02$, $p = .003$. The difference for 3-year-olds constituted a large effect size, $d = 1.60$, 90% CI = [1.30, 3.23], and the difference for 4-year-olds constituted a large effect size, $d = 1.97$, 90% CI = [0.40, 2.02], whereas the difference for 5-year-olds constituted a medium effect size, $d = 0.79$, 90% CI = [0.03, 1.56]. Figure 4 shows the percent of sentential complement sentence imitation by matrix clause type and by age group.

Matrix clause imitation

Are there age- and matrix clause type-related differences in preschoolers' imitations of matrix clauses in sentential complement sentences? With percent matrix clause imitation

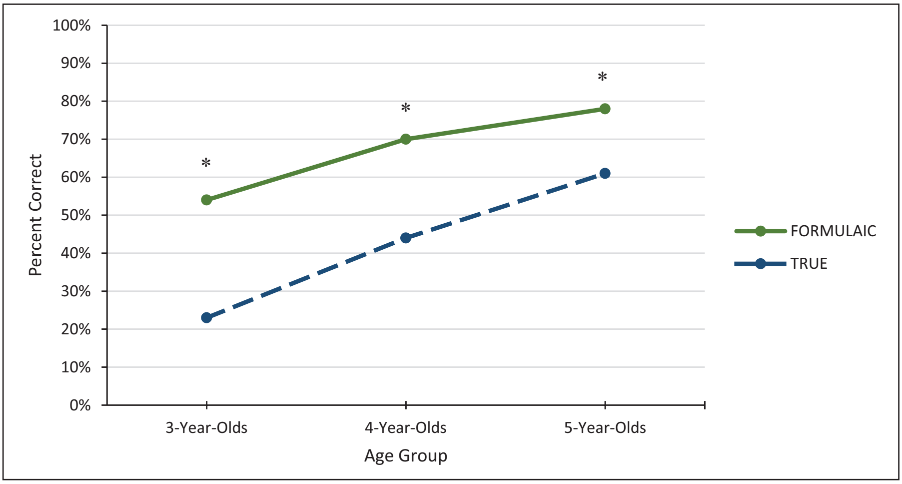

Figure 4. Percent of Sentential Complement Sentence Imitation by Matrix Clause Type and by Age Group.
*$p < .01$.

as the variable to address the second research question, there was a main effect for Age, $F(2, 27) = 10.33, p < .001, \eta^2 = .34$, 90% CI = [.16, .53] and Matrix Clause Type, $F(1, 27) = 75.17, p < .001, \eta^2 = .74$, 90% CI = [.56, .81]. Again, there was a significant Age × Matrix Clause Type interaction, $F(2, 27) = 5.27, p = .012, \eta^2 = .28$, 90% CI = [.05, .46]. Formulaic matrix clauses were imitated at higher accuracy than true matrix clauses ($d = 1.05$, a large effect size, 90% CI = [0.25, 1.82]).

Planned post hoc between-group comparisons for age revealed a significant between-group difference for 3- and 4-year-olds, $t(18) = -3.48, p = .003$, with a large effect size, $d = 1.10$, 90% CI = [0.21, 1.78], as well as for 3- and 5-year-olds, $t(18) = -4.20, p = .001$, with a large effect size, $d = 1.42$, 90% CI = [0.46, 2.09]. However, again, there was no between-group difference for 4- and 5-year-olds, $t(18) = -1.16, p = .26$.

To explore the interaction effect, planned post hoc tests compared percent matrix clause imitation by matrix clause type within each age group. The within-group difference was statistically significant for 3-year-olds, $t(9) = 9.14, p < .001$, as well as for 4-year-olds, $t(9) = 9.36, p < .001$. The within-group difference was not significant for 5-year-olds, $t(9) = 1.66, p = .131$. The difference for 3-year-olds constituted a large effect size, $d = 1.97$, 90% CI = [0.94, 2.72], and the difference for 4-year-olds constituted a large effect size, $d = 1.80$, 90% CI = [1.15, 3.05]. Figure 5 shows the percent of matrix clause imitation by matrix clause type and by age group.

The above results offer an incomplete picture of children's sentential complement sentence imitation. Two additional areas require analysis. First, children's imitation of sentential complement clauses contributed to children's imitation of sentential complement sentences. Given the involvement of sentential complement clauses, we performed an analysis of sentential complement clause imitations to clarify the relation of formulaic sentential complement sentence imitation and formulaic matrix clause imitation. Given

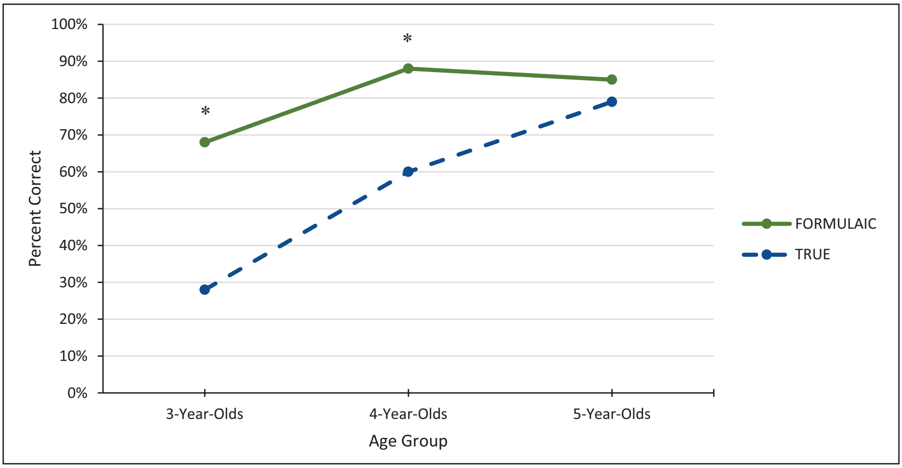

Figure 5. Percent of Matrix Clause Imitation by Matrix Clause Type and by Age Group.
$^{*}p < .01$.

our results, we would expect better sentential complement clause imitation following formulaic matrix clauses than true matrix clauses. Second, children's errors on true matrix clause imitations may be the result of more opportunities to omit or substitute inflectional morphemes for true matrix clauses than formulaic matrix clauses. However, if children's initial knowledge of matrix clauses is restricted to formulaic matrix clauses, it is possible that children's errors on true matrix clauses result in the substitution of formulaic matrix clauses. Given this possibility, we performed an analysis of children's true matrix clause errors that result in substitution of formulaic matrix clauses.

Exploratory analyses of sentential complement clause and true matrix clause imitation

Three variables related to children's imitation of sentential complement clauses: percent sentential complement clauses imitated, percent sentential complement clauses imitated following formulaic matrix clauses, and percent sentential complement clauses imitated following true matrix clauses. Table 6 provides descriptive statistics (means, standard deviations) for the dependent variables by age group.

With percent of sentential complement clause imitation as the dependent variable, there was a main effect for Age, $F(2, 27) = 8.90, p = .002, \eta^2 = .40$, 90% CI = [.13, .54], and Matrix Clause Type, $F(1, 27) = 37.77, p < .001, \eta^2 = .58$, 90% CI = [.35, .70]. There was not a significant Age × Matrix Clause Type interaction, $F(2, 27) = 0.71, p = .50$. Children were more accurate imitating sentential complement clauses after formulaic matrix clauses compared with sentential complement clauses after true matrix clauses ($d = 0.76$, a medium effect size, 90% CI = [0.03, 1.50]). Table 7 provides descriptive statistics (means, standard deviations) for imitations by length of sentence stimuli as measured in morphemes. Percent imitation of sentences, matrix clauses, and

Table 6. Percent of sentential complement imitation by age group.

Variable	Age group		
	3-year-olds (n = 10)	4-year-olds (n = 10)	5-year-olds (n = 10)
	M (SD)	M (SD)	M (SD)
Sentential complements (n = 50)	63.00 (11.32)	74.40 (17.35)	84.80 (10.29)
After formulaic matrix clause (n = 20)	71.00 (13.08)	81.50 (15.47)	92.50 (10.07)
After true matrix clause (n = 30)	57.33 (11.09)	70.33 (19.78)	80.33 (11.70)

complement clauses are reported by sentence length in morphemes and matrix clause length by morphemes. Formulaic or true status is indicated for each variable.

Post hoc between-group comparisons for age revealed a significant between-group difference for 3- and 5-year-olds, $t(18) = -4.51$, $p < .001$, with a large effect size, d = 2.01, 90% CI = [0.90, 3.09], but not for 3- and 4-year-olds, $t(18) = -1.74$, $p = .10$, or for 4- and 5-year-olds, $t(18) = -1.63$, $p = .12$.

With percent of imitations that resulted in the substitution of a formulaic matrix clause for a true matrix clause as the dependent variable, a one-way ANOVA found a main effect for Age, $F(2, 27) = 13.36$, $p < .001$, $\eta^2 = .50$, 90% CI = [.23, .62]. Table 8 provides descriptive statistics (means, standard deviations) for imitations resulting in formulaic matrix clause substitutions.

Post hoc between-group comparisons for age revealed a significant between-group difference for 3- and 4-year-olds, $t(18) = 3.37$, $p = .003$, with a large effect size, $d = 1.50$, 90% CI = [0.49, 2.49], as well as for 3- and 5-year-olds, $t(18) = 4.91$, $p <$ .001, with a large effect size, $d = 2.19$, 90% CI = [1.05, 3.30]. There was no between-group difference for 4- and 5-year-olds, $t(18) = 2.07$, $p = .053$.

Discussion

We investigated whether the nature of matrix clauses influenced preschoolers' imitation of sentential complement sentences. Analyses were conducted at the sentence level and the matrix clause level. As expected, we found that children's percent of sentential complement sentence imitation differed by age. Within each age group, children's percent imitation of formulaic sentential complement sentences was greater than children's percent imitation of true sentential complement sentences. Children's percent of matrix clause imitation also differed by age. However, only 3- and 4-year-olds' percent formulaic matrix clause imitation was greater than their percent true matrix clause imitation. There was no such difference for 5-year-olds.

Preschoolers' imitations of sentential complement sentences provided some support for Diessel's constructivist account of sentential complement sentence acquisition. Diessel and Tomasello (2001) reported that 3- and 4-year-old children rarely produce any instances of sentential complement sentences with true matrix clauses in their spontaneous spoken language. Therefore, we hypothesized that there would be differences in

Table 7. Percent of sentence, matrix clause, and complement clause imitations by age group considering length (in morphemes).

Variable	Age group		
	3-year-olds (n = 10)	4-year-olds (n = 10)	5-year-olds (n = 10)
	M (SD)	M (SD)	M (SD)
Nine-morpheme sentences (n = 25)	47.60 (16.05)	70.80 (17.59)	77.20 (18.19)
Formulaic nine-morpheme sentences (n = 20)	53.50 (18.20)	69.50 (19.36)	77.50 (19.90)
True nine-morpheme sentences (n = 5)	34.00 (25.03)	68.00 (16.87)	76.00 (20.66)
True 10-morpheme sentences (n = 25)	20.80 (19.21)	37.60 (22.17)	55.60 (25.19)
All two-morpheme matrix clauses (n = 25)	62.40 (17.30)	83.60 (10.90)	84.00 (18.95)
Formulaic two-morpheme matrix clauses (n = 20)	68.00 (17.51)	88.00 (12.52)	84.50 (20.20)
Complement clause imitation after formulaic two-morpheme matrix clause (n = 20)	71.00 (13.08)	81.50 (15.47)	92.50 (10.07)
True two-morpheme matrix clauses (n = 5)	44.00 (26.33)	66.00 (13.50)	82.00 (22.01)
Complement clause imitation after true two-morpheme matrix clause (n = 5)	60.00 (13.33)	72.00 (31.55)	70.00 (25.39)
True three-morpheme matrix clause (n = 20)	22.20 (20.62)	58.47 (17.09)	72.15 (21.97)
Complement clause imitation after true three-morpheme matrix clause (n = 20)	56.80 (11.90)	70.00 (22.57)	82.40 (10.70)

Table 8. Percent of formulaic matrix clause substitution for true matrix clauses.

Variable	Age group		
	3-year-olds (n = 10)	4-year-olds (n = 10)	5-year-olds (n = 10)
	M (SD)	M (SD)	M (SD)
Formulaic matrix clause substitution (n = 30)	48.67 (16.04)	25.67 (14.49)	12.33 (17.07)

children's imitations of sentential complement sentences by matrix clause type for the 3- and 4-year-olds but not 5-year-olds. Our hypothesis was partially supported; we found that all age groups were better at imitating formulaic sentential complement sentences than true sentential complement sentences. Notably, the effect size for 5-year-olds, with $d = 0.79$, was substantially smaller than for 3- and 4-year-olds (at 1.60, and 1.97, respectively). The magnitude of the difference suggested that, by 5, children experienced less difficulty imitating true sentential complement sentences than the other age groups. Like 3- and 4-year-olds, 5-year-olds were better at imitating sentential complement clauses after formulaic matrix clauses than true matrix clauses. It is possible that formulaic matrix clauses have a facilitatory effect on sentential complement clause imitation due to their single proposition status. However, further studies are required to determine whether other factors play a role in sentential complement clause imitation (e.g. matching or mismatching tense features in the matrix clause and sentential complement clause).

Preschoolers' imitations of matrix clauses provided strong support for Diessel's constructivist account of sentential complement sentence acquisition. We hypothesized that there would be differences in children's imitations of matrix clauses by matrix clause type for the 3- and 4-year-olds but not 5-year-olds. As expected, we found that 3- and 4-year-olds, but not 5-year-olds, were better at imitating formulaic matrix clauses than true matrix clauses. Post hoc age group comparisons revealed that 3-year-olds were more likely to substitute formulaic matrix clauses for true matrix clauses than 4- and 5-year-olds. This finding revealed that 3-year-olds were the most likely age group to inappropriately produce formulaic matrix clauses, perhaps reflecting a limited proficiency with true matrix clauses. The results provide experimental support for Diessel and Tomasello's (2001) assertion that formulaic matrix clause proficiency precedes true matrix clause proficiency.

Our findings do not support generativist-nativist accounts of sentential complement sentence development, namely that age group differences are attributable to vocabulary knowledge and performance factors (Fisher, 2002; Valian, 1991). It is unlikely that differences in vocabulary knowledge were a significant contributing factor to age group differences; familiar vocabulary words, known to 3-year-old children with typical language development, were selected for our sentence stimuli. Performance factors related to utterance length also do not appear to be a contributing factor to the age group differences. To qualify for our study, participants demonstrated that they could imitate 75% or more of the simple sentences included in the Control Task. The simple sentences included in the Control Task matched the length of the experimental sentences exactly. In regard to matrix clause length, although formulaic matrix clauses (two morphemes) were often shorter than true matrix clauses (three morphemes), length difference did not appear to contribute to differences in imitation. We conducted a post hoc comparison of children's imitations of two types of matrix clauses that matched on length: true matrix clauses with irregular past tense verbs (e.g. *He knew*) and formulaic matrix clauses (e.g. *I know*). This comparison revealed a significant between-matrix clause type difference, $t(29) = 2.90$, $p = .002$, with a medium effect size $d = 0.75$. We would not anticipate a difference between these groups if imitation percent was attributable to matrix clause length. Thus, vocabulary knowledge and performance factors appear to be unlikely contributing factors to age group differences. Next, we consider other potential factors that may have influenced children's sentential complement sentence imitations.

Potential factors that influence sentential complement sentence development

According to Diessel and Tomasello (2001), three factors may influence the early development of formulaic sentential complement sentences: input frequency, complexity, and cognitive development. We first consider the role of input frequency in the early development of formulaic matrix clauses.

The relatively high frequency of formulaic matrix clauses in parental speech compared with true matrix clauses may promote children's acquisition of formulaic sentential complement sentences. In a study of 13 adult conversations with 425 finite complements, Thompson (2002) reported that the majority of adult productions with the complement clause verbs *think, know, guess*, and *remember* were fixed formulas that acted as parenthetical phrases. If Thompson's data are representative of the type of ambient language that children encounter, we would anticipate that children receive more exposure to formulaic matrix clauses than true matrix clauses. In turn, increased exposure may promote the earlier production of formulaic sentential complement sentences compared with true sentential complement sentences. Our findings supported this possibility; 3- and 4-year-old children imitated a greater percent of formulaic matrix clauses compared with true matrix clauses. However, 5-year-old children did not produce a different percent imitation of formulaic matrix clauses and true matrix clauses. We attribute 5-year-olds' proficiency in true matrix clause imitation to their prolonged exposure to the relatively less frequently occurring true matrix clauses. Prolonged exposure to true matrix clauses may offer children opportunities to learn that matrix clauses are not just fixed word pairings but can consist of a variety of possible noun phrases, complement clause verbs, and inflectional markings. Five-year-olds' greater percent imitation of true matrix clauses may indicate that these children possess abstract knowledge of sentential complement sentence syntactic structure.

The complexity of sentential complement sentences may influence the earlier acquisition of formulaic sentential complement sentences than true sentential complement sentences. Diessel and Tomasello (2001) have suggested that formulaic sentential complement sentences, although formally complex, involve just a single proposition. It is possible that formulaic sentential complement sentences are easier for young children to comprehend than true sentential complement sentences. This allows for formulaic sentential complement sentences to be acquired before true sentential complement sentences. Our findings supported this possibility; children in each age group obtained a greater percent imitation of formulaic sentential complement sentences compared with true sentential complement sentences. This finding was particularly interesting because 5-year-old children did not obtain a different percent imitation of formulaic and true matrix clauses. For each age group, the single proposition status of formulaic sentential complement sentences may have resulted in a greater percent imitation of sentential complement clauses following formulaic matrix clauses.

Diessel and Tomasello (2001) suggested that cognitive development factors could also have contributed to the high frequency of formulaic matrix clauses in children's spontaneous sentential complement sentences. For example, children may not have produced true sentential complement sentences because they did not understand that different people have different beliefs about the same state of affairs (Perner, 1991). Bartsch and Wellman (1995) argued that children possess 'the necessary syntax . . . and still do not talk about thoughts or beliefs' due to theory of mind abilities that have not been adequately developed. Our findings do not provide any insight regarding this factor. As predicted by studies employing false-belief tasks, our participants under the age of 4 imitated a greater percent of formulaic sentential complement sentences and a greater percent of formulaic matrix clauses (Bartsch & Wellman, 1995). However, to our knowledge, there have been no studies that have clarified whether sentence imitation performance is influenced by underlying cognitive factors such as theory of mind abilities or whether sentence imitation draws upon children's underlying grammatical competency independent of theory of mind abilities. Because we did not measure children's theory of mind abilities, our study is ill-suited to investigate whether theory of mind abilities contribute to children's imitation of true sentential complement sentences.

Differentiating matrix clause type in studies of language impairment

Our findings have potential implications for clinical practice, especially as they relate to children with specific language impairment (SLI) and children with developmental language disorders (DLD). As the largest subgroup within the DLD diagnostic category, children with SLI have difficulty comprehending and producing several complex syntax types, such as sentential complement sentences and relative clauses (Owen & Leonard, 2006; Schuele & Dykes, 2005). Because we have found support for a developmental sequence of sentential complement clause acquisition, it is possible that progression through this developmental sequence is difficult for children with SLI and children with DLD. A small body of evidence suggests that children with SLI and children with DLD have difficulty producing complex syntax tokens which require abstract knowledge of complex syntax (Novogrodsky & Friedmann, 2006; Owen & Leonard, 2006; Schuele & Dykes, 2005). For example, Frizelle and Fletcher (2014) found that 6-year-old children with DLD were better at imitating lexically specific relative clauses than dual propositional relative clauses. It is plausible that children with SLI and children with DLD are delayed in producing true sentential complement clauses compared with same-age typically developing (TD) peers. A granular analysis of preschool children's complex syntax productions may provide preliminary evidence that children with SLI and children with DLD remain in a period of complex syntax development where predominately formulaic matrix clauses are generated (Frizelle & Fletcher, 2014).

Unfortunately, no research has yet explored whether children with SLI primarily produce formulaic sentential complement sentences. Marinellie (2004) reported that school-aged participants with SLI produced a similar number of sentential complement sentences using the verbs *say, think*, and *know* as children with typical language development. In that analysis, children with SLI were deemed to be 'keeping up' with language-typical children in the production of sentential complement sentences in child–adult conversation, despite the possibility that formulaic matrix clauses were the predominate type of matrix clause produced by the children with SLI (Marinellie, 2004). Without the distinction between formulaic and true matrix clauses, children with SLI may be assumed to match language-typical children in their robust and varied use of sentential complement sentences. If true matrix clauses are semantically and syntactically more substantial than formulaic matrix clauses, sentential complement sentences with true and formulaic matrix clauses should be differentiated in the child language assessment and intervention literature.

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ORCID iD

Ian Morton https://orcid.org/0000-0003-0477-3775

Supplemental material

Supplemental material for this article available online.

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