The Changing View of Input in the Treatment of Children with Deficits in Morphosyntax

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Principal Collaborators and Acknowledgments

Children with Developmental Language Disorder (DLD)/Specific Language Impairment (SLI)

- Significant deficit in language ability
- Normal hearing
- Absence of neurological damage or disease
- Language deficit cannot be attributed to other weaknesses that may also be present
- The use of tense and agreement morphology is especially problematic in particular languages (e.g., English, Swedish, German

Tense/Agreement Inconsistency in English

- *Molly sings every day, Molly sing every day*

- *Chris played the guitar yesterday, Chris play the guitar yesterday*

- *Tanya's running, Tanya running*

Three-Group Design

	DLD	TD-A	TD-MLU
English			
Age	5;0	5;0	3;0
MLU	3.62		3.68

Three-Group Design

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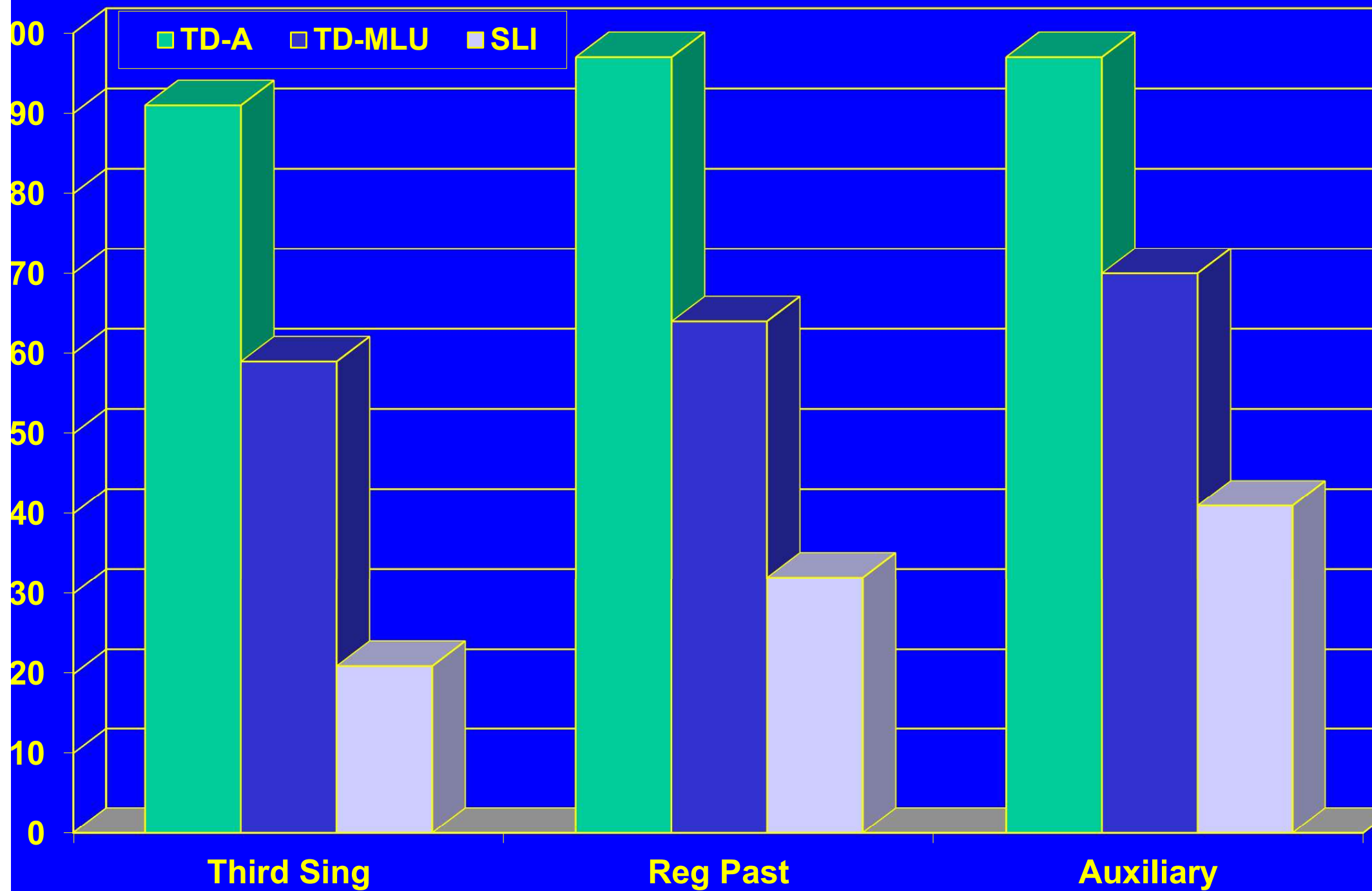
Could input play an important role in FACILITATING these children's development of tense/agreement morphology?

Conversely, could input sometimes play a role in SLOWING UP these children's development of tense/agreement morphology?.

There are currently three input-based approaches that are applicable to DLD/SLI and have empirical support:

- **"Input Informativeness" (Hadley et al., 2011)**
- **"High Variability" (Plante et al., 2014)**
- **"Competing Sources of Input" (Leonard, Deevy and Colleagues)**

There are currently three input-based approaches that are applicable to DLD/SLI and have empirical support:

- **These approaches do not assume that input causes the language impairment. But choice of input can facilitate or slow development.**
- **All three approaches go beyond looking at token frequency, by considering relative frequency and type frequency.**
- **Current evidence based mostly on English but their assumptions seem applicable to other languages.**

There are currently three input-based approaches that are applicable to DLD/SLI and have empirical support:

- **"Input Informativeness" (Hadley et al., 2011)**

Input Informativeness: Emphasis is on OVERT Tense/Agreement Forms in the Input

- *Molly sings every day*
- *Chris played the guitar yesterday*
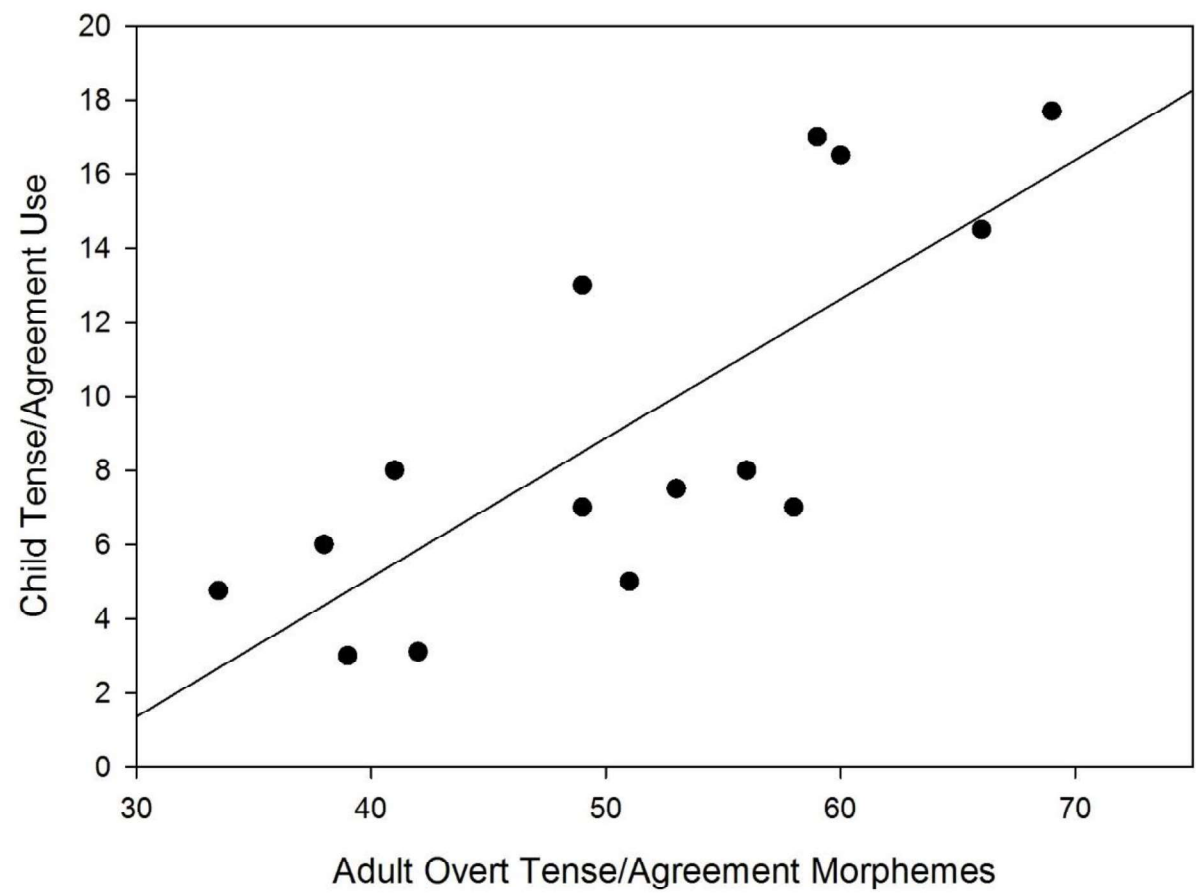- *Tanya's running*
- *The cars are yellow*

Input Informativeness: Rationale

- **Based on the Legate & Yang (2007) finding that, across languages, the proportion of overt and unambiguous tense/agreement forms in the input predicted how early children would become consistent in their use of tense/agreement forms.**

- **In some languages, children hear many bare stems and nonfinite forms and as a result may be slow to learn contexts for tense/agreement use.**

- **Relative frequency is important: proportion of overt forms**

Input Informativeness: Evidence 1

- **Within English, Hadley et al. (2011) found that the degree to which parents' speech to their 21-month-old children contained OVERT tense/agreement forms predicted the rate at which their children used tense/agreement at 30 months.**

- ***Oh, the horse wants to go in the barn; The cow chased the pig; That car is yellow.***

Input Informativeness: Evidence 2

- **Using a treatment design, Hadley et al. (2017) found that a larger proportion of nouns in subject position and uncontracted tense/agreement morphemes in declarative sentences in the parents' speech was predictive of greater growth of tense/agreement morphemes in their children's speech.**

- *The big horse want**s** to go in the barn; The brown cow chas**ed** the pig; That car **is** yellow.*

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- *The big horse wants to go in the barn; The brown cow chased the pig; That car is yellow.*

Input Informativeness: Toy Talk 1

- **Input should emphasize OVERT tense/agreement forms that cannot be misinterpreted as nonfinite forms.**

- **This was operationalized in Toy Talk by teaching parents to: (1) talk about the toys the child is playing with; and (2) give the object its name (e.g., *The tower's tall* instead of *It's tall*).**

Input Informativeness: Toy Talk 2

- **Note: in English, "zero-marked" tense/agreement forms (e.g., *I like ice cream; You need a bath*) are identical phonetically to infinitives, and their tense/agreement status is potentially ambiguous.**

- **Therefore, parent utterances referring to themselves (= first person, as in *I like*) or to the child (= second person, as in *You need*) should be kept to a minimum during Toy Talk activities.**

Input Informativeness: Toy Talk 3

- **Input that uses a noun in subject position is preferred over a pronoun in subject position.**

- **Forms such as *it's, that's, he's, she's* are sometimes memorized wholes and not recognized as containing a tense/agreement morpheme.**

- **Nouns combine with tense/agreement morphemes less often. Therefore, *'s* in *The boy's tall* and *The girl's happy* should be more easily identified.**

Toy Talk Examples:

Child: Me getting the horse out.

Adult: That horse wants a drink

Child: And maybe some hay.

Adult: The hay is in the barn

Adult: Look, the dogs are running after the horse

Child: Where the cat?

Adult: The cat is sleeping in the house.

Adult: The dogs played with the cat and now the cat is really tired.

Child: I like cats.

Adult: And this cat likes you!

There are currently three input-based approaches that are applicable to DLD/SLI and have empirical support:

- **"Input Informativeness" (Hadley et al., 2011)**
- **"High Variability" (Plante et al., 2014)**

High Variability: Emphasis is on Input with a Large Number of Unique Verbs Used with the Target Form

- *runs, jumps, plays, sings, sees, eats, drinks, kicks,* etc.
- **Type frequency** is very important: the number of unique verbs should be large.

High Variability: Rationale

- **Children and adults learn a grammatical form faster when it is the unchanging element in a changing context.**

- **In artificial grammar studies, the number of different exemplars representing the changing context is crucial.**

- **When 24 different exemplars are used for X, the rules *a*X, X*b*, and *a*X*b* are learned more readily than when fewer exemplars are used for X.**

Artificial Language Example *(aXb)*:

pel wadim rud	pel benez rud
pel kicey rud	pel gensim rud
pel puser rud	pel feenam rud
pel fengle rud	pel laeljeen rud
pel coomo rud	pel chila rud
pel loga rud	pel roosa rud
pel gople rud	pel plizet rud
pel taspu rud	pel balip rud
pel hiftam rud	pel malsig rud
pel deecha rud	pel suleb rud
pel vamey rud	pel nilbo rud
pel skiger rud	pel wiffle rud

Artificial Language Example *(aXb)*:

pel **wadim** rud   pel **benez** rud
pel **kicey** rud   pel **gensim** rud
pel **puser** rud   pel **feenam** rud
pel **fengle** rud   pel **laeljeen** rud
pel **coomo** rud   pel **chila** rud
pel **loga** rud   pel **roosa** rud
pel **gople** rud   pel **plizet** rud
pel **taspu** rud   pel **balip** rud
pel **hiftam** rud   pel **malsig** rud
pel **deecha** rud   pel **suleb** rud
pel **vamey** rud   pel **nilbo** rud
pel **skiger** rud   pel **wiffle** rud

High Variability: Evidence

- **Plante et al. (2014):**
- **18 DLD/SLl, age 5 years**
- **Six weeks of treatment (recasting)**
- **X*b* = Verb + *s* (or Verb + *ed*)**
- ***a*X*b* = *is* Verb + *ing***
- **High Variability Condition: X = 24 unique verbs**
- **Low Variability Condition: X = 12 unique verbs**
- **The total number of verb tokens was equal in the two conditions.**
- **Learning in terms of both accuracy and generalization was better when 24 different exemplars were used.**

Percentage Use of Auxiliary *is* in Obligatory Contexts
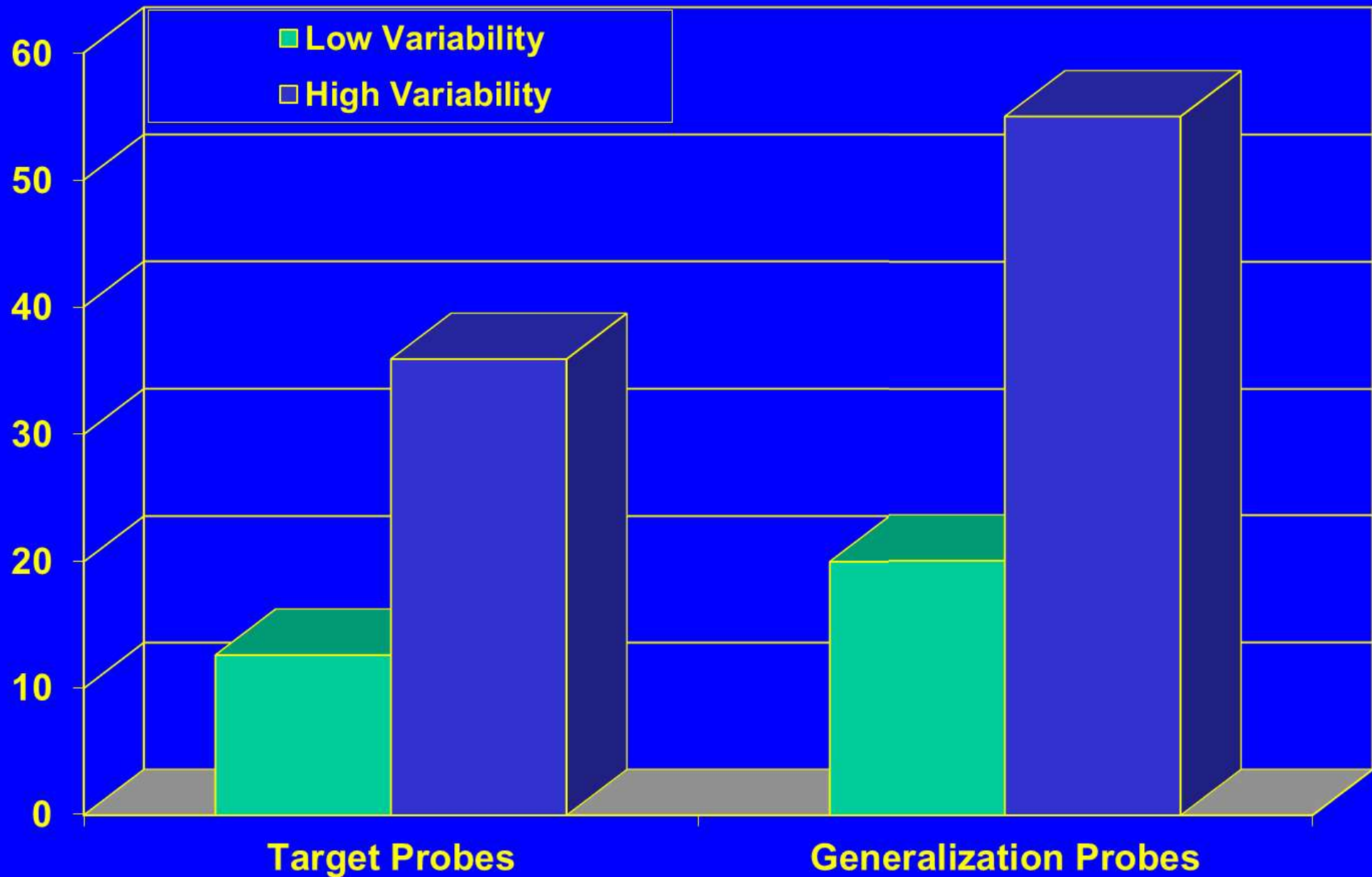
High Variability: Application 1

- **When teaching verb inflections or function words associated with verbs, use a larger number of unique verbs. For example, for English third person singular, 24 unique verbs can be used, as in:**

throws	runs	jumps
plays	sees	likes
hears	reads	drinks
hops	sleeps	opens
hides	listens	cleans
wears	slides	hugs
blows	knocks	writes
stops	makes	walks

throws	runs	jumps
plays	sees	likes
hears	reads	drinks
hops	sleeps	opens
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High Variability: Application

- **When teaching verb inflections or function words associated with verbs, use a larger number of unique verbs. For example, for English third person singular, 24 unique verbs can be used, as in:**

- **The greater diversity can easily be incorporated into stories, and, with proper planning, even procedures such as recasting can be used.**

This is a story about a girl who lik**ed** dogs. Every day she walk**ed** to the park to see the dogs there. She watch**ed** as the dogs play**ed** with each other, and sometimes they bark**ed** when they saw a squirrel. The girl really lov**ed** one dog – a collie. She call**ed** her Lassie, because the dog look**ed** a lot like the famous dog in the movies. One day, Lassie follow**ed** the girl home! The girl tri**ed** to get Lassie to go back to the park, but……

(1) Liked   (5) Barked   (9) Followed
(2) Walked   (6) Loved   (10) Tried
(3) Watched   (7) Called   :
(4) Played   (8) Looked   (24) Opened

Child: Horse go in the barn.
Adult: The horse is going in the barn? Good!
Child: Put him in there with the dog.
Adult: The dog is watching the horse eat the hay.
Child: Where the guy go? The farmer?
Adult: The farmer is cleaning the barn inside.
Child: It dirty inside?
Adult: Yes, the pig is eating his dinner in the barn and
        he is making a mess!

(1) is going   (5) is making
(2) is watching   :
(3) is cleaning   (24) is riding
(4) is eating

There are currently three input-based approaches that are applicable to DLD/SLI and have empirical support:

- **"Input Informativeness" (Hadley et al., 2011)**
- **"High Variability" (Plante et al., 2014)**
- **"Competing Sources of Input" (Leonard, Deevy and Colleagues)**

Competing Sources of Input: Emphasis is on a Combination of: (1) Input with Tense/Agreement Forms; and (2) Avoiding Potentially Confusing Sentence Structures

- **Use:** *The girl likes ice cream; She's running; Dad washed the car*
- **Avoid:** *Does the girl like ice cream? We saw her running. Help Dad wash the car*
- **Relative frequency is important: Easily interpretable forms relative to potentially confusing forms**

Competing Sources of Input: Rationale

- **Hearing overt tense/agreement morphemes in the input is desirable. However, children also hear nonfinite verbs in contexts that they might misinterpret.**

- **Children hear sequences such as *the girl like ice cream* from input such as "Does [the girl like ice cream]?" and sequences such as *her running* from input such as "We saw [her running]."**

- **Could the children mistakenly extract such sequences and use them as a basis for generating new utterances?**

Previous studies suggest that children might extract nonfinite sequences from larger structures in the input:

- **Computational modeling studies (e.g., Freudenthal et al., 2007)**
- **Studies of young typically developing children (e.g., Theakston et al., 2003)**
- **Studies of children with DLD/SLI using priming (e.g., Leonard et al., 2002) and novel verb learning (Leonard & Deevy, 2001; Leonard et al., 2015)**

The dog eating

Little girl happy

He eat ice cream

She at home

She go

My coffee hot

The dog eating

Is [the dog eating]?

Little girl happy

Is [the little girl happy]?

He eat ice cream

Did [he eat ice cream]?

She at home

Was [she at home]?

She go

Can [she go]?

My coffee hot

Is [my coffee hot]?

Me do the dishes

The dog eating

Him hop

My coffee hot

Her at home

Them fly away

Me do the dishes

      Help [me do the dishes]

The dog running

      I see [the dog running]

Him hop

      Let's watch [him hop]

My coffee hot

      I like [my coffee hot]

Her at home

      I want [her at home]

Them fly away

      Did you see [them fly away]?

<u>Adult Swedish</u>:

Kristina dricker kaffe

<u>Common error</u>:

Kristina dricka kaffe

Adult Swedish:

Kristina dricker kaffe

Common error:

Kristina dricka kaffe

Adult Swedish:

Kan [Kristina dricka kaffe]?

Adult Swedish:

Kristina **dricker** kaffe

Common error:

Kristina **dricka** kaffe

Adult Swedish:

Kan **[**Kristina dricka **kaffe]?**

Adult German:

Ich **fahre einen** Toyota

Common error:

Ich einen Toyota **fahren**

Adult Swedish:

Kristina **dricker** kaffe

Common error:

Kristina **dricka** kaffe

Adult Swedish:

Kan [Kristina **dricka** kaffe]?

Adult German:

Ich **fahre** einen Toyota

Common error:

Ich einen Toyota **fahren**

Adult German:

Kann [ich einen Toyota **fahren**]?

The dog eating

Is [the dog eating]?

Little girl happy

Is [the little girl happy]?

He eat ice cream

Did [he eat ice cream]?

She at home

Was [she at home]?

She go

Can [she go]?

My coffee hot

Is [my coffee hot]?

Input: *Look* [*the dog's eating*]

The dog's eating

Input: *Is* [*the dog eating*]?

The dog eating
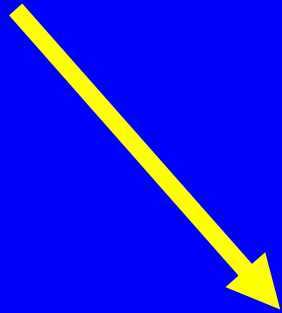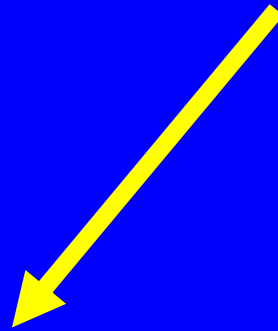
Typical Development

Is [*the dog eating*]?

Typical Development

[*Is the dog eating*]?

The dog's eating   ~~The dog eating~~

The dog's eating

↓
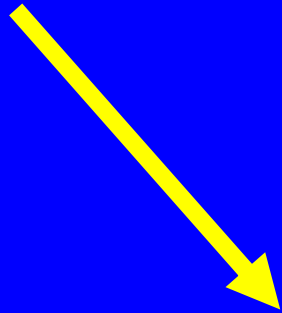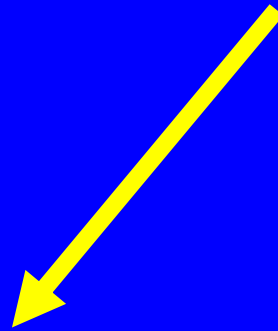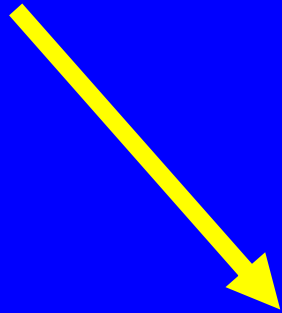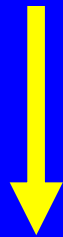
The dog's eating

↓
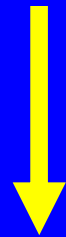
The cat's eating
The bird's eating
The dog was eating
The cat was eating

The dog's eating   *The dog eating*

The dog's eating   *The dog eating*

↓   ↓

The cat's eating   *The cat eating*
The bird's eating   *The bird eating*
The dog was eating
The cat was eating

"Competing Sources of Input"

The dog's eating   *The dog eating*

↓   ↓

The cat's eating   *The cat eating*
The bird's eating   *The bird eating*
The dog was eating
The cat was eating

Is the inappropriate extraction and use of nonfinite subject-verb sequences related to comprehension difficulty with the larger structures?

Example:

Is the dog eating?

Deevy, Leonard, & Marchman (2014, 2017)

Yes-No questions with auxiliary

See the nice little dogs running?

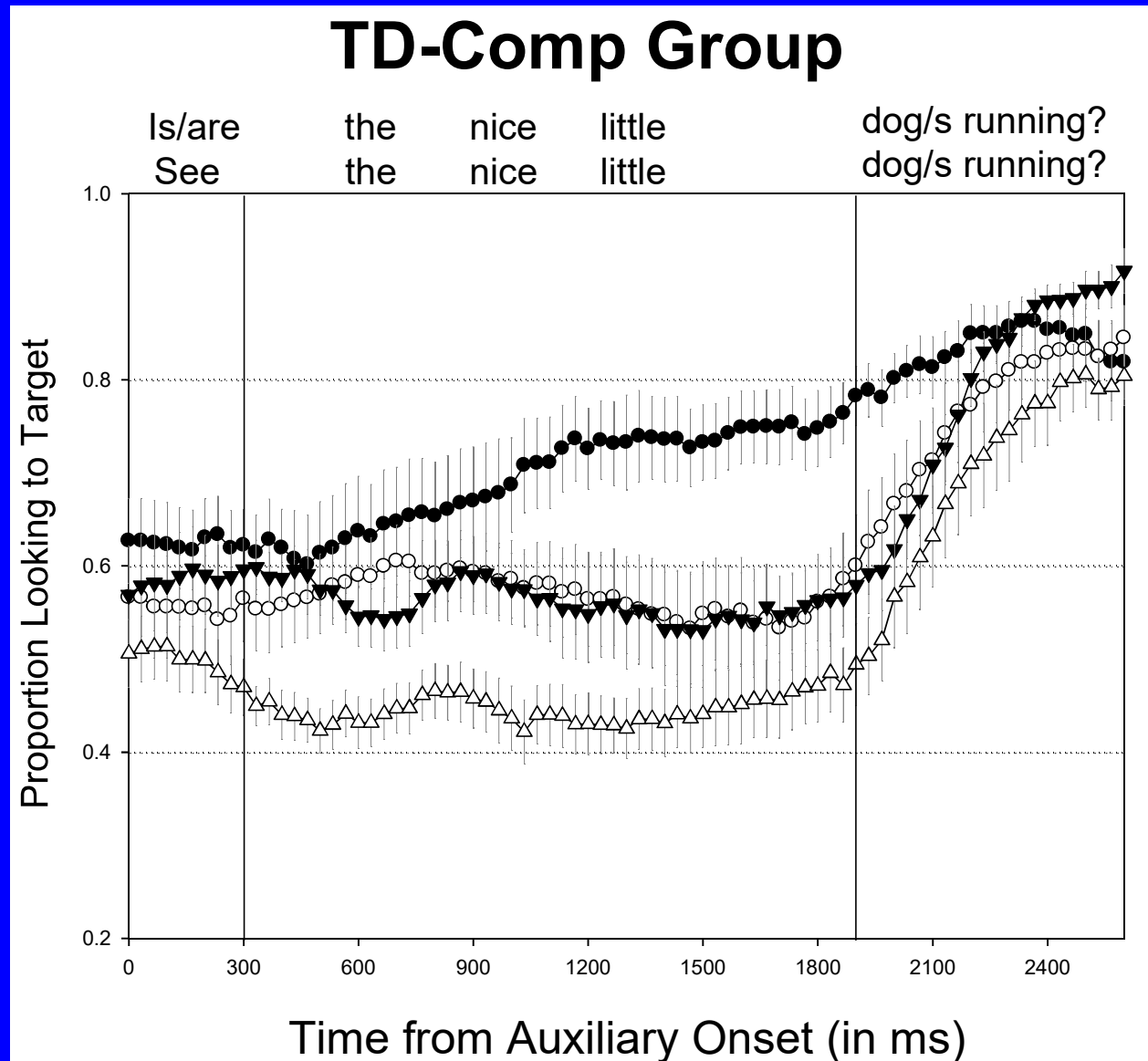Are the nice little dogs running?

See the nice little boy running?

Is the nice little boy running?

Participants

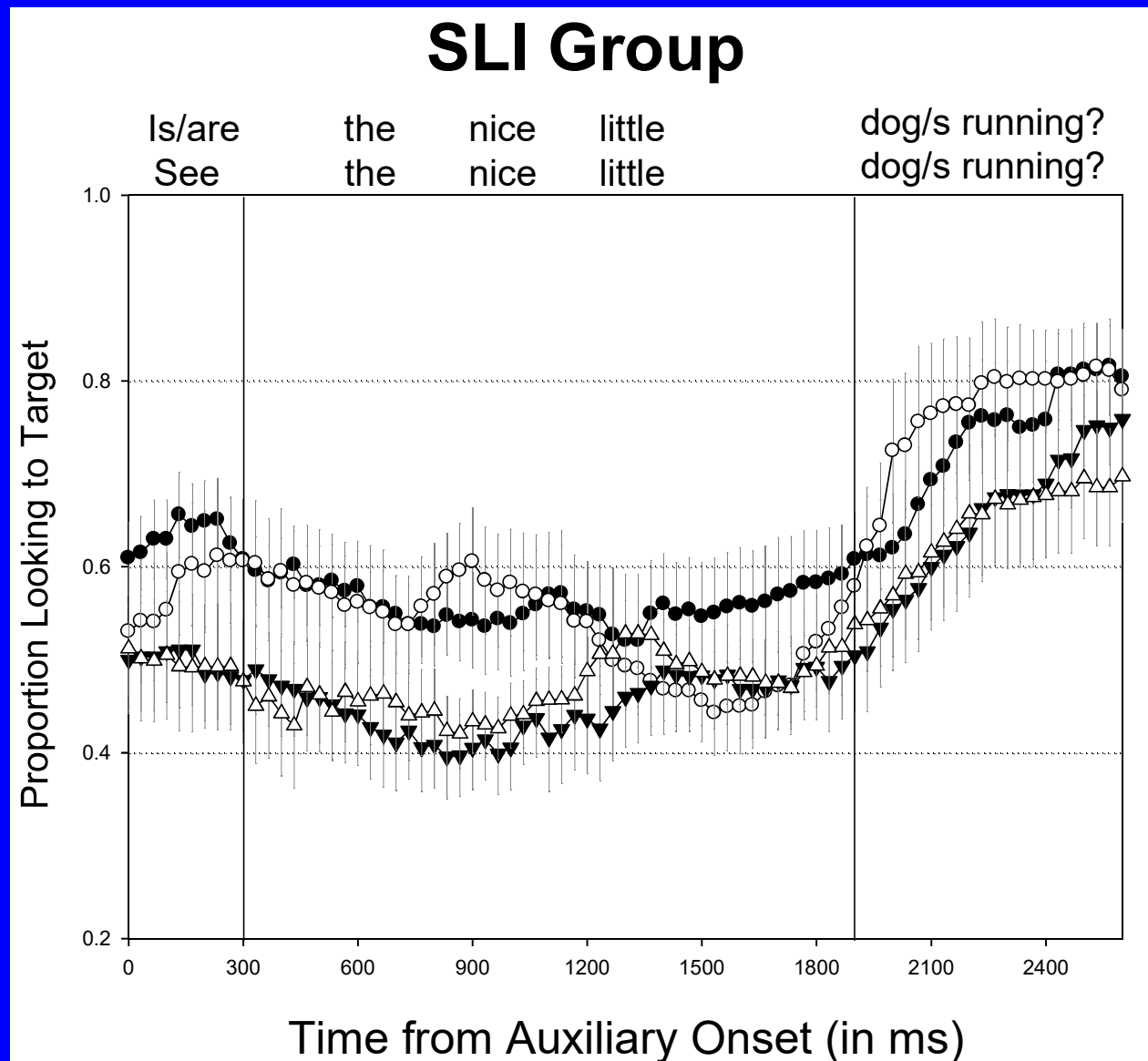| Group	Age	Celf-P2 Sentence Structure subtest (raw)	Aux IS production	Aux ARE production
SLI (11)	4;10	15.3	59%	61%
TD-Comp (11)	3;6	14.7	95%	98%
TD-Age (13)	4;11	18.4	99%	98%

Results

Results

SLI Group

If children learn that subject-verb sequences appearing later in a sentence are constrained by verbs appearing earlier in the sentence, will this facilitate their tense/agreement use?

The Treatment Study

Fey, Leonard, Bredin-Oja, & Deevy (2017)

N = 20 children with DLD/SLI randomly assigned to a "competing sources of input" (CSI) group or a "traditional" (Trad) group. Treatment = 16 weeks.

**Age at Time 1: CSI = 46 months, Trad = 45 months**

Auxiliary *is* use at Time 1: CSI = 15%, Trad = 15%

CSI Versus Trad Sessions

- **Comprehension:** CSI: Is/Was the boy building a tower? Is/Was the girl climbing a ladder? Trad: Is the boy/girl building a tower? Was the boy/girl climbing a ladder?

- **Story:** CSI: 12 declaratives with auxiliary *is* Trad: 6 declaratives with auxiliary *is* and 6 yes-no questions with auxiliary *is*

- **Recasts:** CSI: 12 declaratives with auxiliary *is* Trad: 6 declaratives with auxiliary *is* and 6 yes-no questions with auxiliary *is*

Percentage Use of Auxiliary *is* in Obligatory Contexts
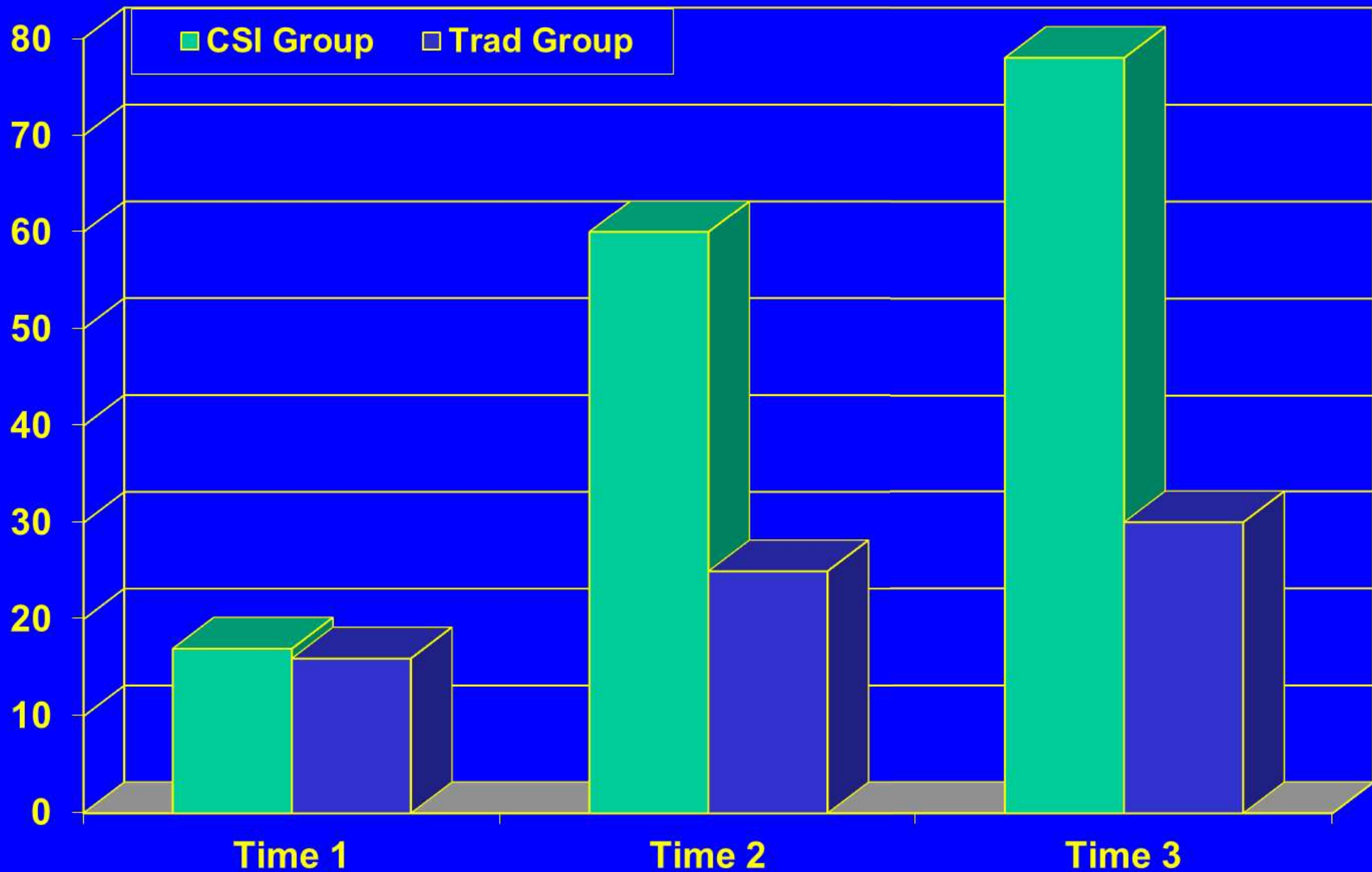
Summary: Can the Three Approaches be Integrated? YES

- **"Competing Sources of Input" = Tense/agreement in simple declarative sentences; avoid subject-nonfinite verb sequences in questions and complex sentences. Taught separately: Structural ties between forms appearing early in the sentence (e.g., *Is*) and those appearing later (e.g., *the girl climbing a ladder?*)**

- **"Input Informativeness" = Overt tense/agreement forms; declarative sentences preferred; nouns in subject position; subject-nonfinite verb sequences (e.g., *"We heard the boy sing")* avoided because no overt tense/agreement**

- **"High Variability" = Many unique verbs (e.g., 24) used for each tense/agreement morpheme**

THANK YOU

Key References

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Applications to Dutch?

- **Overt tense: second person singular present tense (-*t*)**
- **Overt tense: third person singular present tense (-*t*)**
- **Overt tense: past tense (-*de/-te, -den/-ten*)**
- **Context dependent: plural forms in present tense (-*en*) vs. infinitive (-*en*)**
- **Input Informativeness: Both *"The girls run"* and *"We see the girls run"* are avoided**
- **Competing Sources of Input: *"The boy sings"* and *"We hear the boy sing"* are competitors (therefore, the latter is avoided)**

Applications to Dutch? (continued)

- **In Dutch, could first person singular be the source of children's bare stems in second and third person contexts?**

- **Input Informativeness: "zero-marked" forms (e.g., _I like, I need_) are avoided because they decrease the proportion of overt tense/agreement forms in the input**

- **In Dutch, could the (bare-stem) form of second person in Verb + Subject contexts be a source of bare-stem errors in other contexts?**

- **Competing Sources of Input: Children may not appreciate sentence context differences (e.g., "_Did the boy run_" → "_The boy run_")**
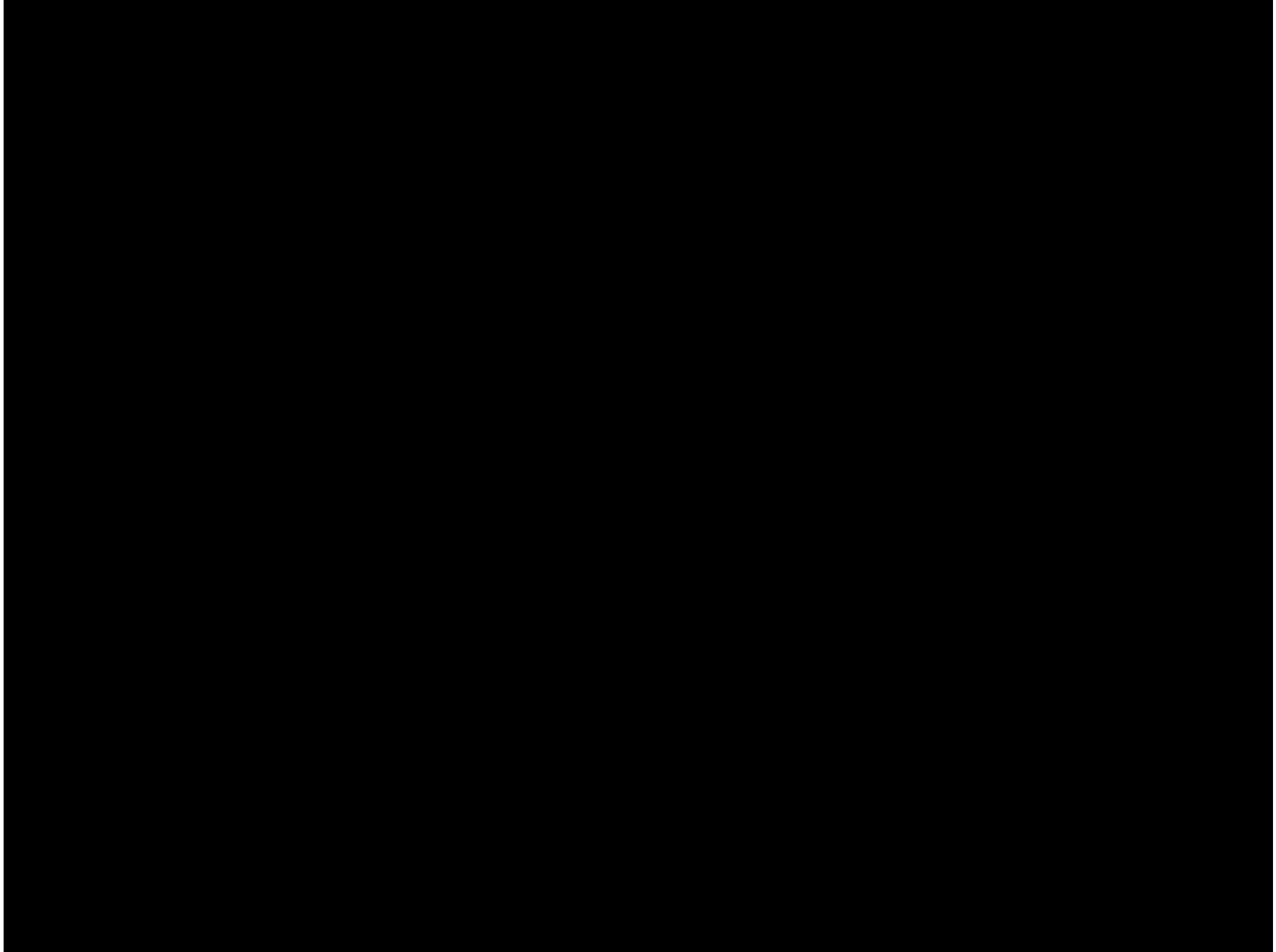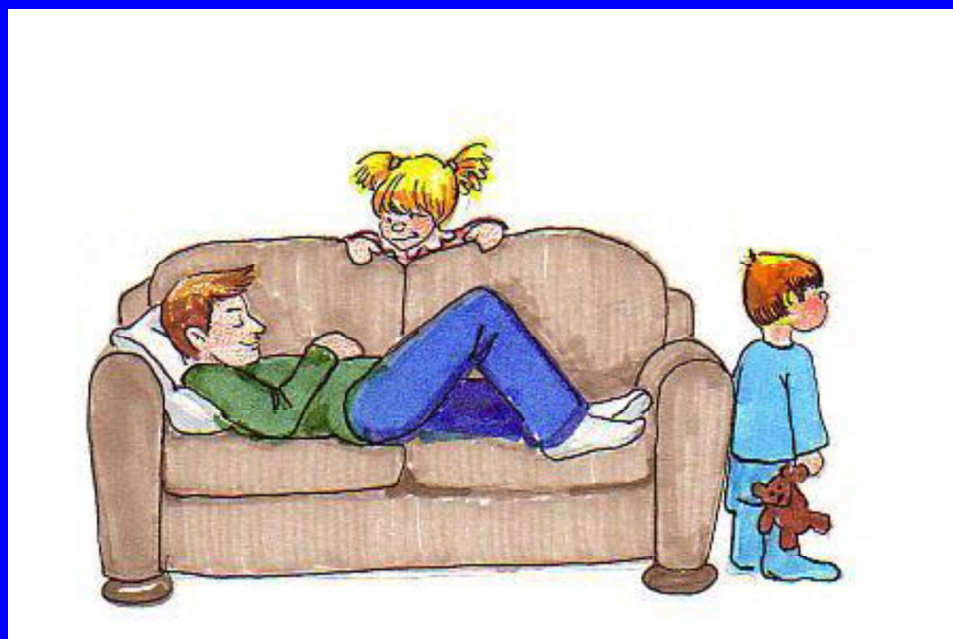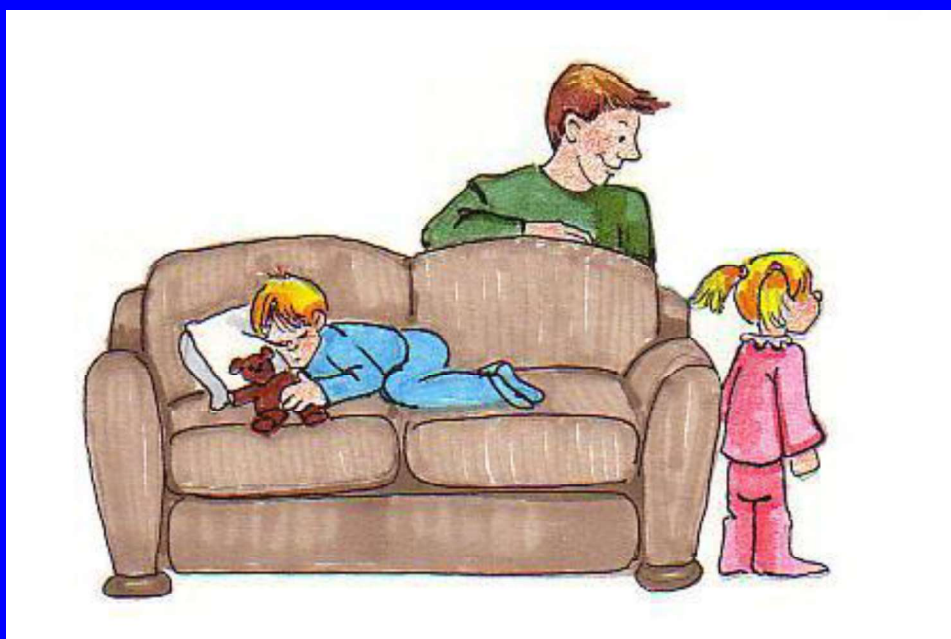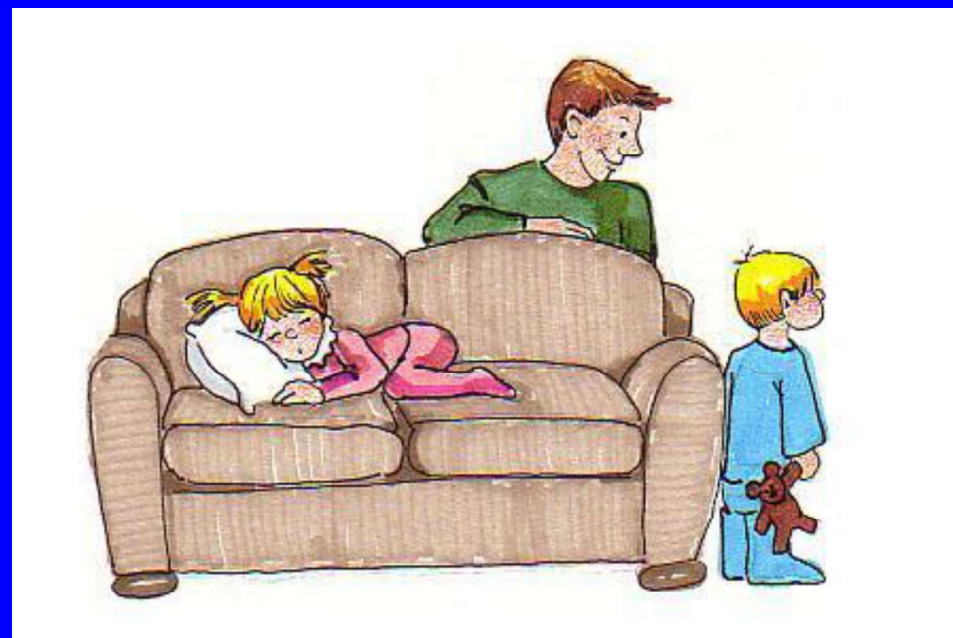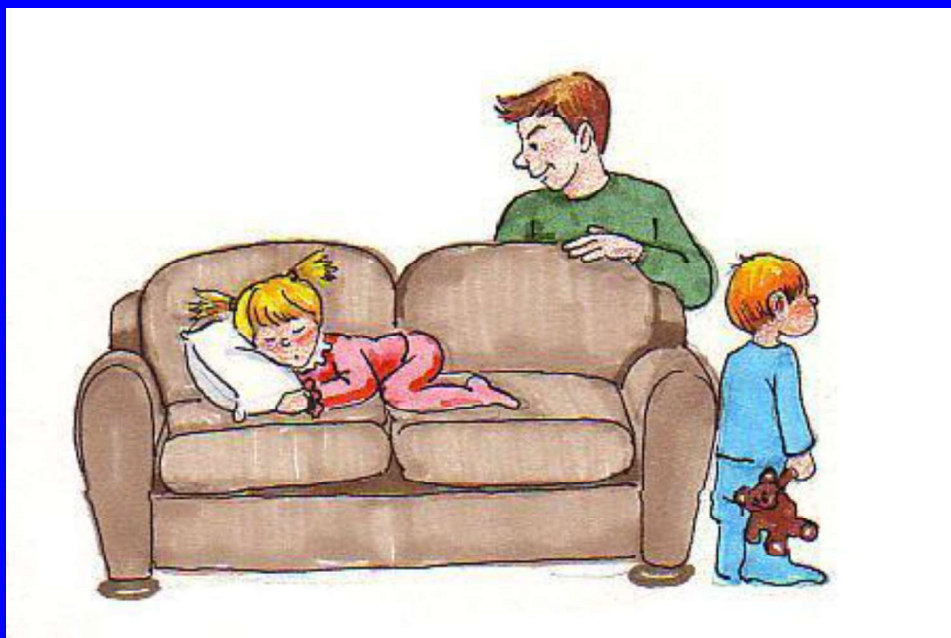
Is the inappropriate extraction and use of nonfinite subject-verb sequences related to comprehension difficulty with the larger structures?

Example:

The dad sees the girl sleeping

(Leonard & Deevy, 2011; Souto et al., 2016)

Comprehension Study 1

(Leonard & Deevy, 2011)

**DLD/SLI group (age 5;0, % use *is* = 30%)
TD-Comp group (age 3;7, % use *is* = 81%)
(matched according to general sentence comprehension test score)**
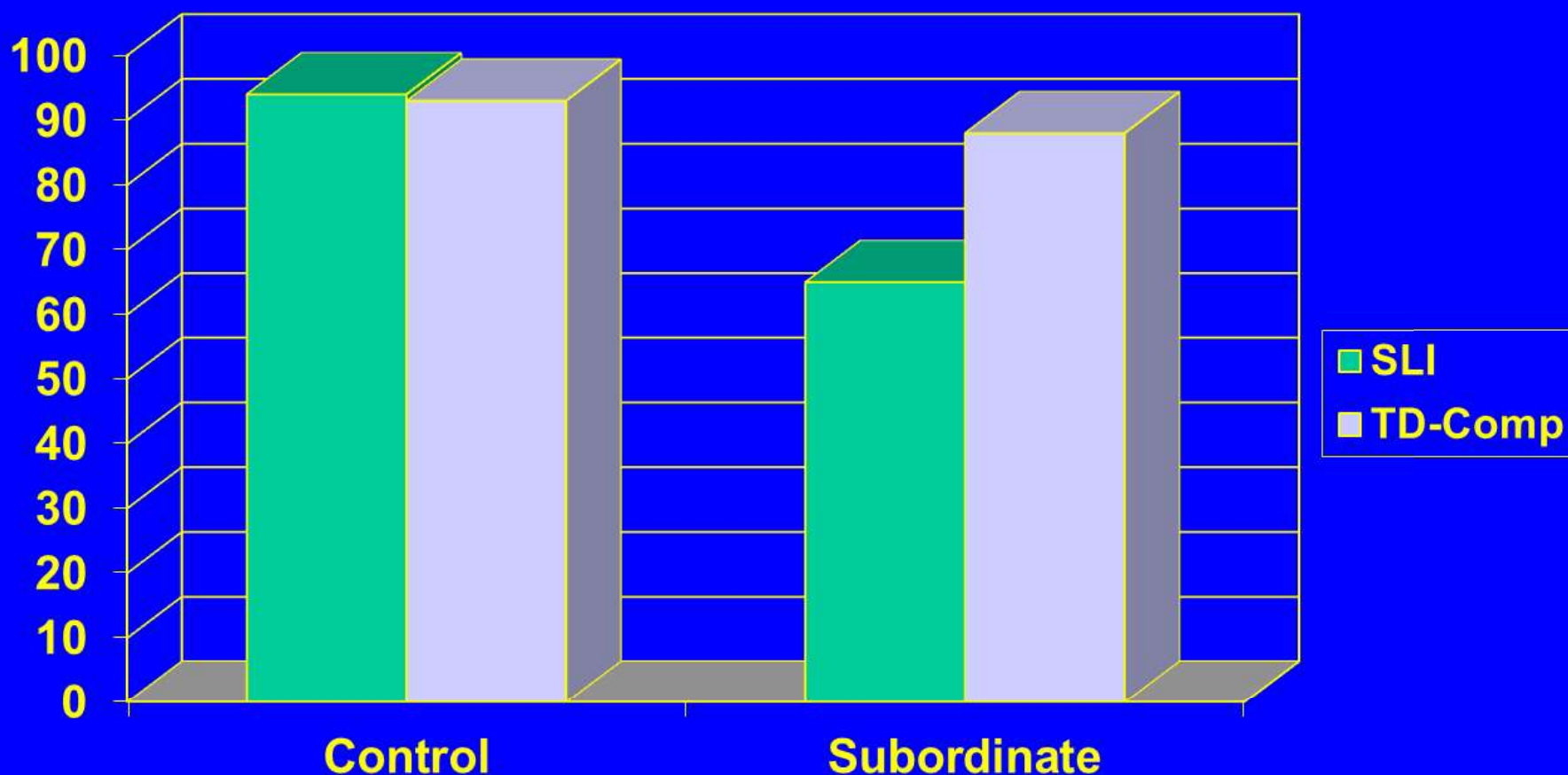
Example of Target Sentence:

The dad sees the girl sleeping

Example of Control Sentences:

The girl is sleeping; The dad sees the girl

Percentage Correct on Control and Subordinate Clause Comprehension Items (Leonard & Deevy, 2011)

Percentage Correct on Control and Subordinate Clause Comprehension Items (Souto, Leonard, Deevy, Fey, & Bredin-Oja, 2016)
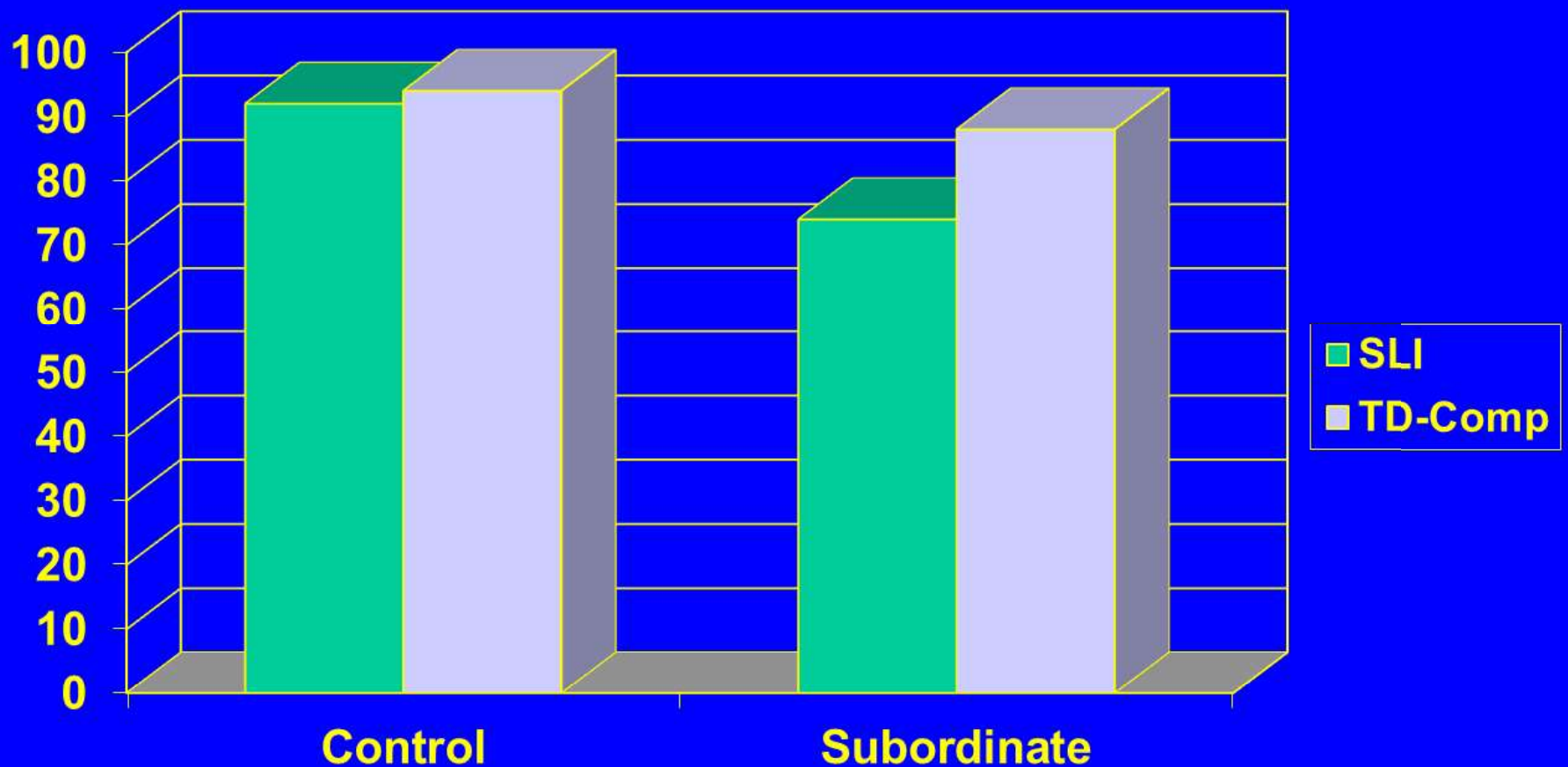
The dad sees the girl sleeping

The dad sees the girl sleeping

The dad sees her sleeping

The dad sees *the girl sleeping*

The dad sees *her sleeping*

Her sleeping

The dad sees the girl sleeping

The dad sees her sleeping

↓

Her sleeping

She sleeping

Her sleeping

Is she sleeping?

↓

She sleeping

Will children with DLD/SLI produce novel verbs in nonfinite form or with tense/agreement depending on how these verbs appear in the input?

Novel Verb Learning Study 1:

From Leonard & Deevy (2011):

DLD/SLI group (age 5;1, % use of *is* = 54%

TD-A group (age 5;1, % use of *is* = 95%

5 novel verbs were presented exclusively in nonfinite form, as in:

We saw the dog pagging

And 5 novel verbs were presented exclusively with auxiliary *was*, as in:

Just now the bird was channing

Following the presentations of each novel verb, probe items were presented that obligated use of auxiliary *is* (i.e., "What's happening here?"). For example:
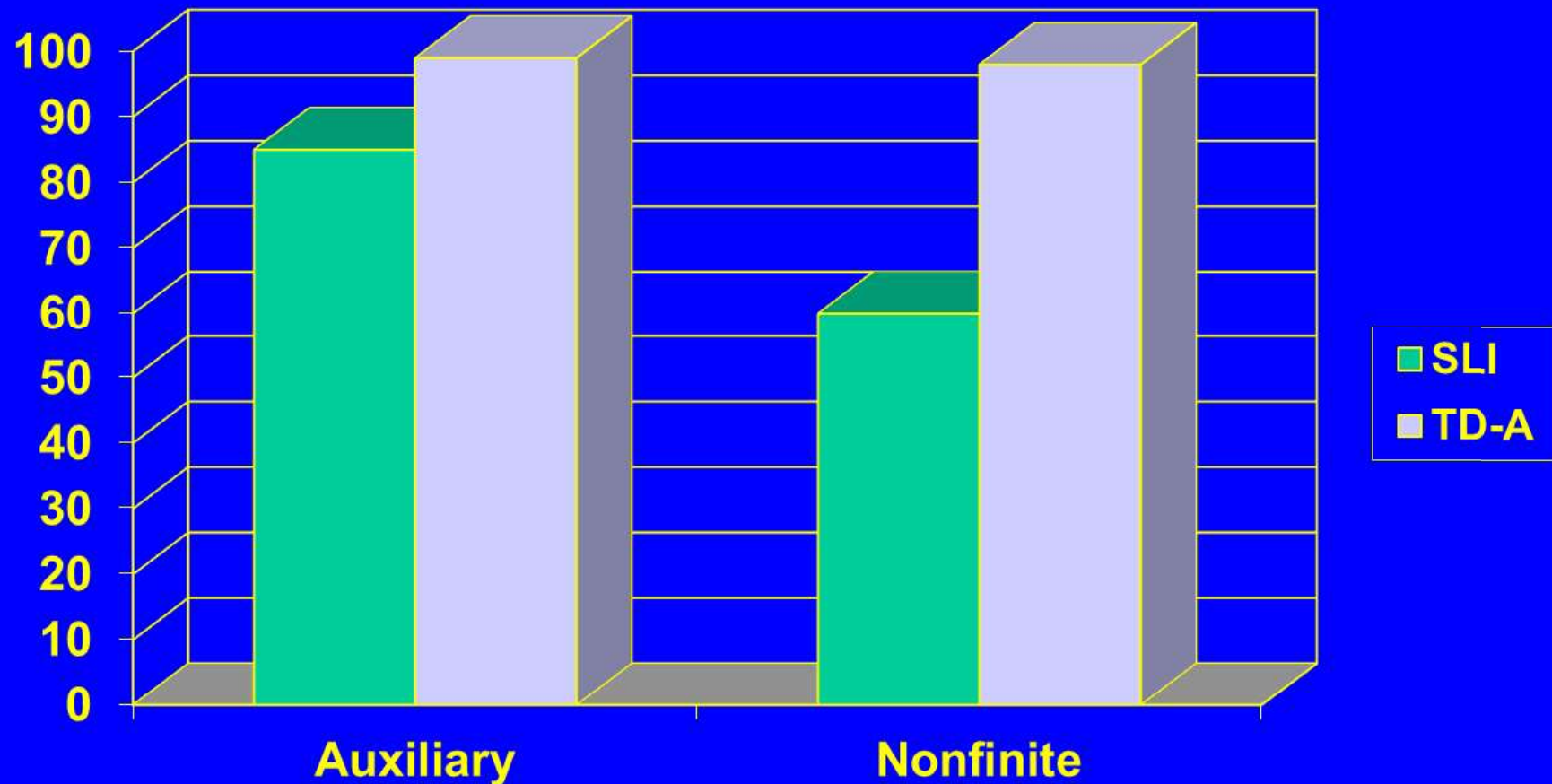
Presented: *The bird was channing*

Probes: *The cat is channing*

Presented: *We saw the dog pagging*

Probes: *The cow is pagging*

Effect of Input Condition: Percentage Use of *is* in Probes

Input Informativeness: Toy Talk 4

- **In English, it is better to avoid questions in second person, because they are often shortened.**
- *Are you going to open it → You going to open it?*
- *Do you like milk? → You like milk?*
- **When questions are shortened in this way, they contain no overt tense/agreement forms**
- **Questions in third person are rarely shortened in English and are permissible though not ideal.**

High Variability: Application 2

- **Even with a diverse set of verbs, care should be taken to use a wide range of sentence subjects:**
- ***The girl** runs, **She** plays, **The monkey** sees, **The horse** jumps, etc.*
- **Consider the alternative:**
- ***She** runs, **She** jumps, **She** plays, **She** sees, etc.*
- **In this case, the child might learn instead the rule *she* + Verb + *s*, and therefore use Verb + *s* only with *she*.**

From Redmond & Rice (2001):
Most judgments of grammaticality by children with SLI were in keeping with predictions. However, sentences such as *He made the robot fell into the pool* were often accepted, contrary to expectations. Note the sequence *[the robot fell into the pool]*

From Fey & Loeb (2002): **Treatment using recasting was uncharacteristically ineffective when teaching auxiliary *is* through questions, as in *Is Daddy driving the truck?* Note that sequences such as *[Daddy driving the truck]* are those proposed to be a source of nonfinite utterances**

Adult Italian:

"Can [Cristina drink coffee]?"
Può [Cristina bere caffè]?
AND
Può bere caffè Cristina?
Cristina può bere caffè?

Adult Italian:

"I make [Cristina drink coffee]"
Faccio bere caffè a Cristina
(I make drink coffee to Cristina)

"I make [her drink coffee]"
Le faccio bere caffè
(To her I make drink coffee")

The Modal Hypothesis: Why is the evidence from English weaker than the evidence from other Germanic languages?

English:
Can [Kristina drink coffee]?
Does [Kristina drink coffee]?
Swedish:
Kan [Kristina dricka kaffe]?

There is extensive evidence of working memory limitations in SLI. Although the proposal does not hinge on an assumption of working memory limitations, any such limitations are surely likely to render sentence interpretation more difficult.

Who is [the happy brown dog washing *x*]?

From Deevy & Leonard (2004): If children with SLI must hold the wh-phrase in memory for a longer sequence of words before the syntactic position to which it is related can be identified, comprehension is much poorer than in younger typically developing children.

"The man drinks beer"

Dutch error:
De man bier drinken
= The man beer drink
Correct: De man drinkt bier

Adult Dutch:
Kan [de man bier drinken]?
Can [the man beer drink]?

<u>Is</u> the boy playing basketball?
The boy <u>is</u> playing basketball.

<u>Does</u> the boy play basketball?
The boy play<u>s</u> basketball

It appears that a different structure is needed to facilitate use of third person singular *–s* (see Next Steps!)

Next Steps

- **Treatment design with other contrasts as targets, as in** *We hear the boy play* **his guitar** **versus** *We think the boy plays his guitar*

- **Treatment designs using interrogative plus emphatic utterances, as in** *Does the girl like ice cream? Yes, she does like ice cream; she likes ice cream*

- **Determine whether similar input effects relate to word order errors in Germanic languages**