Viewpoint

The Changing View of Input in the Treatment of Children With Grammatical Deficits

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Purpose: The purpose of this article is to present 3 approaches that emphasize the role that input plays in the treatment of grammatical deficits in children with language impairments.

Method: These approaches—input informativeness, competing sources of input, and high variability—were selected because they go beyond issues of token frequency and emphasize instead type frequency, relative frequency, and frequency at an abstract as well as a concrete level of grammar. Each of these approaches can be applied to the grammatical deficits seen in children with specific language impairment and can be readily used with

well-established procedures, such as focused stimulation and recasting.

Results: Each approach is supported by a body of laboratory research with children with typical language skills, and the feasibility of each has been tested in studies with a treatment design. Furthermore, the assumptions of the 3 approaches are largely compatible, permitting application of combinations of these approaches without violating any of their principles.

Conclusion: The positive findings from each of these approaches should serve as a basis for further clinical research.

In decades past, input was viewed as a possible contributor to language impairment in children, especially when the children showed no signs of neurological damage, intellectual disability, or hearing loss—children who are often referred to now as exhibiting specific language impairment (SLI). Research of that era focused on the types of speech that adults (usually mothers) directed toward their children. Initial indications were that this speech was too directive and short in length to foster adequate language development. However, using stronger research designs, investigators came to the conclusion that adults' speech to children with SLI is quite similar to the speech addressed to younger children with typical language skills matched according to mean length of utterance (Conti-Ramsden & Dykins, 1991; Warlaumont & Jarmulowicz, 2012). Some differences are seen within the areas of conversational speech (Conti-Ramsden, Hutcheson, & Grove, 1995) and literacy practices (Skibbe, Justice, Zucker, & McGinty, 2008). However, it appears that, for the vast majority of

children with SLI, the linguistic input they receive is sufficient to permit typical language development in most children and is therefore unlikely to be the cause of the impairment itself. In fact, there is evidence from both parent-child (Dale, Tosto, Hayiou-Thomas, & Plomin, 2015; Paul & Elwood, 1991) and clinician-child studies (DeThorne & Channell, 2007) indicating that some of the adjustments made by adults are in response to the children's own linguistic complexity or lack thereof.

Although unlikely to be a causal force in SLI, input can play an important role in the language development of these children. If children with SLI receive an input designed to highlight and clarify especially challenging details of language, they might succeed in narrowing the language ability gap between themselves and their peers.

In the clinical world, the creation of such a focused input falls in the realm of language intervention. This is seen especially in intervention studies that emphasize input frequency measures, such as dose, dose frequency, and cumulative intervention intensity (Warren, Fey, & Yoder, 2007). These studies indicate that dose (i.e., the number of presentations of the target per session, such as 15) and dose frequency (i.e., the number of sessions per week, such as two) are only part of the equation. Also important is the cumulative intervention intensity (i.e., the number

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of weeks of intervention, as in 10; thus, $15 \times 2 \times 10 = 300$ presentations).

Input measures of this type have been applied most often in intervention studies using “receptive” procedures in which learning must depend largely on what the child hears. Two such intervention procedures are *focused stimulation* and *conversational recasting*. In focused stimulation, clinicians present stories or describe play scenes during which they produce preselected grammatical targets with high frequency (Leonard, 1981). In most versions of this procedure, the child is not asked to produce a response. In conversational recasting, clinicians respond to the child’s utterances during play with a conversationally appropriate reply that contains a preselected grammatical target (e.g., Camarata & Nelson, 1992). Although the child initiates the sequence by providing the original (“platform”) utterance, there is no requirement for the child to respond to the clinician’s recast. Of the two procedures, conversational recasting has been used most frequently in the treatment literature. Meta-analysis indicates large average effect sizes for this procedure (Cleave, Becker, Curran, Van Horne, & Fey, 2015), although some of the recasting studies have included focused stimulation along with recasting (e.g., Fey, Cleave, Long, & Hughes, 1993; Leonard, Camarata, Brown, & Camarata, 2004).

Although these procedures have led to gains in children’s language abilities, it is also clear that children with SLI require greater input frequency than is required for children with typical language skills (Proctor-Williams, Fey, & Loeb, 2001). This observation seems to represent a good example of the difference between input and intake; what counts is the degree to which the child can benefit from the input received (Rowe, 2015), and children with SLI may require more input to achieve the same benefit as other children.

It is also possible that input frequency has been viewed too narrowly. Ambridge, Kidd, Rowland, and Theakston (2015) recently reviewed studies of input frequency in typical language development. These investigators noted how frequency effects are not limited to the absolute frequency of tokens (e.g., the number of times a child hears, say, verbs inflected with *-ed*). Much of the influence of frequency can be attributed to type frequency (e.g., the number of different verbs inflected with *-ed*), relative frequency (e.g., the proportion of verbs inflected with *-ed* relative to the number of invariant forms, such as *hit* and *put*), and frequency when measured at a more abstract (e.g., past tense and irregular as well as regular) rather than concrete (e.g., *-ed*) level. In this article, we consider how some of these alternative kinds of input frequency can have an influence on the grammatical abilities of children with SLI. We focus on the use of finite morphemes by English-speaking children—those morphemes that mark tense and agreement (Crystal, 2003). Among children with typical language skills, these morphemes are acquired more slowly in English than in other languages (Leonard, 2014). Among English-speaking children with SLI, these morphemes serve as a clinical marker and are a hallmark of the disorder (e.g., Rice & Wexler,

1996). They include present third person singular *-s*; past tense *-ed*; irregular past; the copula and auxiliary forms *is*, *are*, *am*, *was*, *were*; and the auxiliary forms *do*, *does*, *did*. We consider how these alternative kinds of input frequency might help us identify possible sources of tense–agreement weaknesses in children with SLI and how, in turn, we might provide more successful intervention for these children. We highlight three recent approaches that involve these alternative perspectives on input frequency. In Tables 1, 2, and 3, the major features of each approach are summarized and examples are provided.

The Value of Overt Forms of Tense–Agreement: The Input Informativeness Approach

It is well known that the telegraphic stage of grammatical development seen in English is not a universal phenomenon. Cross-linguistic differences among children are evident at a very young age (Slobin, 1985). Within generative linguistics, these differences are attributed to early parameter setting in children’s grammars (Chomsky, 1981). With only limited input from the ambient language, the relevant parameters are set to the proper value, and for the remainder of the developing years, children’s focus will be on vocabulary and the finer points of the language’s grammar. A variety of parameters has been proposed, dealing with cross-linguistic differences in word order, the obligatory versus optional use of sentence subjects, and the presence versus absence of verb inflections in a language (e.g., Gibson & Wexler, 1994; Hyams, 2011), among others. Not all parameters are properly set at the same time; however, their differences in time of emergence are generally attributed to different maturational points rather than to differences in how much input is required for the proper setting.

One exception is the tense parameter as proposed by Legate and Yang (2007). For an inflection-rich language, such as Spanish, the adult grammar reflects a [+ tense] setting of this parameter, whereas in a language such as Mandarin Chinese that does not use tense, the grammar reflects a [– tense] setting. According to Legate and Yang, instead of requiring only minimal input, the proper setting for this parameter is reached only gradually on the basis of the degree to which overt forms corresponding to [+ tense] are available in the input (see also Yang, 2002). Legate and Yang found that the age at which children became consistent in using tense–agreement morphemes in Spanish, French, and English corresponded to the proportion of forms in the language with overt marking for tense. In English, children hear not only forms with overt tense and agreement (e.g., *He dries the dishes every evening*) but also “zero-marked” forms whose expression of tense and agreement is not overt (e.g., *I/you/we/they dry the dishes every evening*) as well as bare-stem infinitive forms (e.g., *Help me dry the dishes*). The presence of so many unmarked forms in English works against an early setting of the [+ tense] parameter in children acquiring this language.

Table 1. Major features of the input informativeness approach.

Input/activities encouraged	Input/activities not encouraged
Input with overt tense–agreement forms e.g., <i>The dog runs really fast</i>	Input with zero-marked tense–agreement e.g., <i>They run really fast</i>
Input with uncontracted tense–agreement forms or contracted with nouns e.g., <i>She is very tall</i> <i>The girl's very tall</i>	Input with tense–agreement forms contracted with pronouns e.g., <i>She's very tall</i>
Questions with fronted auxiliaries e.g., <i>Are they getting some milk?</i>	Questions with omitted auxiliaries e.g., <i>You getting some milk?</i>

In a language such as Spanish, in which overt inflections for tense–agreement are abundant, this setting occurs earlier. This difference, according to Legate and Yang, may explain why tense–agreement inconsistency persists for a longer time in English- than in Spanish-speaking children. Xanthos et al. (2011) used a different type of measure but also reported a clear relationship between verb inflection frequency in a language and children's range of inflection development.

Rispoli, Hadley, and Holt (2009, 2012) incorporated the gradual tense parameter setting idea of Legate and Yang (2007) into their input informativeness approach with young children acquiring language in typical fashion. These scholars view tense–agreement morphemes as a constellation of related (finite) forms. Although differences in frequency of occurrence and physical form (inflection vs. freestanding morpheme) will affect the sequence in which these morphemes are acquired, it is assumed that children have the basic structural knowledge of how finiteness is applied once they receive sufficient evidence that the ambient language is [+ tense]. Applying this approach within English, Hadley, Rispoli, Fitzgerald, and Bahnsen (2011) found that the degree to which parents' speech to their young children contained overt tense–agreement morphology was related to the rate at which the children developed productive use of tense–agreement forms. Their measure of productivity involved the children's use of tense–agreement inflections with unique verbs (e.g., *runs, jumps, plays*) and copula and auxiliary use with unique nouns (e.g., *boy's, monkey's, bird's*) and pronouns if uncontracted (e.g., *he is, this is*; Hadley & Holt, 2006; Hadley & Short, 2005). Contracted copula and auxiliary forms with pronouns (e.g., *that's, it's*) were excluded under the assumption that they could have been learned through “direct activation” (Rispoli et al., 2012)—that is, learned from the input without grammatical analysis.

The advantages of this type of measure instead of an accuracy measure, such as percentage of use in obligatory contexts, is exemplified in a study by Guo, Van Horne, and Tomblin (2011). In this study, at lower levels of tense–agreement productivity, young children were found to use auxiliary *is* with greater accuracy with pronoun subjects than with noun subjects. At higher levels, the use of pronoun and noun subjects became more balanced. The most reasonable explanation for such a finding is that, earlier in development, children are probably incorporating highly frequent forms into their speech without necessarily treating

the auxiliary as a separable tense–agreement marker—the process of direct activation according to Rispoli et al. (2012). The greater use of auxiliary *is* with noun subjects at high levels probably reflected the influence of grammatical analysis. A simple measure, such as percentage of use in obligatory contexts, would not have been sensitive to this distinction.

Clinical Implications

To promote easier application of this approach by parents of children, these investigators developed a procedure referred to as *toy talk*. The feasibility of this procedure has already been demonstrated with a group of young adults (Hadley & Walsh, 2014). Toy talk is elegant in its simplicity. While interacting with their children, parents are encouraged to comment about the actions of toy characters and other objects that are the focus of play while reducing the number of direct references to themselves or their children. This procedure represents a natural way for parents to use verb forms with overt tense–agreement morphemes as in *That horse really likes the hay* rather than *You really like that horse* or *I really like your horse*. Within third person singular contexts involving copula or auxiliary *is*, the actual names of the characters or objects are encouraged rather than pronominal forms because, as noted earlier, forms such as *that's, it's, he's, and she's* might be learned as memorized wholes, rendering their tense–agreement status less clear to children.

Hadley, Rispoli, Holt, Papastratakos, and Hsu (2017) recently reported an additional benefit to using nouns rather than pronouns in subject position. When parents used a higher proportion of noun subjects, their children showed greater third person sentence diversity—that is, a wider variety of nouns with verbs even when tense–agreement morphemes were not involved (e.g., *The boys run fast*). These investigators attributed these gains to the lower transitional probabilities involved in noun + verb sequences in the input—that is, each verb is much less likely to appear immediately after a given subject noun than after a given subject pronoun. These lower probabilities appear to highlight the combinatorial details in sentences and discourage treating the subject–verb sequence as an unanalyzed package.

Questions such as *Is the girl buying her lunch?* and *Did the boy wash the dishes?* are permitted within toy talk

because it is assumed that children’s structural knowledge includes understanding the relationship between tense–agreement features as they might appear in fronted position (within the complementizer phrase, according to generative linguistics) and those that reside in sentence-internal position (within the inflection phrase).

The emphasis on third person contexts is certainly not a claim that overt morphemes for tense–agreement are limited to these contexts. For example, both *am* and *are* can serve to reinforce a [+ tense] setting. The appearance of these morphemes in the input can be helpful. However, these morphemes are less ideal for two reasons. First, when questions are asked, those expressed in the third person are more likely to include a fronted auxiliary (e.g., *Is the horse going to get some hay?*) than those in the second person because, in the latter case, informal speech allows for the omission of the auxiliary and hence the absence of a tense–agreement marker (e.g., *You going to eat something too?*; see Fitzgerald, Hadley, & Rispoli, 2013). Such non-canonical questions are not infrequent in child-directed speech (Estigarribia, 2010). Second, the first person singular copula or auxiliary form *am* nearly always appears adjacent to *I*, usually in contracted form (*I’m*), and might therefore be learned as a memorized whole (Rowland, 2007), probably to a greater extent than copula and auxiliary *is*, which also appears with subject nouns.

Rispoli, Hadley, and their colleagues do not argue that the tense–agreement weaknesses of children with SLI are caused by an input with reduced informativeness (e.g., Hadley et al., 2011; Hadley & Walsh, 2014). However, given the already weak skills of these children in this area, a significant increase in informativeness through procedures such as toy talk can provide an optimal input for these children. Along with serving as a good model for application by clinicians, the procedure appears to be readily transferable to the home situation, provided that parents receive the proper coaching. Note again that this procedure represents much more than providing an abundance of linguistic input. With its focus on the actions of toy characters and other objects, the proportion of input containing overt tense–agreement marking is increased substantially.

Embedded within the input informativeness approach are different kinds of frequency. The most obvious is token frequency; by focusing on the actions of toys and objects, speakers show an increase in the number of overt tense–agreement forms in their speech. However, relative frequency is also at play because the third-person focus of this speech

reduces the competition of first- and second-person forms produced. Last, frequency at an abstract as well as concrete level is involved in this approach. The emphasis on providing input with third person singular subjects ensures frequent presentations of three different tense–agreement morphemes: third person singular *–s* as well as both copula and auxiliary *is*. Because these different morphemes are viewed as a constellation of related forms (Rispoli et al., 2012), the presumption is that children receiving this input will gain greater knowledge not only of the individual morphemes, but also of more abstract features, such as present tense, third person, and singular number.

Avoiding Long-Distance Tense–Agreement Dependencies: The Competing Sources of Input Approach

When English-speaking children fail to use tense–agreement morphemes in obligatory contexts, omission errors dominate. Commission errors, in which an overt morpheme is inappropriately produced (e.g., *We likes ice cream*) are much less frequent. However, in one important sense, the term *omission* is misleading because it might imply that children attempt but fail to articulate the tense–agreement morpheme during sentence production. In fact, most omission errors can be characterized as the selection of a nonfinite form—that is, a form that lacks tense–agreement.

Some of the best evidence that the verb forms produced are nonfinite comes from Germanic languages other than English—languages whose infinitives are marked by an overt inflection rather than a bare stem. For example, in the German equivalent of the English *I will cry*, the infinitive *cry* is the inflected *wein-en* as in *Ich werde weinen*. In these languages, when young children fail to use tense–agreement, a verb form with an overt infinitive inflection is often used instead as in the German *Ich weinen* instead of the correct first person singular form *Ich weine* for *I cry* (Mills, 1985). This type of evidence seems even more convincing in German because, in this language, infinitive forms appear at the end of the sentence (e.g., *fahren* [*drive*] in *Ich werde einen Toyota fahren* [*I will drive a Toyota*]) whereas verbs marked for tense–agreement appear in second position (e.g., *fahre* in *Ich fahre einen Toyota* [*I drive a Toyota*]). Young German-speaking children often produce what appear to be simple sentences with the sole verb appearing improperly at the end of the sentence in (overt)

Table 2. Major features of the competing sources of input approach.

Input/activities encouraged	Input/activities not encouraged
Input with overt tense–agreement forms in declarative sentences e.g., <i>The dog runs really fast</i> <i>The girl's very tall</i>	Questions with fronted auxiliary verbs e.g., <i>Are they getting some milk?</i> <i>Does she like spaghetti?</i>
Activities that promote comprehension of dependencies between early- and late-appearing sentence information e.g., <i>Is</i> versus <i>Was the girl dancing?</i>	Input with subject–nonfinite verb clauses dictated by a preceding matrix verb e.g., <i>Help Heather pick up the toys</i>

infinitive form as in *Ich einen Toyota fahren*. In English, the best evidence comes from pronoun + verb combinations. When children fail to mark a verb for tense–agreement, non-nominative pronoun forms are sometimes used in subject position as in *Her make popcorn*. Within generative linguistics, nominative case (as in *she*) is licensed by agreement. When agreement is absent, the default case applies, which, in English, is the non-nominative form.

Although productions such as *Her make popcorn* sound rather exotic, child language researchers have noted that they are not alien to the child's input (e.g., Tomasello, 2000). These sequences appear in input utterances, such as *Help her make popcorn* and *We saw her make popcorn*. The difference, of course, is that sequences such as *her make popcorn* are permissible in utterances only when there is a verb earlier in the utterance that calls for a non-finite verb later in the utterance. If children extract sequences such as *her make popcorn* inappropriately from these larger structures, what would be the reason?

One possibility is that young children's processing capacity might be limited, making it difficult for them to grasp all the details of the larger structure. Researchers have developed computational models on the basis of this assumption with results that simulate the early stages of grammatical development quite well. This line of work began with Croker, Pine, and Gobet (2000, 2001) and was refined by Freudenthal, Pine, Aguado-Orea, and Gobet (2007) and Freudenthal, Pine, and Gobet (2006, 2009, 2010). By making the assumption that, early in development, reduced processing ability would restrict children's focus to the most recently heard portions of the input utterance—that is, the end of the utterance—these researchers developed a model with an utterance-final bias. When the model was provided large amounts of child-directed speech in English, it generated an output with a high proportion of nonfinite verbs. This outcome occurred because, in English, verbs occurring late in an utterance represent a significant mix of nonfinite and tense–agreement marked forms. For more richly inflected languages, this is not true, and the output of models applied to these languages (e.g., Spanish) contained much lower proportions of nonfinite utterances, conforming quite well to the greater use of tense–agreement produced by young children in these languages (Freudenthal et al., 2007). Adding credibility to the reduced processing assumption of this computational work, these investigators gradually relaxed the utterance-final bias to simulate a gradual increase in processing capacity that might take place as children develop. The result was an output with many more tense–agreement forms and fewer nonfinite forms.

Several investigators have directly tested children with similar results. Theakston, Lieven, and Tomasello (2003) presented young children with novel verbs that were consistently inflected with a tense–agreement morpheme (e.g., *Look, it keefs*) or consistently appeared in nonfinite form as part of a nonfinite subject–novel verb sequence (e.g., *Will it tam?*). After hearing each novel verb numerous times, the children were asked to produce the novel verb in contexts requiring either the tense–agreement form or

the nonfinite form. The results indicated that the children produced the novel verb in a manner highly consistent with how they heard it (e.g., *It keefs* or *It tam*). Other studies have replicated this finding with slightly different procedures (Finneran & Leonard, 2010).

Detailed study of parent–child transcripts has also revealed potential input influences of the same type. For example, Kirjavainen, Theakston, and Lieven (2009) noted that there was a correlation between the proportion of young children's errors, such as *Me do it*, and the proportion of sentences in the input that contained the same sequence in a complement clause (e.g., *Let me do it*).

In a series of studies, Leonard and colleagues asked if the inconsistent use of tense–agreement morphology by 4- and 5-year-old children with SLI might also have a source in the input (Leonard & Deevy, 2011; Leonard, Fey, Deevy, & Bredin-Oja, 2015). As in the computational modeling work and the research by Theakston et al. (2003), these investigators assumed that children might inappropriately extract nonfinite subject–verb sequences from larger structures in the input and use them as standalone utterances. Given the below age level processing abilities of children with SLI (e.g., Hoffman & Gillam, 2004; Montgomery & Evans, 2009), these children might engage in such an inappropriate extraction process well beyond the age when most children no longer exhibit this tendency.

However, because children with SLI often display limitations in syntactic comprehension as well as production (e.g., Bishop, 2014), Leonard and his colleagues asked if inappropriate extraction of nonfinite subject–verb sequences might be due to the children's failure to understand the dependency relationship between the sentence-final, non-finite, subject–verb sequence (e.g., *Danny clean his room*) and the verb that appears earlier in the input utterance whether that verb is a fronted auxiliary (e.g., *Did Danny clean his room?*) or a lexical verb that takes a nonfinite verb as its complement (e.g., *I made Danny clean his room*; *We saw Danny clean his room*; *Help Danny clean his room*). These investigators termed this hypothesis the *competing sources of input* hypothesis because if sequences such as *Danny clean his room* can serve as a source of generating new utterances, this source would compete with simple sentences in the input that contain tense–agreement morphemes, such as *Every day, Danny cleans his room*. With two sources for generating utterances, inconsistency in tense–agreement use would be a natural outcome.

One way the competing sources of input approach differs from the input informativeness approach is that the former does not assume that children already possess the structural knowledge of dependency relationships. Instead, it is assumed that children might have to learn these relationships in smaller steps, one structure at a time. For example, extracting *Danny clean his room* from *Help Danny clean his room* suggests that the child is not aware that the matrix verb *help* requires a nonfinite verb in the subordinate clause whereas extracting *Danny clean his room* from *Did Danny clean his room* suggests that the child is unaware that the interrogative form *did* provides the tense–agreement that

is required for the utterance even though it is in a fronted position.

As a first step in testing this hypothesis, Leonard and his colleagues presented nonfinite novel verbs in a variety of input frames, such as those noted above, as well as novel verbs with tense–agreement marking (Leonard & Deevy, 2011; Leonard et al., 2015). When tested after the exposure period, the children with SLI were more likely than younger and older peers with typical language skills to use the novel verb in a manner consistent with how it was heard.

Although these results showed a tendency for children with SLI to use novel verbs in the form in which they were heard, such results are not direct evidence that this use can be attributed to comprehension problems. Leonard and Deevy (2011) and Souto, Leonard, Deevy, Fey, and Bredin-Oja (2016) evaluated this comprehension interpretation more directly by testing children with SLI and younger children with typical language skills on their comprehension of sentences such as *The monkey sees the tiger running*—sentences that contain a nonfinite subject–verb sequence (e.g., *the tiger running*). For both the target picture and the three foils, a third character (e.g., a giraffe) was also depicted. One foil showed the monkey looking at the tiger, but the giraffe, not the tiger, was running. Another showed the tiger running, but the monkey was looking at the giraffe. The remaining foil depicted the opposite relationship, in which the tiger was looking at the monkey, who was running. The children with SLI were less accurate than the younger children despite the fact that the two groups were matched on their raw scores on a more general sentence comprehension test. The great majority of errors were instances in which the child pointed to a picture with the appropriate subordinate clause (e.g., *the tiger running*) but an inappropriate matrix clause (*the monkey was looking at the giraffe, not the tiger*) or, as an alternative, pointed to the foil depicting the opposite relationship. This finding suggests that, over and beyond the sentence comprehension limitations of the children with SLI, they may have had special difficulty dealing with sentences that required integration of information across two clauses (one of which involved a nonfinite subject–verb sequence).

To assess children’s sensitivity to the relationship between nonfinite subject–verb sequences and fronted auxiliaries, Deevy, Leonard, and Marchman (2014, 2017) used an eye gaze task in which children viewed pairs of pictures on a large screen, such as a picture of two cats eating and a picture of one girl eating, while listening to sentences such as *Are the nice little cats eating?* and *See the nice little cats eating?* For both types of sentences, children with SLI (mean age 4;10 [years;months]) showed evidence of looking at the correct picture only after the noun was heard (*cats*, in this example). In contrast, younger children with typical language abilities (mean age 3;6) who were matched on a general sentence comprehension test showed evidence of anticipatory looking during sentences with fronted auxiliaries. Upon hearing the auxiliary (e.g., *are*), their eye gaze became more reliably fixed on the correct picture before actually hearing the noun. It is important to note

that the younger children with typical language skills produced both auxiliary *is* and *are* with more than 90% accuracy whereas the children with SLI used these morphemes in only 60% of obligatory contexts.

Clinical Implications

Given the assumptions of the competing sources of input hypothesis, it is clear that clinicians need to be concerned not only with the frequent presentation of tense–agreement morphemes, but also with the kinds of input utterances to avoid. According to this hypothesis, when children with SLI are inconsistent in using tense–agreement morphology, even questions such as *Is the cat hiding in the tree?* might serve as a source for children’s nonfinite utterances (such as *The cat hiding in the tree*) and should be avoided. In fact, Fey and Loeb (2002) offered evidence supporting this idea. Their study was one of the few recasting studies that failed to produce positive results. In an effort to teach the use of auxiliary *is*, these investigators provided recasts in the form of auxiliary-fronted questions (e.g., Child: *That horse running*. Adult: *Is that horse running fast?*). The children did not appear to benefit from this procedure; Fey and Loeb suggested that the children might have recognized the pragmatic function of the questions but lacked the critical information that nonfinite propositions (such as *that horse running*) were structurally constrained and could not be used on their own.

Although input utterances containing nonfinite subject–verb sequences might be avoided early on, this would be an unacceptable approach over the long term. At some point, children with SLI need to be able to interpret such utterances. They need to understand that the information in the nonfinite subject–verb sequence is connected to verb information that appears earlier in the input utterance.

Fey, Leonard, Bredin-Oja, and Deevy (2017) developed a procedure designed to help children acquire this understanding. Children with SLI were randomly assigned to one of two treatment conditions. One was a more traditional condition, involving stories and recasts that had a mix of tense–agreement morphemes in declarative position and fronted auxiliaries in questions. The other treatment condition used tense–agreement morphemes in declarative position only, thus avoiding nonfinite subject–verb sequences, such as those that appear in auxiliary-fronted questions. It is important to note that each treatment session began with a comprehension activity. For the traditional condition, the children viewed a sequence of activities and then answered a question, such as *Is/was the girl painting the fence?* The correct answer did not depend on the auxiliary but rather on the accuracy of the subject–verb proposition (e.g., a girl painting the fence vs. a boy painting the fence). Errors were followed by the clinician’s correction as in “No, I asked *Is the girl painting the fence?* And see, the boy is painting the fence, not the girl.” For the corresponding comprehension activity in the competing sources of input condition, the correct answer depended on the tense of

the fronted auxiliary (e.g., saying no to *Is the girl painting the fence?* because the girl had moved on after painting the fence). Errors were followed by the clinician's correction, such as "No, I asked *Is the girl painting the fence?* And, see, right now, she's not."

The children with SLI in the competing sources of input condition made greater gains on auxiliary *is* than the children in the more traditional condition. These differences were seen in both comprehension and production. However, attempts to teach third person singular *-s* in the same way were less successful. Gains were made in comprehending the tense in the auxiliary-fronted questions, but corresponding gains were not seen in the production of third person singular *-s*. In English, the interrogative equivalent of a declarative in third person singular *-s* must make use of the auxiliary *does*. Fey et al. (2017) suggested that the problem rested with the opaque relationship between the fronted auxiliary *does* and the third person singular *-s* inflection. For example, once children were taught to pay attention to the tense of the fronted auxiliary *is* in a question such as *Is the girl painting the fence?* it may have been relatively easy to relate it to the auxiliary *is* in declaratives such as *The girl is painting the fence*. However, after children learned to pay attention to the tense in the fronted auxiliary *does* in a question such as *Does the girl ride her bike?* it might have been more difficult to recognize its relationship to declaratives such as *The girl rides her bike*. In the former case, one can treat the auxiliary *is* as moving to the initial position of the utterance; in the latter case, one can perhaps think of abstract features of tense-agreement moving to the initial position but not an overt morpheme. It is for this reason that such morphemes are referred to as "dummy" auxiliary *do* forms (Radford, 1997). Even in typical language development, the use of auxiliary *do* forms is more problematic than other types of auxiliaries. For example, young children are more likely to produce an error such as *Do he goes?* than one such as *Can he can go?* (Rowland, 2007).

The findings of Fey et al. suggest that children might have to resolve the tense-agreement inconsistency problem one morpheme type at a time even with intervention. For example, because the relationship between auxiliary *does* and third person singular *-s* may be too obscure, children with SLI might instead receive experience contrasting sentences such as *The girl rides her bike every day*, *We think the girl rides her bike every day*, and *We see the girl ride her bike every day*. The simple sentence can serve as a more

conventional model for third person singular *-s*, and the other two examples can make clear that a verb appearing earlier in the sentence is important for whether third person singular *-s* is required (as in the case of cognitive verbs, such as *think*) or can be omitted (as in the case of perception verbs, such as *see*).

In terms of the different kinds and levels of frequency, the competing sources of input approach places emphasis on relative frequency: not only the need to increase the number of tense-agreement forms in the input, but also the need to actively avoid the appearance of nonfinite subject-verb sequences—structures viewed as potentially misleading to children with SLI. It was seen that the input informativeness approach is also concerned with relative frequency. However, the two approaches differ in the specific types of input to avoid. Unlike the input informativeness approach, the competing sources of input approach places no restrictions on the use of zero-marked forms, such as *like* in *We like apple pie*, on the basis of the scarcity of commission errors, such as *We likes apple pie* in children's speech—a scarcity that suggests children attend to the person and number of sentence subjects when they learn tense-agreement morphemes. On the other hand, although a fronted auxiliary (as in *Is she washing the car?*) represents an overt tense-agreement form, such input would be avoided in the competing sources of input approach because children might fail to recognize that the nonfinite subject-verb sequence (as in *she washing the car*) is dependent on the presence of the auxiliary.

The Importance of Diversity: The High Variability Approach

Important insights about the role of input have come from experiments with very young children using artificial grammars. Gómez (2002) asked if 18-month-olds as well as adults could learn a nonadjacent rule of the type *aXb*, in which *a* and *b* were co-occurring nonwords comparable to closed-class morphemes and *X* represented an open-class nonword set where the members were free to vary. An analogous pattern in English would be *is + verb + ing*, in which the verb can vary, but *is* and *-ing* will appear together on either side of the verb. Gómez found that both age groups could learn the relationship between the *a* and *b* nonwords when 24 different nonwords were used in the open-class

Table 3. Major features of the high variability approach.

Input/activities encouraged	Input/activities not encouraged
Input with 24 different lexical verbs used with the tense-agreement target e.g., (1) <i>runs</i> , (2) <i>jumps</i> , (3) <i>plays</i> , (4) <i>sees</i> , (5) <i>likes</i> , (6) <i>hears</i> , (7) <i>reads</i> ... (24) <i>walks</i>	Input with very few lexical verbs used with the tense-agreement target e.g., (1) <i>runs</i> , (2) <i>jumps</i> , (3) <i>plays</i> , (4) <i>sees</i> , (5) <i>hears</i>
Input with a variety of sentence subjects e.g., <i>The girl runs</i> , <i>The boy jumps</i> , <i>The dog plays</i> , <i>The tiger sleeps</i> , <i>Dad walks</i> , <i>Molly talks</i>	Input with few sentence subjects e.g., <i>She runs</i> , <i>She jumps</i> , <i>She reads</i> , <i>He plays</i> , <i>He walks</i> , <i>He sleeps</i>

X set. When fewer nonwords were used in the *X* set, learning was not successful. Note that the total number of presentations of exemplars was controlled and therefore always the same across conditions; the difference in learning was instead attributable to the number of unique nonwords used in the *X* set. Grunow, Spaulding, Gómez, and Plante (2006) also reported successful learning by a group of adults with language-based learning disabilities when the more expansive, 24-nonword *X* set was used.

An artificial grammar study by Torkildsen, Dailey, Aguilar, Gómez, and Plante (2013) tested adults' ability to learn the morphological rules *aX* and *Yb*—nonword analogs to rules such as *the* + noun and verb + *s*, respectively. Adults with typical language skills were able to acquire the artificial grammar when the *X* and *Y* sets contained only three different nonwords each, but their learning was stronger when the *X* and *Y* sets contained 24 different nonwords. In contrast, adults with language-based learning disabilities were successful only when 24 different nonwords were contained in the set.

As would be expected, the particular paradigms used to assess learning vary according to the age group being studied. For infants and toddlers, a head turn preference procedure is used; for adults, judgments of whether a stimulus is or is not part of the language are elicited. Regardless of paradigm, these studies are important in showing that participants can learn rules of a grammar using distributional cues without accompanying referents (Gerken, Wilson, & Lewis, 2005).

How should a failure to learn a rule be interpreted? Within these paradigms, a failure to learn means that the participant shows no evidence of distinguishing new exemplars that conform to the rule from those that are “ungrammatical.” In practice, with a real language, this might mean that children simply fail to use utterances reflecting the new rule. As an alternative, if the children managed to glean aspects of the rule but failed to identify the proper boundaries of the rule, then their use might reflect misinterpretations of the correct pattern. For example, if children had only partial learning of third person singular verb forms, such as *shakes*, *gets*, and *pats*, they might mistakenly treat the verb forms *chase*, *guess*, and *pass* as suitable to use in the same sentence contexts.

The emphasis in the high variability approach differs considerably from the emphasis in either the input informativeness approach or the competing sources of input approach. For example, whereas the input informativeness approach acknowledges that tense-agreement morphemes might differ in their point of acquisition as a function of how they are used in an utterance (e.g., as an inflection or as a function word), the emphasis is on the overt marking of tense-agreement regardless of the morpheme's particular combinatorial characteristics. In contrast, the high variability approach emphasizes the need to highlight how a tense-agreement morpheme combines with other details in the sentence. The morpheme *-s* in *runs* and *jumps* and the morpheme *is* in *is running* and *is jumping* may both reflect present tense, third person, and singular, but the first requires adequate learning of an *Xa* rule whereas the second requires an *aXb* rule.

Clinical Implications

There are clear clinical implications that emerge from this line of research—one that we shall refer to as the *high variability* approach. Alt, Meyers, and Ancharski (2012) have provided a very appropriate example of how treatment might proceed, using *is* + verb + *ing* as the target. Plante et al. (2014) have since gone even further by actually conducting a treatment study in which they manipulated the variables just discussed. Preschoolers with SLI were assigned one target form (e.g., past tense *-ed*) and one control form (e.g., third person singular *-s*) on the basis of their initial language needs. The children were randomly assigned to learn the target in a high variability condition or a low variability condition. For the high variability condition, the children heard the target with 24 unique verbs during each session; 12 unique verbs were used in each low variability session. Treatment dose was controlled by presenting each verb in the low variability condition two times. A conversational recasting method was used.

The results were encouraging. Children who learned their target forms in the high variability condition made greater gains than children who learned target forms in the low variability condition. This was true not only for degree of use of the target morphemes, but also in terms of the number of unique verbs that they used with the target morphemes. It was somewhat surprising to note that only the target morphemes taught in the high variability condition showed gains that were greater than those seen for the control morphemes.

One of the impressive characteristics of the Plante et al. (2014) study is that children were taught to use morphemes corresponding to several different patterns, such as *Xa* (verb + *ed*, verb + *s*) and *aXb* (*is* + verb + *ing*), ensuring that the advantages of high variability (24 unique verbs) held across morphemes and pattern types. Plante et al. (2014) also made it clear that care should be taken in selecting the combination of words and morphemes to serve as targets in each pattern. For example, if the goal is to teach the child the third person singular *-s* inflection, use of 24 unique verbs could still be problematic if the same sentence subject were used in each input sentence as in *she runs*, *she walks*, *she sleeps*, *she talks*, etc. Because *she* always appears in subject position, the child might learn instead only *she* or, at best, a nonadjacent morpheme rule such as *she* + verb + *s*. A more suitable alternative would be to vary the nouns and pronouns in subject position along with the verbs as in *The girl runs*, *she walks*, *The man sleeps*, *The boy talks*, etc. In this case, the third person singular *-s* inflection would be the only constant, which should promote the learning of the desired verb + *s* pattern.

A study by Plante, Vance, Moody, and Gerken (2013) provides another caution to be followed when teaching grammatical details. They presented an artificial language to preschoolers with SLI and same-age controls. The rules of the language could be considered narrowly or more broadly and allowed for the learner to interpret the exemplars as reflecting a word order rule or a rule that is based

on phonological characteristics. When the exemplars heard by the child reflected a word order rule whose nonwords had a particular phonological composition, the children preferred the narrow interpretation as a word order rule applying to nonwords of a particular phonological type. Although this study did not deal with tense–agreement morphemes, the findings have implications for language intervention. They suggest that, say, an *is* + verb + *ing* input, even with 24 unique verbs, is not likely to be extended by the child to, say, the use of *are* + verb + *ing* because children are not likely to view the *a* element in the *aXb* pattern as extending to elements with a different phonological composition (from *is* to *are*) without an input that encourages a broader interpretation.

The successful intervention study of Plante et al. (2014) illustrates the value of type frequency. In their study, high variability translated into a larger number of unique verbs, which presumably allowed the children to more readily identify the accompanying tense–agreement morpheme. The admonition to avoid presentations such as *she runs*, *she walks*, *she sleeps*, *she talks*, etc., in favor of those such as *The girl runs*, *she walks*, *The man sleeps*, *The boy talks*, etc., can be interpreted as another call for increased type frequency, this time applied to less proximal words. However, at the same time, such use would reduce the role of potential competitor rules (e.g., *she* + verb + *s* rather than the target subject + verb + *s*).

Finding Common Ground: Directions for Future Intervention Research

We have reviewed three different approaches that provide new directions for how input might be manipulated when providing services to children with SLI. Each approach has included an intervention study. In the case of the input informativeness approach, the intervention was applied to young children with typical language development rather than children with SLI, but clear increases were seen in the children's tense–agreement use as a result of the procedures applied. In the case of the competing sources of input and high variability approaches, children with SLI served as participants in the intervention studies.

Before discussing the unique contributions of each approach and how they might be integrated, we should acknowledge the steps that are still needed before these approaches can be adopted as standard clinical practice. First, of course, is the fact that tense–agreement morphology is the focus. It is certainly true that weaknesses in this area of language are a hallmark of SLI during the preschool years. However, it is not yet clear if children's significant gains in tense–agreement morpheme use will translate into overall communicative success. Other weaknesses might contribute to children's continued communicative challenges even if the tense–agreement problem is largely resolved. It is likely that activities centered on tense–agreement should be used in tandem with activities that have broader communicative goals.

Second, the supportive data for these approaches, although promising, are far from definitive. Many of the studies revealing relationships between particular details in the input and children's production profiles are correlational in nature rather than causal. Even when encouraging results emerge from a treatment design, it has not been demonstrated that the statistically significant group differences amount to differences that can be regarded as clinically significant. A related issue is that the input studies have focused on toddlers and preschoolers. Although these age groups represent the period when tense–agreement morphemes are highly inconsistent, children with SLI are likely to regard omissions of tense–agreement morphemes as acceptable well into the school years. We do not yet know if input effects operate in the same way in these older children.

A third type of limitation is that this work has emphasized children whose mainstream American English dialect obligates tense–agreement morphology in main clauses. In nonmainstream dialects that permit certain tense–agreement forms to be optional (e.g., *is*, *are* in African American English), children with SLI nevertheless show less use of these forms than children from the same dialect group who appear to be developing language without difficulty (Garritty & Oetting, 2010). However, it is not yet known what criterion level should be used to mark success when 100% use is not characteristic of the dialect.

Last, it is likely that the input effects reviewed here apply principally to children who have reached a readiness period. Although each of these approaches has demonstrated learning in children showing no use of target tense–agreement morphemes at the outset, it is unlikely that such success would be seen if the children were not yet able to comprehend simple declarative sentences and discern that forms such as *runs* and *jumps* are related to *run* and *jump*.

Turning to the integration of the three approaches reviewed here, it is clear that each contributes useful information that the other two approaches do not address. In the case of input informativeness, the focus on the actions of toy characters and objects by the clinician or parent ensures a higher proportion of utterances containing overt tense–agreement forms than would otherwise be the case even in a rich linguistic environment. Greater use of the actual names of the toy characters and objects rather than pronoun forms (as in *he's*, *she's*, and *it's*) also reduces the likelihood that the tense–agreement morphemes will be treated as unanalyzed wholes by the child.

The competing sources of input approach also calls for frequent presentations of tense–agreement morphemes in the input although it does not place a premium on a name of toy or object focus as does the input informativeness approach. An important component of this approach is a systematic avoidance of input utterances that contain nonfinite subject–verb sequences, at least during the early stages of intervention. At the same time, direct comprehension activities should be undertaken that help children learn the dependency relationships between the nonfinite subject–verb sequences and the verbs that appear earlier in the same input utterance.

The high variability approach contributes yet another important piece to intervention. According to this approach, it is not enough to simply present target tense–agreement morphemes frequently. These morphemes should appear with a wide variety of verbs whether the targets are inflections (e.g., *runs, jumps, eats, walks, sleeps, hugs*, among many others) or auxiliary forms (e.g., *is running, is jumping, is eating, is walking, is sleeping, is hugging*, among many others). For reasons that are similar but not identical to those of the input informativeness approach, the high variability approach also encourages a variety of sentence subjects to be used with the tense–agreement morpheme (e.g., *the boy runs, the girl jumps, she eats, the dog walks*). This arrangement is not intuitive; one can imagine that a clinician would think that a more uniform presentation would be beneficial as in *she runs, she jumps, she eats, she walks*, and so on. However, in such instances, *she* might be what is learned rather than third person singular *–s*.

These three approaches can be integrated without any serious theoretical compromise on the part of any of them. In the input informativeness approach, auxiliary-fronted questions (especially in third person) are permissible but are no more favored than third person tense–agreement forms in declarative position. Because auxiliary-fronted questions are viewed as potentially encouraging the extraction of nonfinite subject–verb sequences according to the competing sources of input approach, the only compromise would be to avoid these questions in the early going. Note that the other structures to avoid initially within the competing sources of input approach—as seen in *Help Molly clean her room* and *We saw Chris washing his car*, among others—would not be encouraged within the input informativeness approach either because, as nonfinite forms, sequences such as *Molly clean* and *Chris washing* lack overt tense–agreement.

To ensure compatibility with the third approach—the high variability approach—one other important input feature is needed. Each tense–agreement morpheme appearing in the input should be associated with a wide variety of verbs (and a variety of subjects as well to prevent the children from learning the wrong grammatical detail). For procedures such as focused stimulation, this is easily accommodated because stories can be constructed that provide a wide range of different verbs. However, for recasting, the clinician might have to arrange the play environment to ensure that it contains a rich array of toys and objects that can be described with many different verbs. The clinician's own utterances used to set up a child's platform utterance might also have to be preplanned. As noted earlier, to promote more targeted learning of the tense–agreement morpheme, a variety of sentence subjects should be used with the verbs. This detail accords well with the principle of the input informativeness approach to avoid frequently occurring sequences, such as *that's* and *it's* that might be learned as unanalyzed wholes.

The final component of intervention would be comprehension activities designed specifically to help children learn dependencies between nonfinite subject–verb sequences appearing near the end of sentences and the

earlier-appearing verbs in the same sentences that permit these sequences. Such comprehension activities are not called for by either the input informativeness approach or the high variability approach. However, these activities do not violate any of the principles of these approaches either.

There are theory-neutral input factors that might also be beneficial to incorporate into tense–agreement intervention. These are not part of any of the three approaches but are compatible with them. In particular, in a language such as English, there are prosodic cues to clause and sentence boundaries, including final lengthening (e.g., Gerken & McGregor, 1998). Lengthening applies not only to sentence-final syllables, but also to sentence-final fricatives. For example, third person singular *–s* in child-directed speech has significantly longer duration in sentence-final position than in sentence-medial position (Hsieh, Leonard, & Swanson, 1999). Presentations of this inflection in sentence-final intransitive verbs might render it more salient, which could hasten its identification by children as an overt tense–agreement form (of importance in the input informativeness approach) and foster its learning as the *a* element in an *Xa* pattern (as specified in the high variability approach).

In summary, these three approaches provide a new look at the role of input in children's use of tense–agreement morphology. All three approaches go beyond token frequency by focusing on specific details of the input, such as an emphasis on third person noun subjects (to increase the likelihood of overt tense–agreement marking), high variability of verbs (to ensure the adjacent tense–agreement morphemes can be better identified and hence learned), and the avoidance of nonfinite subject–verb sequences in input utterances (to prevent inappropriate extraction of nonfinite utterances). Each of these details can be readily incorporated into input-oriented intervention procedures, such as focused stimulation and recasting. Comprehension activities, although not a feature of input, can be added to complete the integration of these three approaches. These comprehension activities might increase the child's intake or ability to make use of the available input.

The empirical support already found for these three approaches could serve as a basis for future clinical research. This work could help refine the theory behind each approach and determine if, singly or in combination, these approaches can serve as a basis for a coherent approach to treatment, one that leads to better outcomes than those that are based on token frequency alone.

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