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PERSPECTIVES

Development of interventions for language impairment: Why universal grammar may be harmful (Commentary on Ambridge, Pine, and Lieven)

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Although theories of specific language impairment grounded in UNIVERSAL GRAMMAR (UG) have advanced the description of SLI considerably, they provide limited utility as far as treatment is concerned. Because UG assumes deficits in language principles and parameter setting, remediation of the difficulty is not possible; rather, reliance on compensatory mechanisms is recommended. Compensatory mechanisms rely on the same learning principles as are adopted by theorists that adopt a more EMERGENTIST view. Thus, we agree with Ambridge, Pine, and Lieven that a UG-based approach is redundant and recommend focusing efforts on identifying and strengthening treatment strategies associated with general learning principles instead.

Keywords: SLI, treatment, child language, language impairment, universal grammar, usage-based approach

1. Introduction. In their article, Ambridge, Pine, and Lieven (2014; AP&L) argue that an emphasis on innate underpinnings of language as they are currently described in UNIVERSAL GRAMMAR (UG) approaches is not useful for explaining the learning process. They provide evidence from five areas of language learning that show that the nativist explanations are (i) redundant, (ii) fail to cover all of the data (data coverage), or (iii) fail to explain how children link innate knowledge to their native language (linking).

Children with SPECIFIC LANGUAGE IMPAIRMENT (SLI) provide a case that allows us to further explore the critiques proposed by AP&L. Children with SLI have a deficit in language learning in the absence of a hearing impairment, mental retardation, autism, or obvious neurological impairments. Because these children, by definition, show deficits in language use in the absence of any obvious causal factors, it is tempting to argue that an innate language capacity has been damaged, leading to isolated deficits in language. This explanation is less than satisfying, however, because the proposed deficits do not fully capture the profile of deficits (data coverage), and in some cases they require that we draw on other non-UG-based mechanisms to fully explain the observed language profile (redundancy). To illustrate this point, we review the profile of SLI and then provide critiques of two of the most commonly appealed to UG-based explanations of SLI: one that explains morphological deficits, the 'unique checking constraint' account proposed by Wexler (1998), and one that explains syntactic deficits, the 'representational deficit for dependent relations' account proposed by van der Lely and colleagues (e.g. van der Lely 1996). Then we argue that UG fails to provide us with clinical tools. Those learning strategies that have been proposed can be captured as parsimoniously through other explanations of language learning (redundancy), and many of the clinical tools applied are language-specific because of the need to link the surface form to the underlying representation (linking rules). Thus we claim that UG-based accounts of language acquisition are not helpful for understanding clinical populations and in fact may be harmful by drawing our attention away from explanations with the potential to provide us with more effective clinical tools.

2. What is specific language impairment? The classic description of SLI is a language learning problem in the absence of any obvious causal factor—by definition, these children do not have a hearing impairment and are not diagnosed with autism or mental retardation, or an obvious incident of neurological damage (see Leonard 1998). These children are usually slow to say their first words and to use two-word combinations. In English, difficulties are observed in the production of morphology (Leonard 1995, Rice & Oetting 1993), with the most obvious deficits in the use of tense and agreement morphemes (Rice et al. 1995, Rice et al. 1998). Difficulties producing complex syntax are observed following a similar profile of later and less accurate use (Leonard et al. 2006, Schuele & Nicholls 2000). Comprehension deficits are also observed, including difficulties with anaphora (van der Lely & Stollwerck 1997), bound morphology (Leonard & Deevy 2009, Leonard et al. 2000), and complex syntax (Deevy & Leonard 2004, Friedmann & Novogrodsky 2004, van der Lely 1996).

Crosslinguistically, the grammatical profile seems to be predictable based on linguistic typology (Leonard 1989). For instance, Romance languages consistently show particular deficits with clitics and articles where number and gender agreement must be marked (Bedore & Leonard 2001, Bortolini et al. 2002, Grüter 2005). Germanic languages reveal deficits in word order and verb morphology (Hamann et al. 1998, Hansson & Bruce 2002). Isolating languages like Mandarin and Cantonese are more likely to show deficits in optional markers or complex syntax (Leonard et al. 2007, Leonard et al. 2006). Perhaps the most unifying description of children with SLI crosslinguistically is that they show early lexical deficits (Leonard 1998), even though this aspect of the disorder is less emphasized in older children in favor of the grammatical difficulties.

3. Strengths and weaknesses of ug-based explanations of sli. Before describing in detail two commonly accepted explanations of SLI, we would like to highlight two challenges that face any account of SLI.

One of the challenges is the fact that it is difficult to identify any aspect of language that is in error 100% of the time. In almost all studies, what is reported is not an all-or-none phenomena, but rather lower levels of accuracy on whatever language area is being tested, increased sensitivity to task complexity, and more protracted developmental trajectories. Any explanation of SLI must therefore explain both why we observe the particular profile of deficits that we see and how these individuals, like all people, improve their use of language over time according to a developmental trajectory (Leonard 1998, Pinker 1984). It also must explain variable, and often above-chance, performance that improves across the lifespan but does so at a rate slower than seen in typical children (Rice et al. 1998). Thus, a 'broken' component of UG must still allow for accurate performance on occasion and must develop over time. Processing-based accounts of language learning have an advantage, in that they assume and actively attempt to explain variability. For instance, although the surface hypothesis (Leonard 1989) has generally been refuted, it hypothesizes that children with SLI are less capable of handling short, transient input. Thus they require more input in order to identify consistent patterns, and these patterns may come at a processing cost, but presumably the child is able to eventually accumulate enough evidence to produce morphemes accurately in simple situations. UG-based explanations assume a more rule-governed approach within the grammar and must posit additional specific reasons for optionality.

A second challenge is the growing body of evidence that these children are not actually specifically (i.e. only) impaired in the grammatical aspects of language (see e.g. Nation 2014 for a review of lexical deficits) or even only impaired in language, broadly speaking (e.g. Tomblin et al. 2007). The dispute over this is sufficient that many people adopt other names for this disorder, like primary language impairment, as a means of expressing the opinion that language is the most observable deficit, but not the only deficit (e.g. Boyle et al. 2007, Kohnert 2010). Children with SLI, despite the strict exclusionary criteria applied, have higher rates of comorbidity than one would expect by chance with a variety of other neurological/psychological deficits (Tomblin et al. 2000), including developmental coordination disorder (Hill 1998), attention deficit disorder and attention deficit hyperactivity disorder (Cohen et al. 1993, Redmond 2005), and possibly autism (Tomblin 2011). They also show consistently lower nonverbal IQ scores (Johnston 1982, 1999), base motor reaction times (Miller et al. 2001), ability to complete perceptual tasks (Powell & Bishop 1992), and poorer visual attention (Finneran et al. 2009). A unified explanation of these deficits along with the unique language profile observed is difficult to achieve using either a domain-general or a domain-specific explanation of SLI.

3.1. The unique checking constraint account. The extended optional infinitive hypothesis (EOI; Rice et al. 1995) and agr/tns omission model (ATOM; Wexler et al. 1998) were originally proposed as explanations of why English-speaking children with SLI showed protracted tense development. Typical children go through a brief period of time wherein they sometimes correctly mark tense on the verbs and sometimes do not (Rice et al. 1995). In English this shows up as the use of bare stem and inflected forms, but in languages such as German or Dutch this period is also characterized by word-order changes that suggest that the verb is truly nonfinite in nature even when the surface form is homophonous with other forms (Rice et al. 1997). Children with SLI are argued to be in this period for a protracted length of time, leading to the observed deficits in production.

The unique checking constraint (UCC) was proposed by Wexler (1998) as an extension and modification of these accounts, and it provided an explanation of the patterns observed in Romance languages as well. Within the minimalist program (Chomsky 1995), grammatical features are associated with different functional projections, and a morpheme moves into position in the sentence in order to have these grammatical features checked. In this account, Wexler argues that all children initially are only able to check one feature per morpheme. For those morphemes with more than one grammatical feature, any features left unchecked will lead to an overt grammatical violation and the morpheme will not be realized; checking twice will allow the morpheme to be produced but will lead to a violation of the underlying constraint. These violations are what lead to optionality—because the system attempts to reduce the number of violations, it selects randomly between these choices, leading to some realizations without the morpheme (in the case of incomplete checking) and some realizations that appear grammatical on the surface but actually violate the child's grammar (violating the UCC). This accounts for errors with third-person singular *-s* (which has tense and agreement features) in English and problems with, say, object clitics in Romance languages (which have grammatical gender and number features).

The strength of the EOI/UCC account is that it makes specific predictions about the types of deficits observed in Romance and Germanic languages (Wexler 1998), with some additional extensions to Semitic languages as well (Rhee & Wexler 1995). Another strength of the EOI/UCC account is that it accurately predicts differences when tense-related morphemes might be produced or omitted within very similar sentences. For instance, as predicted, we do observe more errors on third-person singular *-s*, a form that carries both tense and agreement information, than on regular past tense *-ed*, a form that carries only tense information. Furthermore, bare stems cooccur more often with case-marking errors in contexts for third-person singular *-s* than for past tense *-ed*.

Nonetheless, both the crosslinguistic effects and the details of how these deficits are realized in English can be accounted for within a processing-based account. Freudenthal and colleagues (Freudenthal et al. 2007, Freudenthal et al. 2006) have used MOSAIC, a computational model, to show that limitations in working memory along with an utterance-final processing bias can lead to many of the morphological and case-marking-related changes observed in sentence production. Similar cognitive mechanisms have been instantiated in a model of vocabulary learning and nonword repetition, EPAM-VOC (Jones et al. 2007, 2008), providing a more parsimonious explanation for a range of deficits observed in children with SLI in a variety of areas like lexical learning (Nation 2014) and nonword repetition (Coady & Evans 2008). The UCC also does not adequately account for different profiles that are observed in high- and low-frequency lexical items (Theakston & Lieven 2005). MOSAIC, because of its emphasis on input frequency, may be capable of explaining these differences without appealing to extra mechanisms. Thus we see that the UCC account, a UG-based explanation of SLI, is redundant with a more domain-general explanation that covers a broader range of phenomena.

While it may be that MOSAIC is not the best explanation of the observed morphological deficits, it is currently the most well-developed and precise alternative. Other possible explanations that draw on spreading activation for lexical retrieval (McMurray et al. 2010) or statistical learning mechanisms (Misyak et al. 2010) may be better explanations in the long run but are not yet detailed enough in their application to grammatical morphology to make direct comparisons. It is also possible that another account of SLI within the UG framework would be more parsimonious, but, as we see in our second example, the challenges of data coverage and redundancy persist.

3.2. The representational deficit in dependent relations account. Another account of SLI ground in UG is the representational deficit in dependent relations (RDDR) account proposed by van der Lely and colleagues (van der Lely 1996, van der Lely & Battell 2003, van der Lely & Stollwerck 1997). It argues that children with SLI have difficulty carrying out movement operations accurately. In particular, current instantiations of the minimalist program (MP; Chomsky 1995) claim that two operations are required to build syntactic trees: Merge and Move. The RDDR argues that individuals with SLI lack the principle Must Move and thus treat movement operations as optional rather than obligatory. Within the MP, movement is implicated in many syntactic operations, including feature checking, anaphora, and question formation. Thus, children with SLI sometimes produce morphology, wh-questions, and relative clauses correctly and sometimes do not, because, for them, movement is optional. This account was extended to the computational grammatical complexity hypothesis (CGC; van der Lely 2005, van der Lely et al. 2004), which claims that children are 'impaired in the computations underlying hierarchical, structurally-complex forms in one or more component of grammar' (van der Lely 2005:55). This account is much broader than the previous one and thus covers more data but is less precise in its crosslinguistic predictions.

The RDDR/CGC provides better coverage for a wider range of syntactic phenomena than the UCC account does. Grammatical morphology is accounted for because movement is implicated in feature checking. Wh-questions and relative clauses require overt movement in English in most cases, and passives and anaphora rely on A-movement and traces to connect the thematic and syntactic roles in the surface form to the underlying representation. It has some crosslinguistic support as well. For instance, wh-questions, pronouns, and relative clauses have been explored in Greek (Stavrakaki 2001, 2006, Stavrakaki & van der Lely 2010). Relative clauses have also been examined in Hebrew (Friedmann & Novogrodsky 2004, 2007), with results being attributed to difficulty with thematic role assignment. Further testing in Germanic and Romance languages is warranted.

With regard to data coverage, this account suffers from many of the same concerns facing the UCC account. In addition to the challenges with morphology described above, it also does not directly explain the nonsyntactic deficits observed, including lexical deficits (Nation 2014) and discourse-level problems (Nippold et al. 2008, Peets 2009). It is possible that, at older ages, this deficit might hinder sentence interpretation to such a degree that it would explain limitations in vocabulary, but it is unlikely that it explains early limitations while children are in the single-word stage, and this is one of the few characteristics reported identically across languages (Leonard 1998). Likewise, cascading deficits could be the reason for difficulty with discourse interpretation, but the actual circumstances under which difficulties occur require positing processing-based limitations, which could explain the deficits independent of the RDDR hypothesis (e.g. Deevy & Leonard 2004, Montgomery 1995, Montgomery et al. 2008). For instance, work by MacDonald and colleagues (Gennari & MacDonald 2009, MacDonald & Christiansen 2002, Seidenberg & MacDonald 1999) shows that experience and working memory can explain a good deal of individual variation in the use of noncanonical sentences, something that could readily be extended to children with SLI. While such a mechanism may be posited in addition to the RDDR account, doing so would seem redundant.

Even in a UG account, children need to use some form of statistical learning to track whether their language is, for example, a WH-movement language or a WH-in-situ language (or if their language has both, like French) in order to know when movement is necessary. Because children are already tracking whether the WH-words move in their language, and indeed must also first use statistical information to know which words ARE the WH-words in their language, it is redundant to pose the underlying grammar as necessarily innate, as noted in AP&L's article. Extending this explanation to language impairment, it is more parsimonious to posit that a cognitive deficit is interfering with their ability to track this information than to say that an innate grammatical principle has somehow failed to form correctly in children with SLI, especially since evidence of cognitive deficits exists outside of the linguistic modality.

4. CLINICAL APPLICATIONS. When we consider the usefulness of an explanation within a clinical framework, the question is not just whether the explanation parsimoniously describes the population, but also how this explanation informs assessment and treatment of the disorder. What tools does it provide us in a clinical setting? We argue that, even if UG were to provide a good description of the linguistic profile, it does not provide tools that promote effective EARLY identification of children or the development of high-quality intervention techniques.

4.1. HOW DO YOU IDENTIFY CHILDREN WITH THE DISORDER? Work within the UG framework has perhaps been most useful for developing assessments for children ages three and up that are highly sensitive and specific (three to six years: TEST OF EARLY GRAMMATICAL IMPAIRMENT (TEGI), Rice & Wexler 2001; four to nine years: DIAGNOSTIC EVALUATION OF LANGUAGE VARIATION (DELV), Seymour et al. 2005). These theoretically grounded tests are targeted at the identification of children with SLI rather than simply documenting that children are lower than their peers in language use without hypothesizing a cause. Building on work showing that tense and agreement morphology is a good marker for differential diagnosis (Bedore & Leonard 1998, Bortolini et al. 2002, Leonard et al. 1999), Rice and Wexler have developed the TEGI, one of the most psychometrically sound instruments available. The TEGI assumes the ATOM/EOI framework, and thus the emphasis is on accurate use of tense and agreement morphology. This is unique among speech language tests (Spaulding et al. 2006). While norms begin at age three, the variability reduces and the ability of children to complete the test improves considerably at age four, making the test especially useful between four and six.

The DELV was developed in response to concerns that an emphasis on verb morphology might hinder the identification of impairment in individuals who speak AAE or other nonstandard dialects of English. It makes much weaker hypotheses about the mechanisms involved than the TEGI does (Zurer Pearson 2004). Nonetheless, it draws on careful linguistic description to differentiate between children who speak standard American English, those who speak other dialects, and those who have language disorders. The DELV subtests include measures of word learning via syntactic bootstrapping and nonword repetition tasks, alongside measures that are more traditionally syntactic, such as anaphora and article use. Thus the DELV, while developed in a UG framework, is a bit more agnostic than the TEGI as far as the underlying deficits of SLI are concerned.

That said, both of these tests are best at identifying children after grammar use has become well established. What they fail to do is to predict which children will have difficulty with grammar before spoken language is sufficiently established that the deficits become evident. There is some evidence that a tense composite may be useful in very young children (ages twenty-one to thirty-six months; Hadley et al. 2014). However, tense composites also are less useful for older children (Gladfelter & Leonard 2013), and a wider range of language tasks in more complex settings is needed to diagnose children (Conti-Ramsden 2003, Conti-Ramsden et al. 2001, Moyle et al. 2011).

Processing measures have the potential to be applied to very young children because they do not require that children actually have significant knowledge or the ability to participate in a complex task. One promising measure is the LOOKING WHILE LISTENING (LWL) paradigm, which examines word learning (Fernald et al. 2006, Fernald et al. 2008, Marchman & Fernald 2008). LWL has been linked to vocabulary growth and lexical processing skills, and it has the potential to be applied to children under age two, a notoriously difficult population to test. Other mechanistic approaches may also be worth considering, including working memory (Fitzpatrick & Pagani 2012, Pagani et al. 2012), auditory attention skills (Choudhury et al. 2007), and inhibition (McMurray et al. 2010). Such mechanistic approaches may point to cognitive markers that are present before spoken language develops, leading to earlier identification. UG-based explanations require that children are at least combining words in order to complete an assessment of grammar use. Non-UG-based approaches would be useful for developing measures of early identification that can be applied at eighteen months or earlier.

4.2. HOW DO YOU TREAT THE DISORDER? For the most part, UG-based accounts argue that when children with SLI get the targets right it is either by chance or it is by application of a compensatory strategy. If movement or feature checking is optional, what clinical strategies does that provide us? Can we provide more or better input to encourage children to repair the broken parameter or missing principle? It is not clear how UG provides a strong argument for why any particular compensatory mechanism would work better than another. Mechanistic accounts of language learning and impairments provide theoretically motivated means for developing interventions.

Some approaches grounded in UG also make claims that input frequency influences the probabilistic selection of grammars and thus input structure is important (e.g.

Legate & Yang 2007). The argument, then, would be that children with SLI have difficulty tracking the probabilistic information in the input or receive impoverished input and thus conclude that they need to use the wrong grammar. The forms that they do get right are memorized lexical forms, not forms used productively. Interventions designed around this approach focus on increasing the transparency of the pattern in the input or increasing the frequency with which the grammatical form is used (Fitzgerald et al. 2013). The identification of the problem as one of grammar selection is arbitrary, from a theoretical perspective—if a child must closely track probabilistic information in the input in order to select the correct grammar, why not consider frequency, or the ability to track it, the problem (Freudenthal et al. 2010)? On what grounds does one determine which words are memorized and which forms are used productively? From a clinical perspective, positing underlying grammars (rather than simply constructions to be learned) does not alter or enhance the therapy approach in any way, since in either case, the solution is to increase the transparency of the patterns in the input.

In contrast, domain-general approaches are helpful in designing intervention because they make hypotheses about the structure of the input. For instance, they suggest the degree of variability needed for children to learn a grammatical form (Childers & Tomasello 2001, Grunow et al. 2006) and an emphasis on how the structure of the input can promote pattern learning (Apfelbaum et al. 2013, Onnis et al. 2008). While we do not yet know enough about optimal input structures to make a clear recommendation, turning our attention to this area would advance our intervention strategies. We might be better clinicians if we approached these questions by asking 'How do language learning mechanisms work in typical children?' and 'How do these mechanisms need to be altered or enhanced to promote learning in SLI?'. In this case, identifying a broken mechanism might lead to the thoughtful selection of one strategy over another. For instance, if one thinks that poor working memory is the cause (Leonard et al. 2013), one might choose to use shorter sentences in order to enhance attention to the subject-verb agreement paradigm (Leonard 2013) or to teach vocabulary words with the intent of enhancing verbal working memory (Gupta & Tisdale 2009). If one thinks the problem is overactive lexical decay (McMurray et al. 2010), one might attempt to strengthen the representations of the targets by presenting them more frequently and reducing similarity to alternatives available in the environment. Limited statistical learning skills might indicate adjusting item presentation by blocking patterns (Apfelbaum et al. 2013, Onnis et al. 2004), using cue alignment to draw attention to a pattern (Childers & Tomasello 2001), and/or actively planning for generalization of the pattern to new situations. While all of these could be compensatory strategies applied from within a UG framework, it is more helpful to adopt the language and thought processes associated with a more domain-general mechanism. It is redundant to first pose that certain underlying principles or constraints are missing or ill-formed and then employ cognitive strategies to bootstrap the system when one could simply begin with the cognitive strategies.

The question of linking rules poses a similar conundrum. It is quite possible that children with SLI have difficulty linking the form to the meaning (Chiat 2001), especially since this problem seems so intractable that innate mechanisms have been proposed to overcome it. On the surface, it does not appear that children with SLI have problems with linking rules—their assignment of thematic roles to sentences is generally intact. Deficits do arise related to argument structure, but these are perhaps better captured within a processing framework. Children who speak English (Grela & Leonard 2000) and French (Pizzioli & Schelstraete 2008) have both been shown to omit grammatical morphology as argument structure complexity increases. But what these children do not do is misassign the thematic roles overall. Rather, children with SLI appear to struggle with downstream processes because they have used up their available cognitive resources planning a more complex utterance. There is some evidence that they have trouble with verb alternations, but even here the evidence is mixed (King & Fletcher 1993, Owen & Leonard 2006). Children with SLI do appear to have trouble with passives and object relatives and other noncanonical word orders (van der Lely et al. 2004). Treatment approaches targeting linking as syntactic phenomena and those that target the meaning of the verbs without focusing on linking rules lead to equal gains (Ebbels et al. 2007), a finding that suggests that it is a lack of lexical richness rather than a syntactic problem OR that the lexicon and syntax are inseparable. Regardless of the interpretation, the strategies applied in intervention are similar: practice the noncanonical form, increase its frequency in the input, and provide enhanced cue alignment using a variety of cue types (e.g. for relative clauses, Brandt et al. 2009, Gennari & MacDonald 2009, Kidd et al. 2007; e.g. for passives, Levy & Friedmann 2009, Riches 2013). These strategies are consistent with the processing explanations of language learning and appear to be effective at enhancing learning. Although there is no reason why they could not be effective compensatory strategies, it is redundant to argue for a different mechanism given that the effective approaches can be derived from within a more domain-general learning explanation.

Thus, to conclude, we concur with Ambridge and colleagues that UG-based explanations of language learning are not helpful. We might go further and say that they have the potential to be harmful. By focusing researchers' energies on a set of explanations that do not yield techniques for early identification or for effective intervention, they draw resources away from more useful approaches. Even if a UG-based explanation of SLI is accurate, it is not possible to directly treat the innate deficit. Rather, one would train compensatory approaches, which are derived from mechanistic approaches to language learning. Emphasizing the learning principles and the cognitive mechanisms that underlie SLI is a much more promising avenue to pursue for the development of intervention techniques. Adoption of a UG-based perspective requires demonstrating how this helps provide clinical insights that support the learning process, not just that it adequately describes the population.

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