The item-based nature of children's early syntactic development

Michael Tomasello

Recent research using both naturalistic and experimental methods has found that the vast majority of young children's early language is organized around concrete, item-based linguistic schemas. From this beginning, children then construct more abstract and adult-like linguistic constructions, but only gradually and in piecemeal fashion. These new data present significant problems for nativist accounts of children's language development that use adult-like linguistic categories, structures and formal grammars as analytical tools. Instead, the best account of these data is provided by a usage-based model in which children imitatively learn concrete linguistic expressions from the language they hear around them, and then – using their general cognitive and social-cognitive skills – categorize, schematize and creatively combine these individually learned expressions and structures.

M. Tomasello is at the Max Planck Institute for Evolutionary Anthropology, Inselstrasse 22, D-04103 Leipzig, Germany.

tel: +49 341 9952 400
fax: +49 341 9952 119
e-mail: tomas@eva,mpg.de

By all accounts, a major characteristic distinguishing human beings from their nearest primate relatives is the use of language. A central question in this regard is how human beings maintain the conventions of a particular language across generations in a speech community, that is to say, how children acquire a language. Of special interest to many developmental psycholinguists is the question of how children acquire the syntactic structure of a language, because they do not hear an adult speaking in abstract syntactic categories and schemas but only in concrete and particular words and expressions.

The best known answer to this question – first proposed by Chomsky and more recently popularized by Pinker[1] and others – is that children do not have to learn or construct abstract syntactic structures at all, but rather they already possess them as a part of their innate language faculty. This so-called continuity assumption (innate syntactic competence is fundamentally the same at all points in ontogeny[2]) justifies the use of adult-like formal grammars to describe children's early language. In this view, the 5000 or more natural languages of the world each derive from this same innate universal grammar, differing from one another only in the composition of their lexicons and in a few parametric variations of syntax that are prefigured in the human genome.

Recently, however, a number of empirical findings that challenge this majority view have emerged. Most important is the discovery that virtually all of children's early linguistic competence is item-based. That is to say, children's early utterances are organized around concrete and particular words and phrases, not around any system-wide syntactic categories or schemas. Abstract and adult-like syntactic categories and schemas are observed to emerge only gradually and in piecemeal fashion during the preschool years. These new data are most naturally accounted for by a usage-based model in which children imitatively learn concrete linguistic expressions from the language they hear around them, and then – using their general cognitive and social-cognitive skills – categorize, schematize and creatively combine these individually learned expressions and structures to reach adult linguistic competence.

Some recent findings in language acquisition

Most of children's early language is grammatical from the adult point of view, and this fact has been taken by some theorists as support for the hypothesis of an innate universal grammar. But children can also produce 'grammatical' language by simply reproducing the specific linguistic items and expressions (e.g. specific words and phrases) of adult speech, which are, by definition, grammatical. To differentiate between these two hypotheses, deeper analyses of children's linguistic competence are needed.

Observational studies

Many researchers believe that young children operate from the beginning with abstract linguistic categories and schemas because they not only follow adult grammatical conventions fairly well, but they also on occasion produce some creative yet canonical utterances that they could not have heard from adults – which means that they must be generating them via abstract linguistic categories or schemas. The most famous example is '*allgone sticky*', as reported by Braine[3], and indeed such creativity is convincing evidence that the child has some kind of abstract linguistic knowledge. However, recent

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Box 1. Cross-linguistic evidence for item-based patterns

A number of systematic studies of children learning languages other than English have also found many item-based patterns in early language development. For example, Pizzuto and Caselli (Refs a,b) investigated the grammatical morphology used by three Italian-speaking children on simple, finite, main verbs, between the ages of about 18 months to three years. Although there are six forms possible for each verb root (first-person singular, second-person singular, etc.), the findings were that:

- 47% of all verbs used by these children were used in one form only
- an additional 40% were used with two or three forms
- of the 13% of verbs that appeared in four or more forms, approximately half of these were highly frequent, highly irregular forms that could only be learned by rote.

The clear implication is that Italian children do not master the whole verb paradigm for all their verbs at once, but rather they initially master only some endings with some verbs – and often different ones with different verbs.

In a similar study of one child learning to speak Brazilian Portugese at around 3 years of age, Rubino and Pine (Ref. c) found a comparable pattern of results, including additional evidence that the verb forms this child used most frequently and consistently corresponded to those he had heard most frequently from adults. That is, this child produced adult-like subject–verb agreement patterns for the parts of the verb paradigm that appeared with high frequency in adult language (e.g. first-person singular), but much less consistent agreement patterns in low frequency parts of the paradigm (e.g. third-person plural). Similarly, in a study of six Hebrew-speaking children – a language that is typologically quite different from European languages – Berman and Armon-Lotem (Ref. d; see also Ref. e) found that Hebrew children's first 20 verb forms were almost all 'rote-learned or morphologically unanalysed' (Ref. d, p. 37). Other similar results have been reported for Hungarian (Ref. f), Catalan, German and Dutch (Ref. g), Inuktitut (Ref. h), Spanish (Ref. i) and Russian (Ref. j).

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evidence suggests that, in this example, the only abstract knowledge this child possesses is what kinds of things can be *allgone* – not, for example, what kinds of things may be the subjects or objects of verbs. The general methodological problem is that we can never tell from a single utterance in isolation what is the child's underlying structural knowledge. To determine underlying structural knowledge we must look at *all* of a child's uses – and most especially non-uses – of a whole set of linguistic items or structures.

Using this more systematic method, Tomasello found that although most of his daughter's early language during her second year of life was 'grammatical', it was also very limited, uneven, and item-based[4]. The item-based nature of this child's early language was most clearly evident in her use of verbs. Thus, during exactly the same developmental period some semantically similar verbs were used in only one type of sentence frame and that frame was quite simple (e.g. *Cut* __), whereas other verbs were used in more complex frames of several different types (e.g. *Draw__, Draw__ on__ , Draw__ for __, __draw on__*). In addition, morphological marking (e.g. for past tense) was also very uneven across verbs. Within a given verb's development, however, there was great continuity, with new uses almost always replicating previous uses with only one small addition or modification (e.g. the marking of tense or the adding of a new participant role). Overall, by far the best predictor of this child's use of a given verb on a given day was *not* her use of other verbs on that same day, but rather her use of that same verb on immediately preceding days; there appeared to be no transfer of structure across verbs. The hypothesis was thus that children have an early period in which each of their verbs forms its own island of organization in an otherwise unorganized language system (the Verb Island hypothesis), thereby serving to define lexically specific syntactic categories such as 'drawer', 'thing drawn', and 'thing drawn with' (as opposed to subject, object, and instrument).

Using a combination of periodic sampling and maternal diaries, Lieven *et al.*[5] found some very similar results in a sample of 12 English-speaking children from 2–3 years of age. In particular, they found that children used virtually all of their verbs and predicative terms in one and only one sentence frame early in language development – suggesting that their syntax was built around various particular items and expressions. In fact, 92% of these children's earliest multi-word utterances emanated from one of their first 25 lexically based patterns, which were different for different children. Following along these same lines, Pine and Lieven[6] found that when these same children began to use the determiners *a* and *the* between 2 and 3 years of age, they did so with almost completely different sets of nouns (i.e. there was almost no overlap in the sets of nouns used with the two determiners). This suggested that the children at this age did not have any kind of abstract category of determiner that included both of these lexical items. This general finding of the item-based learning and use of language has now been replicated in a number of different languages of many different types (see Box 1).

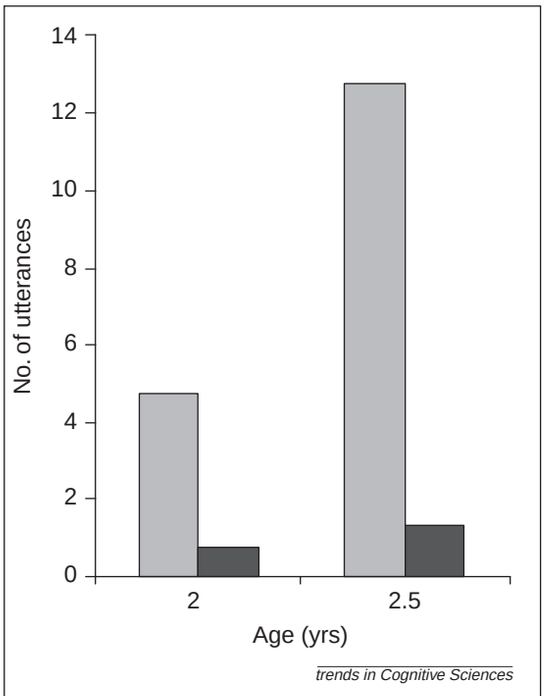

Fig. 1. Imitative production of novel verbs. The number of utterances children produced with the novel verb in one condition of the Tomasello and Brooks study[12]. Conservative utterances (light gray) were those in which children heard an intransitive use of the novel verb and then reproduced a similar intransitive utterance, even when they were encouraged to produce a transitive utterance. Productive utterances (dark gray) were those in which children used the novel verb (heard in an intransitive utterance) in a transitive utterance. (Adapted from Ref. 12.)

Of special note in children's spontaneous speech are so-called overgeneralization errors because the child has presumably not heard such errors from adults. The overgeneralizations of most interest in the context of a focus on syntax are those involving basic sentence frames, for example, '*She falled me down*' or '*Don't giggle me*', in which the child uses intransitive verbs transitively (i.e. a verb normally used with a subject only is used with both a subject and an object). Bowerman[7,8] documented a number of such overgeneralizations in the speech of her two English-speaking children, and Pinker[9] compiled examples from other sources as well. The main result of interest was that these children produced very few of these types of overgeneralizations before about 3 years of age. This developmental pattern again provides support for the hypothesis that the construction of abstract linguistic categories and schemas is a gradual process that takes place over many months, and even years, of ontogeny.

Experimental studies

The other main method for studying the nature of children's linguistic knowledge involves teaching them novel linguistic items and seeing what they do with them. The idea is that if the child uses the novel item in creative yet canonical ways, we may infer that she has assimilated it to some kind of abstract category or schema. If she does not use it in any creative ways (despite repeated opportunities), but only in ways she has heard from adults, the inference is that there is no abstract system to take up the new element, and the child is simply imitatively learning a specific linguistic item or structure (assuming that there are no performance limitations, involving limited memory or the like, that prevent the child from demonstrating her syntactic competence in the experiment).

Experiments using novel verbs have demonstrated that by 3–4 years of age most children can readily assimilate novel verbs to abstract syntactic categories and schemas that they bring to the experiment, for example, taking a verb they have heard only in a passive sentence frame and using it in an active sentence frame[10,11]. However, the same is not true for younger children. For example, Tomasello and Brooks[12] exposed 2–3 year old children to a novel verb used to refer to a highly transitive and novel action in which an agent was doing something to a patient. In the key condition the novel verb was used in an intransitive sentence frame such as '*The sock is tamming*' (to refer to a situation in which, for example, a bear was doing something that caused a sock to 'tam' – similar to the verb *roll* or *spin*). Then, with novel characters performing the target action, the adult asked children the question, '*What is the doggie doing?*' (when the dog was causing some new character to tam). Agent questions of this type encourage a transitive reply such as '*He's tamming the car*', which would be creative as the child has previously heard this verb only in an intransitive sentence frame. The outcome was that very few children at either age produced a transitive utterance with the novel verb. As a control, children also heard another novel verb introduced in a transitive sentence frame, and in this case virtually all of them produced a transitive utterance. This demonstrates that children can use novel verbs in the transitive construction when they have heard them used in that way (see Fig. 1).

The generality of this finding is demonstrated by a number of similar studies using different modelled constructions and measurement procedures. These studies have used children of many different ages and have tested for a variety of different constructions (see Box 2). Most of the findings concern children's ability to produce a simple transitive utterance (subject–verb–object; SVO), given that they have heard a novel verb only in some *other* sentence frame (e.g. intransitive, passive, imperative, etc.). When all of these findings are compiled and quantitatively compared, we see a continuous developmental progression in which children gradually become more productive with novel verbs during their third and fourth years of life and beyond (see Fig. 2 and Table 1). It is clear that this overall pattern is not consistent with the hypothesis that children possess abstract linguistic knowledge early in development, but rather it is consistent with a more constructivist or usage-based model in which young children begin language acquisition by imitatively learning linguistic items directly from adult language, only later discerning the kinds of patterns that enable them to construct more abstract linguistic categories and schemas.

The validity of these findings is further corroborated by two control studies that deal with alternative hypotheses. First, it is possible that young children are simply reluctant to use newly learned words in novel ways. However, when even younger children (22 months) are taught novel nouns, they use them quite freely in novel sentence frames[13,14]. Young children are thus not reticent with all newly learned words, and indeed they seem to form something like a category of

Box 2. Other experimental studies of children's early productivity

A number of studies have used the same basic design as Tomasello and Brooks (Ref. a), but with different age children and with the novel verbs presented in different sentence frames. With specific reference to children's ability to generate a novel transitive (subject–verb–object; SVO) utterance:

(1) Children were presented with a novel verb in a presentational construction such as 'This is called gorping', and encouraged via questions to produce a transitive utterance (Refs b,c,d).

(2) Children were presented with a novel verb in an imperative construction such as '*Tam, Anna!*', and encouraged via questions to produce a transitive utterance (Lewis and Tomasello, unpublished data).

(3) Children were presented with a novel verb in a passive construction such as '*Ernie's getting meeked by the dog*', and encouraged via questions to produce a transitive utterance (Ref. e).

In all of these studies the overall finding was that children below 3 years of age were very poor at using their newly learned verbs in the transitive construction, with the vast majority of children below this age never producing a single transitive utterance. In most cases we also had control conditions in which those very same children did produce a transitive utterance (using different object names as subject and object) when they had heard a novel verb modelled for them in this way.

It is also noteworthy that the few novel verb studies on languages other than English (although using slightly different syntactic constructions) have found very similar results – a general lack of productivity with novel verbs before 3 years of age (Ref. f, Hebrew; Childers and Tomasello, unpublished data, Chilean Spanish).

One other study is of special importance because it did not only show children failing to be creative; it actually succeeded in inducing children to produce non-grammatical English utterances (which should not be possible if certain innate parameters, such as head direction, were already set). Akhtar modeled novel verbs for novel transitive events for young children at 2;8, 3;6, and 4;4 years of age (Ref. g). One verb was modeled in canonical English SVO order, as in '*Ernie meeking the car*', whereas two others were in non-canonical orders, either SOV ('*Ernie the cow tamming*') or VSO ('*Gopping Ernie the cow*'). Children were then encouraged to use the novel verbs with neutral questions such as '*What's happening?*' Almost all of the children at all three ages produced exclusively SVO utterances with the novel verb when that is what they heard. However, when they heard one of the non-canonical SOV or VSO forms, children behaved differently at different ages. In general, the older children used their verb-general knowledge of English transitivity to 'correct' the non-canonical uses of the novel verbs to canonical SVO form. The younger children, in contrast, much more often matched the ordering patterns they had heard with the novel verb, no matter how bizarre that pattern sounded to adult ears. Interestingly, many of the younger children vacillated between imitation of the odd sentence patterns and 'correction' of these patterns to canonical SVO order. This indicated that they knew enough about English word-order patterns to discern that these were strange utterances, but not enough to overcome completely their tendency to imitatively learn and reproduce the basic structure of what the adult was saying with the novel verb.

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'concrete noun' quite early in development (see also Ref. 15 and related studies for additional evidence.) Second, it might be that children's lack of productivity in the novel verb studies does not have to do with their linguistic knowledge, but only with production difficulties. However, in comprehension tests they perform no better. That is, they are first taught a novel verb in a simple sentence frame ('*Look! Tamming! This is called tamming!*'), and they are asked to act out a transitive construction with that verb ('*Show me: the dog's tamming the cat*'). Perhaps surprisingly, children younger than 3 years of age do no better in comprehension than they do in production[16]. (The study of Naigles[17] is sometimes taken to be discrepant with these findings, but in fact it is not relevant because the two sentences that were compared in that study were '*The duck is glorping the bunny*' and '*The bunny and the duck are glorping*' – with one picture depicting the duck doing something to the bunny and the other depicting the two participants engaged in the same parallel action. The problem is that children might very well have been using the word *and* as an indicator of the parallel action picture[18].)

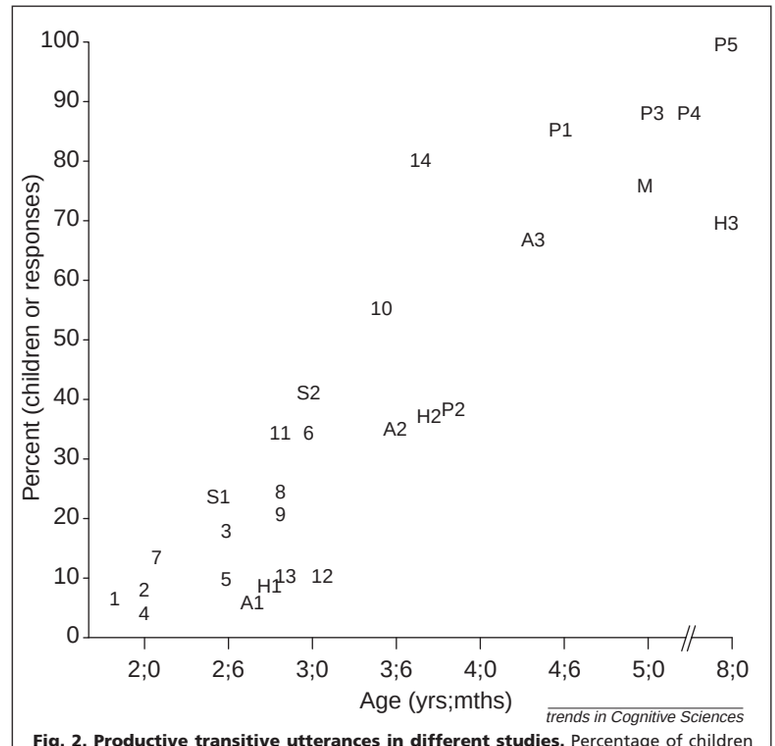

Fig. 2. Productive transitive utterances in different studies. Percentage of children (or responses in some cases – see Table 1) that produced transitive utterances of a novel verb that was heard in some other sentence frame. The data points correspond to the studies listed in Table 1.

Implications for theories of language acquisition

Combining the results from naturalistic and experimental studies, it is clear that young children are productive with their early language in only limited ways. They begin by learning to use specific pieces of language and only gradually create more abstract linguistic categories and schemas. These

Table 1. Research using novel verbs

Reference[a]	Data point in Fig. 2	Age (yrs;mths)	Productivity	Linguistic model	Eliciting question	Scoring
Ref. 14	1	1;10	0.07	Presentational	Neutral	% children
Ref. 12	2	2;0	0.06	Intransitive	Agent	% children
	3	2;6	0.19			
Ref. 43	4	2;0	0.06	Imperative	Neutral	% children
	5	2;6	0.13			
	6	3;0	0.38			
Ref. 18	7	2;1	0.13	Presentational	Neutral	% children
Ref. 39	8	2;10	0.25	Presentational	Neutral	% children
Ref. 40	9	2;10	0.20	Passive	Agent	% children
	10	3;5	0.55			
	11	2;10	0.35			
Ref. 16	12	3;1	0.20	Presentational	Neutral	% children
	13	2;9	0.10			
	14	3;8	0.80			
Ref. 38	I	3;5	0.67	Intransitive (low freq. English verbs)	Agent	% responses
Ref. 11	P1	4;6	0.86	Passive	Agent	% responses (action verbs)
	P2	3;10	0.38			
	P3	5;1	0.88			
	P4	6;1	0.88			
	P5	7;11	1.00			
Ref. 10	M	5;0	0.75	Intransitive	Agent	% children
Ref. 41	A1	2;8	0.08	SOV and VSO	Neutral	% children
	A2	3;6	0.33			
	A3	4;4	0.67			
Ref. 42	H1	2;9	0.09	Intransitive (Hebrew)	Sentence completion	% responses
	H2	3;9	0.38	1st or 3rd person verb (Spanish)	Neutral	% children
	H3	8;0	0.69			
Ref. 44	S1	2;6	0.25			
	S2	3;0	0.38			

[a]Studies investigating children's ability to produce transitive (SVO) utterances as a function of age, given a nonce (made-up) verb modelled in some other sentence frame. Each data point in the table corresponds to one data point in Figure 2 (keyed by numbers or letters).

findings have important implications for current theories of child language acquisition.

Linguistic nativism

Classically, as espoused by Chomsky for example, linguistic nativism has emphasized that child language acquisition: (1) takes place quickly and effortlessly because children have full linguistic competence at birth and need only to learn to express this competence overtly in performance; (2) relies only indirectly on the language children hear (i.e. 'input' only serves to 'trigger' innate syntactic structures or to 'set parameters'); and (3) is creative from early in ontogeny because it is generated by an abstract grammar. The data just reviewed are clearly at variance with each of these claims, and in addition, the data call into question altogether the use of adult-like grammars to describe children's early language.

The classic response of linguistic nativism to children's syntactic limitations is to invoke hypothesized (but never measured) performance limitations that inhibit the full expression of children's innate linguistic competence (e.g. limited working memory)[19]. Many of the control conditions in the above experiments, however, put performance demands on children very similar to those of the experimental conditions, but children experienced no learning difficulties – for example, in using a newly learned noun in novel ways and in using a newly learned verb in a transitive utterance when they had heard it modelled in that way. It is also noteworthy that children's performance was also conservative and item-based in two different comprehension experiments, which place many fewer performance demands on young children.

Recently, some linguistic nativists have also proposed the idea that children are not born with fully adult-like syntactic competence. On this view, children's early language development might be item-based and piecemeal, but the genes for many adult-like syntactic structures begin to 'turn on' sometime between 2 and 3 years of age[20]. The problem in this case is that, in the experimental data reviewed, the gradual and piecemeal developmental process was all within the same syntactic structure, namely, the English transitive construction. Children who can use the simple transitive construction for familiar verbs presumably already have the required genetic bases in place, and so it becomes a mystery why they cannot use these same genetic bases to use novel verbs in transitive utterances in experimental contexts.

Box 3. A more complex example of structure combining

As a more complex example of structure combining, Diessel and Tomasello (Ref. a) looked at the earliest complex sentences with sentential complements of six children. They found that virtually all early complement sentences are composed of a simple sentence schema that the child has already mastered, combined with one of a handful of matrix verbs (see also Ref b).

These matrix verbs are of two types. First are epistemic verbs such as *think* and *know*. In almost all cases children used *I think* to indicate their own uncertainty about something, and they basically never used the verb *think* in anything but this first-person form (i.e. no examples of '*He thinks…*', *She thinks…*', etc.). This form was also virtually never negated (no examples of '*I don't think…*'), virtually never used in anything other than the present tense (no examples of '*I thought…*'), and never with a complementizer (no examples of '*I think that…*'). It thus appears that *I think* is a relatively fixed phrase meaning something like *maybe*. The child pieces together this fixed phrase with a full sentence, but this piecing together does not amount to 'sentence embedding' as it is typically portrayed in more formal analyses – it is more like simple concatenation because the main verb (*think*) is not really acting as a verb. Second, children also use attention-getting verbs like *look* and *see* in conjunction with full sentences. In this case, they use them almost exclusively in imperative form (again no negations, no non-present tenses, no complementizers). Therefore, these early complex sentences do not appear to be abstract sentence embeddings, but rather concatenations of a formulaic expression and a full sentence.

Examples from Sarah:	**Examples from Nina:**
I think he's gone	See that monkey crying
I think it's in here	See Becca sleeping
I think my daddy took it	See that go
I think I saw one	See my hands are washed
It's a crazy bone, I think	See he bite me
I think dis is de bowl	See him lie down

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Finally, it is also possible to posit that children's early language is item-based, but that after 'sufficient' linguistic triggering experiences, it becomes linked with the innate universal grammar[21]. The problem in this case is that there is only one serious theory of how this linking might take place – Pinker's theory of innate linking rules[9] – and this theory does not fit with the empirical data[22,23] (see Ref. 24 on problems of hypothesizing linguistic universals). In general, it is very difficult to envision how an innate universal grammar could be biologically prepared ahead of time to link up its specific categories and schemas to the particular syntactic conventions of the many different languages of the world (e.g. ergative–absolutive versus nominative–accusative systems).

Usage-based accounts

Usage-based approaches to language acquisition attempt to characterize children's language not in terms of innate, adult-like, formal grammars, but rather in terms of the cognitive and communicative processes involved. With respect to the data reviewed above, the hypothesis would be that children's earliest language is based on the specific linguistic items and expressions they comprehend and produce. Children begin to form an abstract category of 'concrete noun' quite early, and this allows them to use any symbol categorized in this way productively in a wide range of linguistic contexts. It takes some time for children to categorize or schematize the relational–syntactic structure of their various item-based (verb island) constructions, however, and thereby to become productive with their language in more adult-like ways. The adult endpoint of this developmental process is not an abstract formal grammar, but rather an 'inventory of symbolic resources' including everything from words and morphemes to whole grammatical constructions as kind of linguistic gestalts[25] (see papers in Ref. 26). This developmental trajectory depends on cognitive and social-cognitive processes common to all human beings (and, of course, on experiential human universals like growing up in the midst of language users). Three of these processes are especially important.

First in importance is cultural learning or, more specifically, imitative learning in the specific sense used by Tomasello *et al.*[27] On this view, imitative learning is not simply repeating or mimicking the surface form of adult utterances. Rather, it is the attempt by children to reproduce the language adults produce and for the same communicative function – the reproduction is of both the linguistic form and its conventional communicative function. At one level of analysis, this absolutely must be true because all children learn the language to which they are exposed, and for all non-canonical aspects of language structure – all idioms, lexical items, quirky constructions and the like – nobody has ever proposed any mechanism other than some form of imitative learning. (For example, only by observing and reproducing particular linguistic symbols can one learn that, in English, '*That won't go down well with him*' means that he won't like that.) The current proposal is simply that, initially, imitative learning is *all* that children do for all linguistic constructions, canonical and quirky alike. This approach thus highlights the role of the language that children hear around them, and it also takes seriously the possibility of individual differences based both on children's potentially different perceptual and cognitive skills and on their potentially different language learning environments[28,29].

Secondly, children go beyond these early item-based constructions in due course. The only way they can do this is to find patterns in the language they are hearing, and thereby to form some kinds of abstract categories and schemas. Children do this in the case of the category of concrete noun quite early. But in addition they abstract across more complex relational structures as well, for example, whole constructions such as the simple transitive construction. Although there are no good data on how they do this, the work of Gentner on analogy and 'structure mapping' provides some interesting hypotheses[30]. The idea is that children must see both the structural and the functional similarities in utterances such as '*I draw tree*', '*She kissed me*', '*I hit Jeffrey*', '*You hug Mommy*', '*Jamie kicking ball*', in terms of their relational structure, independent of the specific words involved. A reasonable as-

Box 4. Grammaticalization

Each of the 5000 or more languages of the world has its own inventory of linguistic conventions, including syntactic conventions, which allow its users to share experience with one another symbolically. This inventory of symbolic conventions is grounded in universal structures of human cognition, human communication, and the mechanics of the vocal–auditory apparatus. The peculiarities of particular languages come from differences in the kinds of things that different speech communities think it important to talk about and the ways they think it useful to talk about them – along with various historical 'accidents'. All of the conventions and constructions of a given language are not invented at one time, of course, and once invented they often do not stay the same for very long, but rather they evolve, change and accumulate over time as humans use them with one another. This set of processes is called grammaticalization, and it involves such well-attested phenomena as free-standing words evolving into grammatical markers, and loose and redundantly organized discourse structures congealing into tight and less redundantly organized syntactic constructions (see Refs a,b for some recent research). Some examples are as follows:

(1) The future tense marker in many languages is grammaticized from free-standing words for such things as volition or movement to a goal. So in English the original verb was *will*, as in '*I will it to happen*', and this became grammaticized into '*It will happen*' (with the volitional component 'bleached' out). Similarly, the original use of *go* was for movement ('*I'm going to the store*') and this was grammaticized into '*I'm going to die some day*' (with the movement bleached out).

(2) The English past perfective, using *have*, is very likely derived from sentences such as '*I have a broken finger*' or '*I have the prisoners bound*' (in which *have* is a verb of possession) into something like '*I have broken a finger*' (in which the possession meaning of *have* is bleached out and it only now indicates perfective aspect).

(3) English phrases such as '*on the top of*' and '*in the side of*' evolved into '*on top of*' and '*inside of*' and eventually into '*atop*' and '*inside*'. In some languages relator words such as these spatial prepositions have also become attached to nouns as case markers – in this instance as possible locative markers.

(4) Loose discourse sequences such as '*He pulled the door and it opened*' may become syntacticized into '*He pulled the door open*' (a resultative construction).

(5) Loose discourse sequences such as '*My boyfriend…he plays piano…he plays in a band*' may become '*My boyfriend plays piano in a band*.' Or, similarly, '*My boyfriend…he rides horses…he bets on them*' may become '*My boyfriend, who rides horses, bets on them*.'

(6) Similarly, if someone expresses the belief that Mary will wed John, another person might respond with an assent '*I believe that*', followed by a repetition of the expressed belief that '*Mary will wed John*' – which become syntacticized into the single statement '*I believe that Mary will wed John*.'

(7) Complex sentences may also derive from discourse sequences of initially separate utterances, as in '*I want it…I buy it*' evolving into '*I want to buy it*.'

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sumption is that there must be some 'critical mass' of exemplars of particular utterance types necessary for the human cognitive apparatus to be able to make the requisite analogies and subsequent categories and schemas[31]. It may be that the critical factor is the number of different verbs heard in the construction – because verbs are the central organizing element in utterance-level constructions and because many exemplars with only one or a few verbs would seem to be a very inadequate basis for generalizing the construction[32].

Third and finally, children also combine various kinds of linguistic constructions creatively, involving both concrete and abstract constructions of varying levels of complexity. They combine much more complex structures than just words or word classes. As one example, one child's earliest utterances with three or more words were things like '*See Daddy's car*'[4]. But previously this child had said things like '*See ball*' and '*See Mommy*', on the one hand, and also things like *'Daddy's shirt*' and *Daddy's pen*', on the other. So, the likelihood is that she creatively combined something like a '*See ___*' schema with a '*Daddy's __*' schema. Note that to do this she had to understand that '*Daddy's car*' as a complex expression was in some sense equivalent to the other things she previously had been talking about seeing (*Ball* and *Mommy*), and so this combination indicates some knowledge of the functional equivalence of these different referring expressions. It should be noted that many different procedures may be used to combine established constructions in these ways. For example, a child might combine an item-based construction with a more abstract construction, or she might combine two item-based or two abstract constructions with one another. Diessel and Tomasello[33] report a further illustration of these processes in more complex constructions (i.e. those with sentential complements; see Box 3).

Outstanding questions

- When children imitatively learn some complex linguistic expression, how do they come to understand the communicative functions of the different constituents involved?
- On what basis do children make analogies or form schemas as they abstract across their verb island and other relational linguistic schemas?
- What principles govern the ways in which children combine established linguistic constructions with one another creatively?
- How do children select what they need from all the language they hear around them?
- What is the nature of the cross-linguistic and individual differences that can be observed in children acquiring natural languages?

Conclusion

If grammatical structures do not come directly from the human genome, as the above-reported data suggest they do not, and if children do not invent them *de novo*, as they clearly can not, then it is legitimate to ask, Where do grammatical structures come from? The answer is that, in the first instance, they come from processes of grammaticalization in language history. That is to say, at some point in human evolution, *Homo sapiens* evolved the ability to communicate with one another symbolically[34]. When human beings communicate symbolically with one another in extended discourse interactions, the stringing together of symbols begins to become grammaticalized; for example, content words such as nouns and verbs become function words such as prepositions and auxiliaries, and loosely concatenated symbols acquire syntactic relationships involving constituency and

dependency (see Box 4). These transformations of linguistic structure occur as a result of social-interactive processes in which (1) speakers try to abbreviate linguistic expression as much as they can, and (2) listeners try to make sure that speakers do not go so far in this direction that the message becomes incomprehensible. Grammaticalization processes are well-attested in the written records of numerous languages in their relatively recent pasts, and it is a reasonable assumption that the same processes were at work in the origin and early evolution of language, turning loosely organized sequences of single symbols into grammaticized linguistic constructions[35,36].

Even so, grammaticalization by itself is not enough because it does not account for the abstractness of linguistic structures. Abstractness, as Chomsky recognized in even his earliest writings, must be contributed by the minds of individual children as they acquire the use of particular pieces of particular languages. It is possible – albeit very difficult – to imagine that children make this contribution by simply linking an innate universal grammar with the particular structures of the particular language they are learning. However, it is also possible, and more in accord with recent data, to imagine that children make this contribution in more extended developmental processes in which they apply their general cognitive, social-cognitive, and vocal–auditory processing skills to the historical products of grammaticalization[37]. Overall, then, we may hypothesize that human language originated ultimately from a species-unique biological adaptation for symbolic communication, but the actual grammatical structures of modern languages were humanly created through processes of grammaticalization during particular cultural histories, and through processes of cultural learning, schema formation, and structure combining during particular individual ontogenies.

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