15. The acquisition of complex sentences*

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Complex sentences are structures that are built up of simpler sentences through the recursive operations of *co-ordination* and *embedding*. In the early period of syntactic development, children are working on the structure of simple sentences and do not yet have knowledge of these operations (Brown *et al.*, 1969). The onset of ability with complex sentences greatly increases the child's generative capacity and thus is an important step forward in language acquisition. This chapter reviews recent evidence on how this step takes place.

A brief overview of the major types of complex sentences is first in order.[1] In co-ordination, the constituent sentences (termed 'clauses' when they become part of a larger sentence) are linked together by a co-ordinating conjunction (e.g. *and, but, or, either . . . or, both . . . and, and then, or else*), with neither sentence being syntactically dependent on the other. In embedding, in contrast, one sentence (the 'embedded sentence') is subordinated to – i.e. serves as a constituent in – the other (the 'matrix sentence'). There are two major types of embedding. In one, the embedded sentence fills in an empty slot in the matrix sentence and functions in a syntactic role such as subject, object, or indirect object (THE FACT THAT JOHN LEFT/JOHN'S LEAVING/FOR JOHN TO LEAVE *surprised me; Mary wanted* JOHN TO LEAVE; *I'll give this cookie to* WHOEVER WANTS IT). This is called *complementation*. In the second type of embedding, the embedded sentence modifies a constituent of the matrix sentence, e.g. a noun phrase (resulting in a relative clause: *The man*

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[1] This overview, which is drawn from Quirk *et al.* (1972) and Langacker (1973), deals only with sentences that are complex at the level of surface structure – i.e. that contain more than one clause. However, Langacker suggests that 'all sentences are probably complex at the level of conceptual structure, being decomposable into component propositions' (p. 112). There is discussion in a later section of this chapter of some sentence structures that superficially appear to be simple but that many linguists have argued should be assigned complex underlying representations.

WHO CAME TO SEE YOU *was tall*), an adjective (*Harry is ready* TO LEAVE), or the main verb (resulting in an adverbial clause introduced by a subordinating conjunction of time, causality, conditionality, etc.: *Mary left* BEFORE/AFTER/WHEN/BECAUSE YOU CAME, *You can come* IF YOU ARE READY).[2]

1. The development of complex sentences in spontaneous speech

Most research on the acquisition of complex sentences has consisted of experimental studies of comprehension in children of 3 years or older. There are surprisingly few studies detailing the development of complex sentences in spontaneous speech. The following discussion draws primarily on Limber (1973) and Brown (1973), supplemented by other sources where possible.

Investigators differ somewhat in the age at which they place the onset of the ability to produce complex sentences.[3] Most studies indicate that the major types of complex sentences emerge between the ages of about 2 and 4. On the basis of data collected from his three subjects during this age period, Brown proposed that learning about sentence embedding is a major task of Stage IV (Mean Length of Utterance (MLU) from 3·0–3·50 morphemes), while productive ability with co-ordination comes a bit later, at Stage V (MLU 3·50–4·0).

The first complex sentences appear after simple sentences about four words long become common. These involve *object complementation*: embedded sentences functioning as nominals in the role of direct object of the verb of the matrix clause. Explicit grammatical subjects are initially lacking from the embedded sentences (e.g. *I wanna read book*), but these appear before long (e.g. *I don't want you read that book, Watch me draw circles, I see you sit down, Lookit a boy play ball;* these examples are from Limber, 1973). In addition to *want, watch, see,* and *lookit,* other complement-taking verbs that appear early include *like, need, make*[4], *ask,*

[2] Alternatively, adverbial clauses can be interpreted as attached directly to S_1 rather than as a constituent of the verb phrase; see Williams (1975).

[3] These differences stem from individual variation among the children studied, from differences in the kinds of sentences defined as 'complex', and from differences in the kind of knowledge attributed to a child on the basis of the sentences he produces (cf. Limber, 1973). With regard to this last factor, Ingram (1975a) and R. Clark (1974) argue that early 'complex' sentences probably do not involve recursive operations at all, but are produced by the simple juxtaposition of sentence fragments. Arguments in the extreme opposite direction are presented by Antinucci and Parisi, who conclude on the basis of evidence from Italian-speaking children that 'aside from nominalizations, all the basic structural mechanisms of human language [including embedding] appear to have . . . been acquired by the 2-year-old child' (1975: p. 199).

[4] See Baron (1972) on the development of complex causative constructions with *make, get,* and *have* in spontaneous speech.

let, and – to express direct speech – *say* and *go*. Somewhat later in the third year come *think, know, hope, show, help, forgot,* and a number of others. Complement-taking verbs first appear with simple NP direct objects if syntax allows this (e.g. *want book, make train, help me*); clausal direct objects follow within a few weeks.

After sentences involving object complements, the next complex sentences to appear (at about age 2;6 in Limber's data) are a variety of constructions involving embedded clauses introduced by *wh*-words: *Do it how I do it, Can I do it when we go home?, I show you how to do it, I don't know who it is.* These *wh*-clauses function either as direct object in the matrix sentence or as place, manner and time adverbials. Soon after this, explicit relative clauses modifying abstract nouns of place and manner (although not yet time) come in: e.g. *I show you the place I went, This is the way I did it.* Still later come relative clauses attached to 'empty' head nouns functioning as direct object in the matrix sentence (. . . *thing I got,* . . . *ones mommy got*), and even later (still rare before age 3) come relative clauses on common nouns in object position (e.g. . . . *ball that I got*). The first relative clauses involve no relative pronouns; later, *that* is used in this role (Limber, 1973). Errors in relative pronoun selection at later stages of development include the frequent substitution of *what* for *who, which,* or *that,* e.g. *I get everything what you got* (Menyuk, 1969).

Co-ordinating and subordinating conjunctions begin to appear in about the second half of the third year (Hood, 1977; Jacobsen, 1974; Limber, 1973). Before this, sentences that in adult speech would ordinarily be linked by a conjunction are simply temporally juxtaposed, as in *You lookit that book, I lookit this book* (Clancy *et al.,* 1976; Hood, 1977; Limber, 1973).

The conjunction that appears first and is used most frequently is *and,* followed shortly by *and then*; later, apparently in somewhat variable order, come *because, so, when, if, or, but, while, before* and *after* (the last two are still very infrequent at age 5 (Cromer, 1968)). The order in which these conjunctions emerge seems to be related in part to the relative difficulty of the concepts they encode. Clancy *et al.* (1976), who studied the order in which English- , German- , Turkish- and Italian-speaking children began to juxtapose propositions, with or without conjunctions, found the following shared sequence of development: first, notions of symmetric co-ordination, antithesis, sequence and causality; next, conditional notions; then conditional and temporal statements with *when*; then simultaneity with *when*; and finally *before* and *after.* These authors observe that their findings support Slobin's hypothesis that 'The rate and order of development of the semantic notions expressed by language are fairly constant across languages, regardless of the formal means of expression employed' (1973: p. 187).

Still missing at the end of the third year are *participial* object complements (e.g. *I like eating lollipops*) and operations on sentence subjects, including subject complementation and relative clauses modifying subjects (Limber, 1973). Object complementation at this stage nearly always involves infinitival forms (e.g. *I like to eat lollipops*), juxtaposition of simple sentences with optional *that* missing (*I hope I don't hurt it*), or *wh*-clauses (*I show you how to do it*) (Brown, 1973; Limber, 1973). Limber (1976) proposes that the delay in subject operations may be due to pragmatic factors rather than to deficits in linguistic knowledge or information processing capacity. According to Limber's analyses, most subject noun phrases in children's simple sentences are pronouns, demonstratives, or proper names, which do not lend themselves well to sentential expansion or modification; in contrast, many object noun phrases are common nouns or 'empty' nouns like *one*, which do.

2. Strategies for parsing complex sentences

Complex sentences present formidable challenges to a listener's ability to break a sentence down into its components and match the parts up with each other in the right way to arrive at an accurate interpretation (cf. Bever (1970a) for relevant discussion). Problems may arise because one clause interrupts another, because major constituents such as subject or object are replaced by pronouns or missing entirely in embedded and conjoined clauses, because the normal word orders of free-standing sentences are rearranged, and for a variety of other reasons. Much of the research on children's acquisition of complex sentences has consisted of experimental studies designed to explore how children of different ages resolve these problems of parsing and of inferring the referents for missing or underspecified elements. These studies have revealed interesting regularities in the way children approach the problem of interpreting sentences whose structures they do not yet fully understand.

2.1. The Minimal Distance Principle

An important early investigation of how children interpret complex sentences was carried out by Carol Chomsky (1969). Among other things, Chomsky was interested in how children understand object complement sentences that do or do not conform to a very general principle of English termed the Minimal Distance Principle (MDP) (Rosenbaum, 1967). According to the MDP, the implicit subject of a verb in a complement clause that is missing a subject is the first matrix clause NP preceding it. Thus, in *John wanted to leave, John wanted Bill to come* and *John told Harry what to*

do, it is *John, Bill,* and *Harry* who are to *leave, come,* and *do* something, respectively. Most verbs that take object complements adhere consistently to the MDP but a few, such as *promise,* consistently violate it and a few others, such as *ask* and *beg,* follow the MDP in some sentences, allow a choice of subject in other sentences, and violate the MDP in still others. For example, in *John promised Bill to leave* it is *John*, not *Bill* who is to leave. In *Mary asked to leave,* it is *Mary* who will leave. In *Mary asked Laura to leave* it is normally *Laura* who is to leave but a reading such as *Mary asked Laura (for permission for Mary) to leave* is possible, and in *Mary asked Laura what to feed the doll* it is *Mary,* not *Laura,* who will be doing the feeding.

Chomsky explored how children from 5 to 10 interpret such sentences by asking them to follow instructions like these (using toys where called for):

> Donald tells Bozo to lie down. Make him do it
> Donald promises Bozo to lie down. Make him do it
> Ask Laura what to feed the doll

Her results indicated that children start out applying the MDP everywhere. Thus, they consistently get sentences with *tell* right (Bozo is made to lie down) and they misinterpret those with *promise* and *ask.* Gaining control over verbs that violate the MDP appears to be a very late acquisition. *Promise* is mastered before *ask,* which Chomsky attributes to the fact that *promise* at least consistently violates the MDP while *ask* does not. An additional finding was that children at first interpret *ask* as if it means *tell.* Thus, when presented with a sentence like *Ask Laura what to feed the doll* they promptly *tell* Laura what to feed the doll. Learning to interpret *ask* correctly is a drawn-out process that is accomplished at different times for sentences with different kinds of object complements introduced by *ask.*

Kessel (1970) and Kramer *et al.* (1972) have replicated aspects of Chomsky's study with similar results, although Kessel found earlier mastery of *ask* than did Chomsky. Aller *et al.* (1977) found that the MDP is overgeneralized by Arabic-speaking children just as by English-speaking children. Interestingly, though, they found that *tell* is misinterpreted as *ask* rather than the other way around; they account for this by reference to language-specific factors. Additionally, they note that although their subjects, like Chomsky's, mastered *ask* later than *promise*, this cannot be attributed to differences in the consistency with which the two verbs violate the MDP, since both verbs are consistent violators in Arabic.

Aspects of Chomsky's study have been challenged by researchers who have delved further into the problem of how children retrieve 'missing subjects' in complement clauses. For example, Maratsos (1974b) notes that Chomsky's test sentences do not allow one to select between two possible

interpretations of why children choose the NP nearest to the complement verb as subject: the MDP strategy – i.e. simply computing the surface structure distance between the complement verb and candidate NPs in the matrix clause – versus the semantic knowledge that the missing subject of complement clauses after verbs of speaking (*tell*, etc.) is usually the *goal* to whom speech is directed. Maratsos pitted these interpretations against each other by asking 4 and 5 year olds to act out passive sentences like *The bear is told by the elephant to get in.* The semantic role principle (choose *goal*) was clearly supported: as long as children could understand passives in simple sentences, they consistently selected the bear as the missing subject, not the elephant as the MDP principle would predict.

It has generally been assumed that selection of the nearest preceding NP as complement subject in active sentences is children's first strategy, whether it is interpreted in terms of the MDP or in terms of knowledge of semantic roles. But Tavakolian (1977) reports data indicating that there is an earlier stage of development (roughly ages 3 to 4) in which children pick the *subject* of the matrix clause, rather than the indirect object, as the subject of the complement verb. Thus, they interpret sentences with *promise* and *ask* correctly and those with *tell* incorrectly. This pattern is exactly opposite to the one Chomsky obtained with children of 5 years and older. Tavakolian argues that this earlier strategy results from children's attempt to parse multiple-clause sentences as if they were conjoined sentences, for which it is appropriate to pick the first NP as the subject of both verbs: e.g. *The lion jumps over the pig and stands on the horse.*

2.2. 'John is easy/eager to see'

A second type of complex sentence that poses a challenge to children's powers of sentence analysis is illustrated by the following pair:

(1) John is eager to see

(2) John is easy to see

Who is going to be doing the seeing? In (1), interpretation is fairly straightforward, since standard word order is preserved. *John* is the subject of the sentence and also the subject of the complement verb *see*. But in (2), John is only a surface structure subject. In underlying structure, *John* is the *object* of *see*; that is, it is someone else who will be seeing *John*. Surface word order is thus misleading as to the underlying relationships that hold between the sentence constituents.

Children's acquisition of the structures illustrated by this pair has been extensively studied, starting with Chomsky's (1969) pioneering work on later problems of syntactic acquisition. Chomsky presented children with a

blindfolded doll and asked them 'Is this doll easy to see or hard to see?', following this up with further questioning. She found that almost all 5 year olds answered incorrectly ('hard to see'), taking *doll* to be the logical subject of the verb *to see,* presumably on the model of sentences like (1) above. Answers by 6 to 8 year olds were mixed and by 9 all children answered correctly.

Several subsequent studies have confirmed that there is an initial stage at which children interpret *John* as the logical subject of the infinitive in sentences like *John is easy to see* (Cambon and Sinclair, 1974; Cromer, 1970, 1972, 1974c; Kessel, 1970; Morsbach and Steel, 1976); Cromer (1970) has termed this the use of the 'primitive rule'. However, these investigations (plus that of Fabian, 1977) have shown that the lateness with which the children in Chomsky's study demonstrated understanding of the structure is attributable to her use of a stimulus (the blindfolded doll) that seems to bias towards incorrect answers. When this bias is eliminated by the use of more neutral stimulus objects or other techniques, children show an understanding of this sentence structure sometime between the ages of about 4 and 7.

Interestingly, the 'primitive rule' is not simply part of a more general strategy of taking the first-mentioned noun to be subject, since it is used even by children who are correctly able to assign an object role to the first noun in passives such as *The wolf is bitten* (Cromer, 1970). Progress from the end of the 'primitive rule' stage to adultlike knowledge is slow, with children vacillating in their responses from day to day (Cromer, 1970) or as a function of the particular verbs the test sentences contain (Fabian, 1977). Sentences like *John is easy to see* are apparently mastered earlier than closely related sentences like *Mary is pretty to look at* (Solan, 1978).

2.3. Relative clauses

Two variables are of major importance in describing the structure of relative clause containing sentences in English (de Villiers, Tager Flusberg, Hakuta and Cohen, 1976). One is the position of the relative clause in the sentence, termed its *embeddedness.* This is a function of the syntactic role of the matrix clause NP (called the 'head' NP) that the relative clause modifies. If the clause modifies the subject it is called 'centre-embedded', while if it modifies the object it is termed 'right-branching'. The other variable is the way the head NP functions syntactically within the relative clause, called its *focus.* These two variables jointly specify four major kinds of relative clause containing sentences on which most research has centred.[5]

[5] The examples are taken from de Villiers *et al.* (1976).

Embeddedness (Role of complex NP)	*Focus*		
Subject	Subject	(SS)	The cat that bit the dog ate the rat
Subject	Object	(SO)	The cat that the dog bit chased the rat
Object	Subject	(OS)	The cat bit the dog that chased the rat
Object	Object	(OO)	The cat bit the dog that the rat chased

Many investigators have explored how children process different kinds of sentences containing relative clauses (e.g. Brown, 1971; Cook, 1973; de Villiers, Tager Flusberg, Hakuta and Cohen 1976; Gaer, 1969; Gordon, 1972; Lahey, 1974; Sheldon, 1974; Smith, 1974; Solan and Roeper, 1978; Tavakolian, 1977). This literature presents a tangled web of conflicting findings and alternative interpretations. Some of the discrepancies can probably best be attributed to the fact that some studies concentrated only on the role of embeddedness and failed to control adequately for focus. Task differences may also be a factor (see de Villiers, Tager Flusberg, Hakuta and Cohen, 1976 for an excellent critical review). However, even when we consider only well-controlled studies using comparable tasks, certain differences in obtained response patterns and interpretation remain.

Three major types of hypothesis have emerged from these recent studies. The first was Sheldon's (1974) 'parallel function hypothesis'. In a study of children aged 3;8 to 5;5 involving an acting-out comprehension task, Sheldon found that neither embeddedness nor focus alone could account for the obtained pattern of relative difficulty of the four sentence types outlined above. Rather, these variables interacted such that SS sentences were responded to the most accurately, followed by OO, OS and SO, in order of increasing difficulty. Sheldon proposed that the ease of SS and OO sentences, relative to OS and SO sentences, is due to the fact that the head NP of the relative clause plays the *same grammatical role* in both the matrix clause and the relative clause – either subject or object. In OS and SO sentences, in contrast, the head NP plays one role in the matrix clause and another in the relative clause. Sheldon hypothesized that double grammatical function was difficult for children (cf. also Bever, 1970a: pp. 336–7).

The parallel function hypothesis has been challenged on at least two grounds. Tavakolian (1977), studying 3 to 5 year olds with an acting-out task, obtained the same basic pattern of outcomes as Sheldon did (SS < OO < OS < SO). However, after performing detailed analyses of her subjects' errors, she concluded that the parallel function hypothesis does not account for this pattern as well as the hypothesis that children initially attempt to impose a *conjoined clause analysis* on sentences containing relative clauses. That is, children try to process the sentence as if it consisted

of two conjoined clauses, and, in accordance with this analysis, they select the first NP as subject of both the first verb and the second verb. This strategy leads to correct acting out responses for SS sentences (e.g. *The cat that bit the dog ate the rat*), and systematically incorrect ones for OS sentences (*The cat bit the dog that chased the rat*), since these latter require that the *second* NP be taken as the subject of the second verb. Tavakolian's subjects responded to OO and SO sentences much more variably than to SS and SO sentences. Tavakolian hypothesizes that this is because these sentences are difficult to process by means of the conjoined clause analysis, since, unlike conjoined sentences, they involve rearrangements of normal word order (e.g. *the cat* THAT THE DOG BIT *(O-S-V) chased the rat*).

Other researchers have rejected the parallel function hypothesis on the ground that their subjects did not respond to SS and OO sentences more accurately than to OS and SO sentences (de Villiers, Tager Flusberg, Hakuta and Cohen, 1976; Smith, 1974 (English-speaking children); Hakuta, 1976 (Japanese); Aller, 1977 (Arabic)). For example, Smith (1974), using a sentence-imitation task (a technique thought to tap comprehension, cf. Slobin and Welsh, 1973; Smith, 1970) with 29 to 36 month olds, found OS to be less difficult than SS, followed by OO and SO, in order of increasing difficulty. De Villiers, Tager Flusberg, Hakuta and Cohen (1976), who used an acting-out task similar to Sheldon's and Tavakolian's with 3 to 5 year olds, obtained results very similar to Smith's, except that they found OS and SS to be of approximately equal difficulty.

These data challenge the parallel function hypothesis, since sentences involving parallel function nouns were not consistently easier than those involving double function nouns. They also conflict with the conjoined clause analysis hypothesis. The most serious disagreement in this respect concerns children's handling of OS sentences. Recall that Tavakolian found that children systematically misinterpreted these, acting them out such that the subject of the first (matrix) verb was taken to be the subject of the second (embedded) verb as well. De Villiers, Tager Flusberg, Hakuta and Cohen (1976), in contrast, found this analysis to be somewhat less popular among their subjects than the analysis whereby the direct object of the matrix verb is chosen to be the subject of the embedded verb.

On the basis of their outcomes, Smith (1974) and de Villiers, Tager Flusberg, Hakuta and Cohen (1976) conclude that children's early interpretations of sentences containing relative clauses reflect their efforts to parse received strings into N-V-N sequences that can be construed as representing agent–action–object relations.[6] The N-V-N strategy, which de Villiers,

[6] See Bever (1970a), de Villiers and de Villiers (1973b), Roeper (in press) and Sinclair *et al.* (1971) for discussion of this strategy, which appears to be used widely

Tager Flusberg, Hakuta and Cohen (1976) term a type of 'processing heuristic', gives accurate results on OS strings like *The cat bit the dog that chased the rat* (N_1-V_1-N_2-V_2-N_3), where N_2 can be the object of V_1 and the subject of V_2.

At this point it is unclear why different researchers have obtained different patterns of results, which in turn point towards conflicting interpretations of how children process sentences containing relative clauses. It is possible that children have at their disposal more than one strategy for handling multiple-clause sentences; which strategy appears dominant in a given study may be a function of the exact nature of the task, the scoring procedures adopted, etc. (Tavakolian, personal communication).

3. Sentences with adverbial clauses

Unlike the sentence structures discussed in the section above, sentences containing adverbial clauses introduced by subordinating conjunctions like *before, after, when, until, if, because,* etc., need not present serious parsing problems for children. All the basic constituents may be present and normal word order is preserved in the two clauses: e.g. *John went downtown after he ate dinner.* Nevertheless, many studies have shown that children as old as 6 or 7 have trouble interpreting such sentences. What accounts for this difficulty?

Clark (1971) proposed an explanation focusing on knowledge of word meaning. On the basis of the results of an acting-out task she conducted with 3 to 5 year olds, she hypothesized that children pass through the following sequence in their approach to sentences with adverbial clauses introduced by *before* or *after*. At first children do not know the meanings of either *before* or *after*. They act out the first clause first and the second clause second, apparently assuming that the order in which the clauses are mentioned mirrors the order in which the events should occur.[7] This strategy results in correct responses for sentences like (3) and (4) below, but incorrect responses for those like (5) and (6).

(3) The boy jumped the fence before he patted the dog
(4) After the boy jumped the fence he patted the dog
(5) Before the boy patted the dog, he jumped the fence
(6) The boy patted the dog after he jumped the fence

in the early stage of development, but is not applied indiscriminately to all sentence patterns.

[7] See Bever (1970c) for further evidence for this strategy in comprehension tasks, and Ferreiro and Sinclair (1971) and Clark (1970) for discussion of children's tendency to order clauses in spontaneous or elicited sentences on the basis of order-of-event occurrence.

Later children learn the meaning of *before* and act out sentences with this word correctly, but they either treat sentences with *after* as if they contained *before* or they interpret them according to the order-of-mention strategy. Finally, children learn the meaning of *after* and interpret all the sentences correctly.

Several researchers have questioned whether children's initial problems interpreting sentences with adverbial clauses are due to ignorance of the meanings of the conjunctions. They suggest that even when the meanings are known, children may have trouble processing the syntax of the sentences. Amidon and Carey (1972), using an acting-out task with 5 to 6 year olds, found no evidence for an order-of-mention response strategy. Most errors by their subjects involved omission of the event mentioned in the subordinate clause, suggesting that the event described in the main clause was more accessible to them, regardless of whether it came first or last. Children who received feedback on their performance improved rapidly, which Amidon and Carey took as evidence that initially poor performance was due to the main clause response strategy rather than to failure to understand *before* and *after*.[8]

Related evidence that children's interpretive difficulties may stem from syntactic rather than semantic problems has been presented by Coker (1978). Coker, also studying 5 and 6 year olds with an acting-out task, found that even children who, by their correct responses to questions like *What did I show you before/after the X?*, showed that they knew the meanings of the words in one syntactic context, made many errors when acting out sentences in which *before* and *after* functioned as subordinating conjunctions. Coker's findings are consistent with those of a number of other recent studies of children's knowledge of word meaning (e.g. Grieve, Hoogenraad and Murray, 1977; Richards, 1976) in indicating that factors irrelevant to word meaning can affect children's performance under some conditions, thereby obscuring knowledge that they are able to demonstrate under different conditions.

Regardless of whether children's difficulties with sentences containing adverbial clauses are due to semantic or syntactic problems, information about how children proceed in attempting to interpret such sentences is valuable for the light it can shed on their 'operating principles' (Slobin, 1973) for language acquisition. At present, however, findings on children's

[8] After performing a second study, Amidon (1976) concluded that children's difficulties in interpreting sentences with adverbial clauses do in some cases reflect ignorance of word meaning. She found that even after her subjects became capable of retaining the information in both clauses they continued to make errors with *unless* and *unless – not*.

response patterns are mixed (see Flores d'Arcais (1978) for a recent review). Some investigators hypothesize that children's 'choice' of strategy is strongly influenced by task factors. For example, Amidon (1976), Hood (1977) and Johnson (1975) suggest that tasks that call for an acting out of two events tend to elicit an order-of-mention response organizing strategy, whereas tasks not making this demand do not (see Johnson (1975) for positive experimental evidence). Factors in the child as well as in the task may also be at work. For example, Bever (1970c) proposes that the two strategies are developmentally ordered, with 2 year olds tending to omit subordinate clauses in their acting out and 4 year olds relying heavily on order of mention. In a similar vein, Amidon and Carey (1972) and Coker (1978) propose that the main-clause-first approach is a '5 year old strategy'.

Finally, however, a recent study by French and Brown (1977) casts doubt on the whole concept of strategies for interpreting sentences with *before* and *after*. Although these investigators found weak group trends for their $3\frac{1}{2}$ to 5 year old subjects, their inspection of individual response patterns indicated that half the children used no consistent strategies at all and that there was no apparent developmental ordering among the strategies used by the other half.

Clark's claim that the meaning of *before* is mastered earlier than the meaning of *after* has, like her proposals about the order-of-mention strategy, been a source of controversy. For example, Barrie-Blackley (1973), who studied 6 year olds, found performance better on *after* than on *before*; Amidon (1976), Amidon and Carey (1972), Coker (1978) and French and Brown (1977) found no differences; Harner (1976) found that *before* is understood better than *after* when these words introduce subordinate clauses but *after* is understood better than *before* in adverbial contexts (e.g. *a toy for* AFTER *this day*); and Coker and Legum (1975) found that some children learned *after* first while others learned *before* first.

What is lacking from all these studies, as from most investigations of children's comprehension of word meaning, is information about how the words in question are used in spontaneous speech. Does failure to understand sentences with temporal subordinating conjunctions imply inability to produce them? Or might accurate production precede (the demonstration of) comprehension in this domain, as has been shown in other domains (e.g. Chapman and Miller, 1975; see Bloom (1974) for general discussion)? If the latter is true, then we must view these various comprehension studies not as investigations of how children pass from not knowing to knowing something, but rather as studies of how children come to extend information that they already draw upon in one performance modality to meet the demands of another performance modality.

Unfortunately, little is known about the development of sentences with *before* and *after* in spontaneous speech (although see Clark, 1970; Cromer, 1968; Jacobsen, 1974). However, Hood (1977), in a recent longitudinal study of the acquisition of two-clause sentences expressing causal relations, presents findings that may well have parallels in the acquisition of other kinds of sentences with adverbial clauses. Hood's eight subjects began to produce causal sentences containing *because* and *so* between the ages of 2 and 3. The clauses in these sentences were ordered appropriately for the conjunction: S_1 (cause clause) *so* S_2 (effect clause) and S_2 *because* S_1. This early production with appropriate ordering stands in sharp contrast to experimental outcomes that have indicated that children's concept of causal relations is global and undifferentiated up to the age of 7 or 8, such that regardless of the causal connective involved, they interpret cause and effect propositions as either randomly juxtaposed (Piaget, 1955b, 1969) or as temporally ordered with cause preceding effect (Werner and Kaplan,1963). Hood suggests that one important reason that past studies have placed the emergence of the ability to understand sentences with *because* so late is that they have focused primarily or exclusively on types of causal relations (physical, logical) that differ from those expressed in early spontaneous speech (motivational, psychological).

Hood's findings bear not only on the nature of the relationship between production and comprehension for sentences with adverbial clauses but also on the sequence in which the particular members of a conjunction pair are learned. She found that the order in which her subjects acquired *so* and *because* was related to clause ordering preferences that were established well before the conjunctions themselves were learned. Those children who tended to juxtapose causally related sentences in the order S_1-S_2 (cause, effect) acquired *so* first, while those who preferred the reverse order, S_2-S_1, acquired *because* first. Children who used both orders approximately equally acquired both words at about the same time and used them in sentences of the appropriate clause order. Interestingly, the causal clause order preferences of Hood's subjects were matched by those of their mothers, although, as Hood notes, the direction of causal relationship, if any, cannot be inferred from this information alone.

Before and *after,* like *because* and *so,* have opposite clause order requirements in the normal main clause-preceding-subordinate clause pattern: S_1 (first event) *before* S_2 (second event); S_2 *after* S_1. Therefore, differences in the order in which children acquire *before* and *after* in spontaneous speech (see Jacobsen, 1974) may also be related to patterns established earlier for juxtaposing temporally related clauses and perhaps to mother's speech.

4. Derivational complexity and patterns of acquisition

For many aspects of language structure, the sequence in which various forms appear is consistent across children. What determines this regular order of emergence? Regularities have been linked to both complexity of meaning and formal linguistic complexity (Brown, 1973; Slobin, 1973).[9]

Relatively little is yet known about the effects of meaning on the acquisition of complex sentence patterns, since this topic has been largely unexplored except for some studies investigating the emergence of the concepts underlying certain conjunctions (e.g. Clancy *et al.*, 1976, see p. 287 above; Beilin, 1975). The complexity of the meaning encoded by a given linguistic form is presumably the ultimate constraint on time of acquisition, since no matter how simple the form is linguistically it will not be mastered unless the child has achieved at least a rough understanding of the meaning it expresses. However, Slobin (1973, 1975) has amply demonstrated that even when a meaning is potentially accessible to a child, he may be delayed in expressing it, at least in the conventional way, because of complexity in the formal linguistic mechanism used to encode it.

One way of approaching the concept of formal linguistic complexity for certain sentence structures is to define complexity in terms of *derivational history*: a sentence, Y, is considered more complex than another sentence, X, if the derivation of Y from the underlying structure assigned to it involves all the rules that the derivation of X involves, plus at least one more rule (Brown and Hanlon, 1970).[10] Derivational complexity, defined *cumulatively* in this way, is particularly relevant to the question of how complex sentences are acquired. This is because many sentences that superficially appear to be simple – i.e. do not contain more than one clause – may be complex at an underlying level (see p. 285, n. 1 above). A 'simple' sentence of this type would actually be derivationally more complex than its semantically equivalent multiclausal counterpart, since its derivation would require extra rule(s) to compress material into a single surface clause. We might

[9] Slobin uses the term 'linguistic complexity' in a very general sense to cover many sources of formal difficulty for the child. It should not be confused with the use of the term 'complex' to refer specifically to sentences composed of more than one underlying proposition. The relative linguistic complexity, in Slobin's sense, of various kinds of complex sentences is a matter for empirical investigation.

[10] It is now well understood that a psychologically meaningful measure of relative derivational complexity cannot be obtained simply by comparing the absolute number of rules involved in the derivation of sentences (see Brown and Hanlon (1970), Fodor and Garrett (1966) for discussion). This is why contemporary discussions of the role of relative derivational complexity are limited to the special case of relative *cumulative* complexity, as defined here.

therefore expect that the child would master it later. With this possibility in mind, let us look at some recent investigations of the acquisition of sentences involving co-ordination with *and* and sentences expressing causal relations.

4.1. Co-ordination

According to a widely accepted model of co-ordination (e.g. Chomsky, 1965), sentences containing phrases linked by *and* have deep structures that contain two (or more) full propositions. For example, *Mary sang and danced* would be derived from a structure such as *Mary sang and Mary danced.* The phrasal co-ordination is achieved by deletion of repeated constituents through an operation termed 'conjunction reduction'. Which redundant element is deleted? Several linguists (e.g. Harries, 1973) have argued that there is a universal constraint on direction of deletion such that it always takes place in a *forward* direction: *Mary sang and [Mary] danced→Mary sang and danced.* When the redundant elements are positioned in such a way that forward deletion would result in an ungrammatical sentence – e.g. *Mary sang and John [sang]→* Mary sang and John* – a further transformation such as a rule to group like constituents together is applied: **Mary sang and John→Mary and John sang.*

If the conjunction reduction model is correct and if cumulative derivational complexity plays an important role in the acquisition of complex sentences, then we should expect to find that children produce and understand sentential co-ordinations earlier than phrasal ones, since the latter require application of an extra rule (conjunction reduction) and therefore are cumulatively more complex. Additionally, if there is a universal constraint on direction of deletion such that sentences with apparent backward deletions are derived from structures with forward deletions, we can predict that children understand and produce sentences with forward deletion patterns earlier than those with backwards deletion patterns.

After reviewing the sparse available literature on co-ordination in child speech (e.g. Menyuk, 1969; Slobin and Welsh, 1973), Lust (1974, 1977) set these predictions out and tested them on 3 to 5 year olds, using elicited imitation tasks. She found support for both: the children performed more accurately on sentential than on phrasal co-ordinations, and a fine analysis of their errors (e.g. deletions or additions of elements) indicated that phrasal conjunctions with forward deletion were easier than those with backward deletion. Lust concluded that 'in the temporally extended acquisition process, sentential conjunction forms are available as structural referents in the language system for the emergence of phrasal conjunctions, as the grammatical model of conjunction reduction would require' (1977: pp. 283–4).

Lust's conclusions have been challenged by de Villiers, Tager Flusberg and Hakuta (1976, 1977). These researchers did two experiments with 3 to 5 year olds, one an elicited imitation task similar to Lust's and the other an act-out comprehension procedure. Contrary to Lust, they found that sentential co-ordinations and backward deletion patterns were no more difficult than phrasal co-ordinations and forward deletion patterns. They suggest that even when children do imitate sentential co-ordinations better than phrasal co-ordinations, this outcome may reflect not differences in derivational complexity, but rather the fact that the former sentences, but not the latter, contain repeated elements that could aid memory.

Noting that their negative findings in themselves give few clues to the development of co-ordination, de Villiers, Tager Flusberg and Hakuta (1976) turned to analysis of spontaneous speech samples from Brown's (1973) subjects, Adam, Eve and Sarah. They found that phrasal co-ordination emerged long before sentential co-ordination. They conclude from this that the conjunction-reduction model does not provide a valid account of the structure of phrasal co-ordination for children. They propose instead that 'the roots of coordination are found in the conjunction of similar elements. The elements increase in complexity and length until the ability to coordinate complete propositions develops' (1976: p. 9).

Interestingly, almost all the phrasal co-ordinations of Adam, Eve and Sarah involved *forward* deletions. Put structurally, this means that almost all constituents linked by *and* were elements of the predicate rather than subjects. De Villiers, Tager Flusberg and Hakuta (1976) propose that this preference in production for predicate conjunction can be accounted for without invoking a universal constraint on deletion direction by reference to the difficulty of *planning* for compound subjects, given the characteristic right-branching structure of English (i.e. recursive operations typically take place in a forward, or rightward, direction). A recent study by Lust and Wakayama (1977) lends support to this proposal. They found that children learning Japanese, a left-branching language with subject-object-verb word order, imitated *backwards* phrasal co-ordination patterns better than forward ones, even though these often involved compound subjects.

4.2. Reorganization of linguistic knowledge: causative sentences

Predictions about order of acquisition that are based on relative derivational complexity may fail for several reasons. For example, in some cases the derivational history that linguists have assigned to a given structure may be faulty: the form that is putatively more complex should in fact not be derived from the same underlying structure as the form that is putatively less

complex. Alternatively, even if the assigned derivational history is optimal, other factors may be more important as determinants of order of acquisition (see Smith (1970) for some suggestions along these lines). A third possibility is that the derivational history assigned to a sentence pattern correctly captures adult knowledge, but that children initially produce such sentences *without* the full adult knowledge. In this case, a child at some point would have to analyse the construction pattern more deeply and restructure it.

De Villiers *et al.* (1977) raise the possibility that a reorganization takes place in children's knowledge of co-ordinated structures at around the age of 4, although they leave open the question of whether this means that phrasals become derived from sentential forms at this time. The primary evidence for restructuring was a significant increase among their 4 year old subjects in errors of imitation involving the *addition* of redundant elements to phrasal co-ordinations and the *deletion* of redundant elements from sentential co-ordinations: 'Children at this age are evidently confused about whether the model sentence was presented in phrasal or sentential form' (1977: p. 6). Additional evidence was that in the spontaneous speech data at about age 4, 'sentential forms with and without potentially deletable elements appear at approximately the same time, thus allowing for the possibility that one serves as a model for the other' (1977: p. 6).

Some related evidence for linguistic reorganization is presented by Bowerman (1974, 1977), who studied the acquisition of sentences expressing causal relations. The proper representation of the underlying structure of superficially simple causative constructions like *Mommy opens the door* and *Daddy cut the tree down* has been hotly debated in the recent linguistic literature. Some linguists argue that sentences like these are complex at an underlying level, having structures such as are suggested by the paraphrases *Mommy makes the door (become) open* and *Daddy cut the tree, which made it fall down* (e.g. Fillmore, 1971b; Kastovsky, 1973; Lakoff, 1970; McCawley, 1968; Talmy, 1976). Other linguists maintain that these sentences are simple in underlying as well as in surface structure (e.g. Fodor, 1970; see Shibatani (1976) for a review of the controversy).

A cursory analysis of spontaneous speech development would appear to favour the latter interpretation, since surface structurally simple causative sentences (e.g. *Mommy open door, Daddy cut tree down*) emerge well before their surface structurally complex counterparts (e.g. *Mommy make door open, Daddy cut tree, and that made it fall down,* etc.). However, Bowerman argued that children's knowledge of the structure of the simple sentences is initially superficial. The evidence lies in the existence of errors of over-regularization involving these sentence patterns, and in the timing of their onset. In Bowerman's longitudinally collected spontaneous speech data

from two children, acceptable simple sentences with transitive causative verbs like *open* and *break* emerged several months before the appearance of structurally analogous but overregularized sentences involving 'novel' causative verbs, such as *I'm just gonna fall this on her* (= make fall/drop), *She came it over there* (= made come/brought) and *How would you flat it?* (= make flat/flatten). Similarly but at a later stage of development, acceptable sentences like *Daddy cut tree down* and *I eat cereal allgone* appeared many months before structurally analogous but ungrammatical sentences like *Untie it off* (= untie it, thereby causing it to come off), *I pulled it unstapled* (= I pulled on it, which caused it to become unstapled) and *I'm patting her wet* (= I'm patting her, which is causing her to become wet).

This sequence of development is very similar to that involved in the better known phenomenon of morphological overgeneralization, in which the acceptable production of particular inflected forms (*shoes, walked,* etc.) considerably predates the extension of the inflectional pattern to irregular lexical items to produce novel forms such as *foots* and *comed.* In the morphological case, correct forms used prior to the onset of overregularization are generally interpreted as 'unanalysed': it is assumed that the child has not yet grasped the regular patterning that underlies them (e.g. Ervin, 1964). Bowerman argues that the initial correct use of causative verbs can be interpreted similarly. More specifically, she hypothesizes that in order to acquire rules for creating truly original causative sentences, both grammatical and overregularized, the child must break down 'received' causative sentence patterns such as *open X, break X, cut X down, pull X up,* and *eat X all gone* into components corresponding to a cause proposition and an effect proposition. With this knowledge the child can manipulate the components independently to create novel structures cut to the same linguistic pattern. Thus, at some point the child comes to recognize implicitly that a conceptual structure such as *Mommy* CAUSE *door open* underlies a sentence like *Mommy open door.* At this point (and not before), when she entertains a novel but analogous structure like *She* CAUSE *it came over there*, she assumes that an analogous surface realization such as *She came it over there* is possible. Similarly, but at a later time, the following type of analysis and generalization takes place: the child recognizes (again implicitly) that underlying a sentence like *Daddy cut tree down* is a conceptual structure like *Daddy cut tree* CAUSE *tree (come) down*. Now when she wants to express the semantic content suggested by the structure *(you) untie it* CAUSE *it (comes) off,* she assumes that a surface realization analogous to *'Cut X down'* is possible, i.e. *Untie it off.*

Intriguingly, the onset of errors of overgeneralization, which provide the evidence that Bowerman's subjects had performed implicit analyses such as

these, was just slightly preceded by the onset in their spontaneous speech of complex sentences encoding equivalent semantic content. For example, the first errors of the *how would you flat it* (= make it flat) type came just after the appearance of embedded sentences with *make*, e.g. *This make me sneeze.* Similarly, the first errors like *I pulled it unstapled* (= I caused it to come unstapled by pulling on it; I pulled on it and that made it come unstapled, etc.) came right after the emergence of complex multi-clause sentences that explicitly relate two events causally, e.g. *You made me cry with (= by) putting those up there, Don't put my blanket on because that makes me too hot, The boy pushed the witch in the oven and that made her dead.* This coincidence of timing suggests that – just as the hypothesis that derivational complexity plays a role in order of acquisition specifies – the structure of superficially simply causative sentences is not fully grasped until after the structure of their 'less derived', surface structurally complex counterparts is understood.

5. Conclusions

How children acquire complex sentence structures has been the subject of extensive investigation over the last decade. As a result of this research we have gained a rough picture of the sequence in which complex sentences of various types enter spontaneous speech and quite a bit of information about how children tend to interpret sentences whose structures are hard for them to process. A great deal remains to be done, however.

The first and most critical need is for more, and more detailed, studies on how and when children begin to *produce* complex sentences of various kinds. Particularly valuable would be investigations that analyse the emergence of a broad range of structures in the same children, so as to reveal possible links in acquisition across structural domains. Identifying such links and determining their nature (e.g. a function of shared conceptual content? transfer across similar structural patterns? development of a cognitive skill prerequisite to more than one sentence structure?) would lead to a much deeper understanding than we currently have of the processes underlying the acquisition of complex sentences.

A second important need is for studies that explore the role played by 'interpretive strategies' in the acquisition of complex sentence structure. In a discussion of the currently widespread interest in developmental strategies for language, Cromer makes the following well-taken point:

> 'The emphasis on "strategy" has had, overall, a beneficial effect. It has made us aware of some of the ways by which the child may possibly "get

> into" the linguistic system. It has shown us the importance of perceptual mechanisms for interpreting utterances, and how as adult speakers with full linguistic competence we nevertheless rely on a number of short-cuts to understanding... The concept of language acquisition strategies has told us much – except how the child acquires language' (1976: p. 353).

The problem, as Cromer points out, is that children seem to apply strategies to sentences that they cannot process fully. Once they *can* process these sentences, they no longer need the strategies and begin instead to interpret them on the basis of structural knowledge. But how is the necessary knowledge acquired? This is the critical question, and it is one for which we as yet have few answers. In particular, it is unclear whether the response patterns detected in children's performance on psycholinguists' tests of comprehension actually play any role at all in acquisition. Different children appear to use different strategies for the same sentence structures, and some children seem to use no consistent strategies at all. Yet, as Cromer notes, they all end up learning the constructions.

A first step in efforts to come to a better understanding of the function of strategies in the acquisition of complex sentences will be to find out more about the relationship between the comprehension and production of these structures. Are strategies often applied as processing shortcuts for sentences of a type the child already knows something about, as demonstrated in his spontaneous speech? Or are they more typically used in connection with structures about which the child is truly ignorant? What conclusions we draw about the role of interpretive strategies in learning about complex sentences will depend in part on the outcomes of studies addressing these questions.

Finally, it should be noted that our knowledge of how complex sentences develop is still limited because only a rather narrow range of topics has been investigated. As coverage in this paper indicates, most attention has been paid to questions of how children acquire knowledge of object complementation, relative clause formation and *easy to please* structures, how they handle sentences with adverbial clauses, and what the developmental relationship is between sentential and phrasal co-ordination.[11] But

[11] Two other important questions that have been experimentally investigated, but have not been dealt with in this chapter due to space limitations, are (a) how do children learn to identify the referents for pronouns in two-clause sentences like *After he got the candy, Mickey left* and *Susie jumped over the old woman, and then she jumped over Harry* and (b) when do children begin to understand presupposed information in sentences like *John thought/knew/pretended/forgot/was glad (etc.) that Mary came* (did Mary come?) and *It isn't surprising/true/nice that the fish pushed the tree* (did the fish push the tree?)? For studies on the former topic see

we still know nothing about many other important topics. For example, when and how do children learn to distinguish between *restrictive* and *nonrestrictive* relative clauses (those that single out the intended referent versus those that simply add more information about it)? When children start to co-ordinate sentences, do they just string any two sentences together with *and* or do they respect, from the beginning, certain restrictions on what propositions can be meaningfully co-ordinated? When do children begin to produce and understand sentences with verbless clauses like *With John away at school, the house is quiet*? In summary, there is much virgin territory left to explore in the study of how complex sentences are acquired.

Chomsky (1969), Maratsos (1974b) and Tavakolian (1976). For information on the latter, consult Harris (1975), Hopmann and Maratsos (1975) and Macnamara *et al.* (1976).