

A Cross-linguistic Study of the Development of Sentence Interpretation Strategies

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bates, elizabeth; macwhinney, brian; caselli, cristina; devescovi, antonella; natale, francesco; and venza, valeria. *A Cross-linguistic Study of the Development of Sentence Interpretation Strategies*. *Child Development*, 1984, **55**, 341-354. Studies of the development of sentence comprehension strategies in English have indicated that, at first, children tend to rely on pragmatic and semantic strategies, whereas, later on, they rely primarily on word order to determine the basic grammatical relations. However, before making strong conclusions regarding the role of semantics in comprehension, it is necessary to distinguish between (1) extragrammatical knowledge of world events and (2) abstract semantic distinctions that may be an integral part of the parsing process. An earlier study of American and Italian adults indicated that use of such abstract semantic strategies may be a core strategy for parsing in Italian. In the present study, we compared sentence interpretation in American and Italian children between the ages of 2 and 5. From the earliest stages, children showed sensitivity to the relative information value of the various cues in their native language; Italians relied primarily on semantic cues, whereas American children relied on word order. In general, the data did not support claims regarding the existence of universal hypotheses about language structure. There was also evidence that the failure of these young children to make full use of certain interpretive cues resulted from their inability to appreciate the discourse functions of these cues.

Although most researchers in the field of child language are interested in universal processes, the bulk of our knowledge of acquisition derives from studies of children acquiring English. As a result of these limitations in the data base, we run the risk of elevating idiosyncratic facts about English to the status of language universals. To see why this is true, let us consider two recent proposals regarding universals in language acquisition.

Case Marking versus Word Order

The first of these two acquisitional universals has been proposed most recently by

Pinker (1981, p. 78) in this form: "For case-inflected languages, children will utter sentences in the dominant word order, and will use the dominant word order as a cue in comprehending sentences, before they have mastered their language's morphology." Similar proposals were offered on the basis of production data for both English (Brown, 1973) and German (Stern & Stern, 1907). The principle also fits well with data on sentence comprehension in English (Keeney & Wolfe, 1972). However, data from other languages show that, in its strongest form, the developmental priority of word order over morphology cannot be a language universal. For example, Hakuta (1982) has

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shown that young Japanese children acquire order and inflectional cues simultaneously and cannot use one in the absence of the other. In Polish, Weist (in press) found that 2-year-olds can make reliable use of both case marking and word order in sentence interpretation. Still stronger evidence against the universalist perspective comes from a study of sentence interpretation in four languages by Slobin and Bever (1982) and an investigation of Hungarian sentence comprehension by MacWhinney and Pleh (Note 1). In Slobin and Bever's data for Turkish and MacWhinney and Pleh's data for Hungarian, it was clear that children had attained almost perfect use of the suffixes marking the nominative/accusative distinction by 2Vz years of age. However, the statistically predominant order cue (subject-object-verb [SOV] in both of the languages) had no effect on comprehension until after the age of 4. Slobin and Bever (1982) conclude that there is no universal predisposition to prefer word order as a cue to sentence interpretation; rather, children use those patterns that are most regular and consistent.

Word Order versus Lexical Semantics

The second proposed universal in language acquisition holds that there is a developmental primacy of semantic strategies over word order strategies. These two types of strategies converge on a common interpretation for the vast majority of naturally occurring noun-verb—noun (NVN) sentences in English. However, there is a potential conflict between strategies when listeners are asked to interpret such improbable sentences as "The dog pats the mother."

Based on the performance of American children with probable and improbable sentences in the active and the passive voice, Bever (1970) proposed that 3-year-olds rely primarily on semantic strategies, whereas 4-year-olds make primary use of word order. In a further study of sentence comprehension in 45 American children 2-5 years of age, Strohner and Nelson (1974) concluded that, even at 2 and 3, children control a standard subject-verb-object (SVO) expectation (leading to correct performance on probable or simple reversible actives). However, they argue that, until 4-5 years, this word-order expectation is completely overcome by semantic strategies. Because of this, the 2-3-year-olds overwhelmingly chose the more probable actor in sentences such as "The baby feeds the

mother," whereas 4-5-year-olds shift to choice of the first noun regardless of lexical relations. Note that the major conflict between the Strohner and Nelson study and the Bever study involves the age of the first appearance of word order strategies. Both studies find that word order ultimately predominates over semantic strategies and that semantic strategies are stronger than word order strategies at first.

Chapman and Kohn (1978) suggest that sentence interpretation strategies depend strongly on the kind of semantic information that is set into competition with word order. Given lexical items such as "baby," "mother," and "feed," the canonical relationship among terms is so familiar and so powerful that children might well act out the expected event without any linguistic input at all. By contrast, pairs of sentences such as "The ball hit the boy" and "The boy hit the ball" are not subject to the same amount of bias. In the world of a preschool child, it must seem equally plausible for balls to hit people as it is for people to hit balls.

We will refer to the contrast noted by Chapman and Kohn (1978) as the contrast between strategies based on "lexical semantics" and those based on "event probabilities." If children have a general "agent-action" heuristic in sentence interpretation, then we should always expect the more human and/or animate of two nouns to be chosen as sentence subject. We say that a strategy of this sort is based on "lexical semantics," since features such as [+ animate] and [+ human] are coded directly in the lexicon. A parsing system that depends on lexical semantics does not need to reconstruct the likelihood of an event. It simply looks up the major class features such as [+ animate] or [+ human] on the noun and creates a construal of the sentence on this basis. Alternatively, children may process sentences by relying on "local" event probabilities for specific combinations of objects and actions. Thus, they might be quite consistent in interpreting strings with "Mommy," "baby," and "feed" (e.g., "The Mommy feeds the baby," "Feeds baby Mommy," or "The baby was fed by the Mommy"), just because they know that mothers feed babies and that babies do not feed mothers. Chapman and Kohn provided strong evidence supporting the importance of this distinction between strategies based on lexical semantics and those based on event probabilities. They controlled the degree of event probability in their stimulus

sentences and found no evidence for a general semantic strategy like "agent-action" at any age level. Children were influenced by event probability for familiar items, but they relied on word order (or performed randomly) for items without strong a priori relationships. The finding that children rely on event probabilities in comprehension is, of course, nothing new (Bloom, 1974; Clark, 1973, 1980). What is new here is the realization that formal semantic strategies are fundamentally different from strategies based on event probabilities and that only the latter are clearly present in English-speaking preschoolers.

The Chapman and Kohn (1978) findings place limits on the generality of the progression from semantic strategies to SVO that had been noted by Bever (1970) and Strohner and Nelson (1974). Nevertheless, it does seem to be true in all three studies that, up to the age of 4, English-speaking children are swayed more by meaning relations than by word order. Only after that point is their reliance on SVO order powerful enough to overcome predictable meaning relationships.

When we turn to the cross-linguistic data on the acquisition of sentence comprehension strategies, a markedly different picture begins to emerge. In French, Sinclair and Bronckart (1972) found that reliance on SVO word order increased from 2 to 7 years of age. But interpretations based on event probabilities were also strong at all ages. They used sentences with the three possible orderings of two nouns and a verb (noun-verb-noun [NVN], noun-noun-verb [NNV], and verb-noun-noun [VNN]) with the verb in the infinitive. On NVN sentences with an inanimate first noun, such as "the bottle to push the boy," the most frequent interpretation was patient-action-agent. Unlike English, where SVO word order eventually completely dominates over any alternative strategy, at no point in the Sinclair and Bronckart study did an SVO word order strategy "defeat" a probable event strategy when the two strategies were placed into direct competition. Thus, there is reason to believe that, even in languages as closely related as English and French, children may be learning quite different ways of parsing sentences. Unfortunately, Sinclair and Bronckart did not include in their stimuli sentences with an animacy contrast that did not also represent high-probability activities such as opening a bottle. In other words, there were no sentences

like "The dog the pencil pushes" in their experiment. Inclusion of such sentences would allow us to distinguish application of event probabilities from more formal strategies based on lexical semantics.

A recent study by Hakuta (1982) provides us with clearer evidence regarding the status of lexical semantic strategies in languages other than English. Hakuta's stimuli were created by random assignment of nouns such as "tiger," "goat," "chair," and "banana" to verbs such as "push" and "chase." He found that, when word order and lexical semantics were placed in direct competition in Japanese, lexical semantics dominated quite clearly. Hakuta's stimuli were designed in a way that required use of formal semantic strategies, not just strategies based on probable events. When his experiment is compared with that of Chapman and Kohn (1978) in English, there seems to be evidence for marked differences between Japanese and English in regard to the use of formal lexical strategies in sentence comprehension. Unfortunately, Hakuta did not report the results for the competition between animacy and word order in full detail (apparently because the role of animacy was so absolute), nor did he present comparison results for Japanese adults. However, his results certainly suggest the possibility that, in some languages, formal semantic strategies may be acquired well before word order strategies.

It is important to collect adult data in experiments like these for several reasons. First, the discrepancy between the studies in English and those in other languages might well reflect differences in the target languages. Certainly, we cannot assume that syntactic strategies will prevail in all adult samples, since adults (including English-speaking adults) have been shown to use semantic information in sentence interpretation under some conditions (e.g., Gleitman & Gleitman, 1970, in a study on the interpretation of nominal compounds). Second, it has been argued that comprehension experiments of this sort have no ecological validity; when children are presented with semi-grammatical or anomalous stimuli, they may respond in bizarre ways that have nothing to do with their day-to-day use of the grammar (Bridges, 1980; Cromer, 1976). However, if we can show that adults from different languages respond to such stimuli in consistent and language-specific ways, then it seems fair to conclude that interesting facts about the target language may influence the behavior of children under similar circumstances. This is

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particularly true if the language-specific outcomes of laboratory experiments relate in a theoretically coherent way to facts about language use in natural circumstances.

English, Italian, and the Competition Model

To provide a concrete instance of the ways in which a variety of cues can interact in sentence interpretation, let us take a look at two related languages—English and Italian. Both languages use SVO word order without case inflections to indicate basic semantic-syntactic relations. However, in Italian, all possible word orders can and do occur under certain conditions, including oddities like "The lasagna ate Giovanni" (OVS). In deviations from SVO, assignment of semantic-syntactic roles must be based on some combination of cues other than word order: number of person agreement with the verb, the presence of a clitic object pronoun, contrastive stress to suspend "default" interpretation, or a variety of semantic-pragmatic cues, in the verbal and nonverbal context, that make it obvious who did what to whom (Bates, 1976; Duranti & Ochs, 1979). This means that Italian listeners must be prepared to integrate semantic-pragmatic information directly into the parsing process.

By contrast, word order is rigidly preserved in English, although some variations are possible in informal conversation. Specifically, informal English permits OSV topicalizations (e.g., "Egg creams I like") and VOS topicalizations (e.g., "Really gets on my nerves, that guy"). Although these noncanonical orders are rare, they do occur in spontaneous speech and therefore should be available as schemata for the interpretation of nonstandard orders in comprehension. By comparison, SOV and VSO are not permissible in modern English under any circumstances (e.g., "I egg creams like" or "Really gets on, that guy, my nerves"). Furthermore, in sentences such as "I petted the cat Mary liked," the relative clause is an OSV fragment. In imperatives such as "Kick the ball, Harry," we see the use of a VOS order. This means that, for simple declarative sentences with any combination of two nouns and a verb (NVN, NNV, or VNN), English-speaking listeners can always find a model of that word order in their language (i.e., SVO, OSV, or VOS) that yields a single consistent interpretation of who did what to whom. In Italian, on the other hand, all possible word orders exist, but none yields a single, consistently correct interpretation of who was the actor and who was acted upon.

The effect of these informal language differences on sentence processing out of context has been demonstrated by Bates, McNew, MacWhinney, Devescovi, and Smith (1982). Middle-class Italian and American adults were asked to interpret 81 grammatical and semigrammatical sentences with orthogonal variations of word order, lexical animacy, contrastive stress, and topicalization. The major result was that Italians and Americans used completely opposite strategies to interpret the same sentences. That is, given a sentence such as "the pencil kicks the cow," Italians choose the cow as subject while Americans choose the pencil. The main effect of animacy in Italian accounted for 42% of the variance, compared with 3% in English; the main effect of word order in English accounted for 51% of the variance, compared with 4% in Italian. One might argue that Italians were simply "stuck for an answer," since word order is ambiguous in their language, and they had to carry out special extragrammatical computations to interpret these sentences. However, regardless of word order, reaction times for the Italians were very fast if an animacy contrast was present, suggesting that the semantic distinction between animate and inanimate nouns is a readily available part of the Italian parsing process. There was also a tendency in both languages to choose the topicalized element as the actor. Contrastive stress had an effect in that reactions were faster and clearer for NVN items with default stress (the pragmatically neutral, "best" combination) and for VNN and NNV items with contrastive stress (the pragmatically marked, "best" variations). However, the effect of these pragmatic cues was significantly greater in Italian. In fact, in the absence of semantic or pragmatic cues, Italians gave extremely slow and inconsistent responses—even on the canonical word order.

Elsewhere (Bates & MacWhinney, 1982), we have developed a model of the functional control of sentence processing called the "competition model." Early divergences between children exposed to different language structures are directly predicted by this functionalist approach to grammatical development. Thus, we would expect English-speaking 2-year-olds to rely extensively on word order in processing and Italian-speaking 2-year-olds to rely extensively on semantic and pragmatic strategies.

According to the competition model, decisions in sentence interpretation are made by evaluating the relative weights of the cues present in the stimulus. Similar models for

comprehension are currently espoused by Anderson (1983) and Thibadeau, Just, and Carpenter (1982). These models assign no role to universal predispositions or to underlying separations of autonomous processing components (Forster, 1979). In such competition models, semantic contrasts are integrated into the parsing system on an equal footing with traditional grammatical cues. Proceeding from a model of this type, our developmental model (Bates & MacWhinney, 1982; MacWhinney, 1978; MacWhinney, Bates, & Kliegl, in press) claims that the age of acquisition of cues to sentence interpretation is determined by the relative "cue validity" (Brunswik, 1956) of those structures in the target language. A functionalist/competition model of this type is proposed as a theoretical baseline for research in this area. To the degree that evidence can be gathered for universals, predispositions, or separations of components, we may be required to make our developmental model more complex. In general, we believe that it will be necessary to account for both the creativity and the plasticity of the acquisitional processes used by children while they are discovering grammar.

Method

Subjects.—Eighty children participated in the study: 40 were English-speaking children attending middle-class preschools in the Denver area; 40 were Italian-speaking children attending middle-class preschools around Rome. Within each language group, there were 10 children (five males and five females) at each of four age levels: 2½, 3¼, 4½, 5½. The children's ages varied within 2 weeks of the half-year mark. These four groups will be referred to as 2-year-olds, 3-year-olds, 4-year-olds, and 5-year-olds, although the actual age range is narrowly restricted.

Materials.—Each child received a total of 54 grammatical or semigrammatical sentences to enact. There were two sentences at each level of a 3 x 3 x 3 design, representing orthogonal combinations of word order (NVN, VNN, NNV), animacy (animate/animate, animate/inanimate, inanimate/animate), and contrastive stress (default stress only, contrastive stress on first noun, contrastive stress on second noun). Each sentence consisted of two singular common nouns with definite articles and a transitive action verb in the present tense. All verbs were given in the third-person singular. The animate nouns were taken from a set of 18 names for familiar animals (dog, goat,

monkey, etc.). The inanimate nouns were taken from a set of nine simple objects (rock, ball, pencil, etc.). The verbs were selected from a group of nine verbs representing simple actions (eats, bites, grabs, etc.). A total of 40 different protocols were constructed, each with a unique random assignment of animate nouns, inanimate nouns, and verbs to appropriate conditions. This procedure insured that *specific* event probabilities resulting from *particular* lexical combinations (e.g., lions are inherently fiercer than sheep) were completely homogenized across children and conditions. The between-sentence randomization procedure was exactly the same as the one described for American and Italian adults in Bates et al. (1982). The 40 protocols were translated into matching English and Italian forms, so that each protocol could be randomly assigned to one Italian and one American child.

Experimental objects included small plastic versions of the 18 animals (approximately 2 inches in height), plus exemplars of the nine inanimate objects (which were roughly equivalent in size to the toy animals). A plastic cheese tray with a transparent plastic dome was used to present the objects to the child while each sentence was read aloud.

Procedure.—All children were tested individually in their preschools, except for a subset of the 2-year-olds in each language group who had to be tested individually in the home. Italian children were tested by native speakers of Italian; Americans were tested by native speakers of English. Only female experimenters were used.

The experimenter began the testing session by introducing the experimental toys to the children, asking them to name each one, and repeating the object name (whether or not the children had named it correctly). Then she explained that they were going to play a game in which the children must act out (i.e., "Show me with the toys") every sentence uttered by the experimenter. Before each stimulus sentence was read, the two associated objects for that item were placed on the plastic tray under the clear plastic dome. This insured that children would watch the objects "on stage" without touching them until the entire sentence was delivered. To minimize bias introduced by place-directed responses (e.g., picking the animal on the right, or picking the nearest object), toys were placed on the tray in random positions following a clockwise circular pattern across trials (i.e., horizontal from the children's

perspective on one trial, diagonal on another, vertical on another, etc.). Each sentence was read aloud to the children, using a standardized and exaggerated intonational pattern to underscore the contrast between default and contrastive stress (as in Bates et al., 1982). Then the clear plastic dome was removed, and the children were told to "show me." If a child had clearly forgotten the sentence, or asked for a repetition, the sentence was read a second time without replacing the dome. This procedure greatly reduced the number of idiosyncratic responses (e.g., the children acting as agents on both toy objects) and place-oriented errors that have been reported in many studies using the enactment method (for a review, see Bridges, 1980).

Scoring.—While one experimenter presented stimuli, a second wrote down the children's behaviors with the toys on each trial. With a few exceptions, the first object picked up and moved by the children was considered to be the object chosen as agent. Exceptions included cases where the children clearly indicated having changed their minds by setting the first one down and picking up the second in a clear agentive motion (e.g., shoving it heavily against the first when instructed to make one object hit or push another). There were also some idiosyncratic exceptions for cases in which the first object moved was quite clearly intended as the patient. An example includes a case in which a child responded to "eat" or "kiss" by holding the body of the patient toy up against the agent animal's mouth.

The level of uninterpretable responses obtained in this experiment was consistently lower than that reported by other investigators, perhaps because of some of the methodological changes we introduced (e.g., use of the plastic dome during sentence presentation). Even in the youngest age groups, no child fell below 50% interpretable behaviors across trials. For all but two children, at least 86% of the responses were interpretable.

Results

The overall design of the experiment permitted a $2 \times 4 \times 3 \times 3 \times 3$ analysis of variance (language \times age \times word order \times animacy \times stress) with language and age as between-subjects variables, and order, animacy, and stress as repeated measures. Although we conducted a full five-factorial ANOVA and two four-factorial ANOVAs for each language, the results are most clearly

understood by looking at the eight three-factorial ANOVAs for the four age groups in the two languages. Each of these analyses was based on data from 10 subjects. These eight analyses permitted us (a) to determine the age level in which each effect first reached significance and (b) to calculate the amount of variance accounted for (sum of squares effect/sum of squares total from the ANOVA) by different grammatical cues and combinations of cues at each point in development.

Figures 1, 2, and 3 illustrate the interactions between order and animacy at each age level. Figure 4 displays the percentage of variance accounted for in each age and language group. In all these figures, corresponding values for American and Italian adults from Bates et al. (1982) are included for comparison with the developmental findings.

Two-year-olds.—Among the youngest American children, there is a significant main effect of word order, $F(2,18) = 4.06$, $p < .05$. Figure 1 displays the percentage of choice of the first noun in NVN sentences at each age. Figures 2 and 3 display choices for VNN and NNV sentences, respectively. Comparing Figure 1 with Figures 2 and 3, we see that the word order effect is primarily because of a first noun strategy with NVN items. Performance on the other two word orders is essentially random when summed across conditions. There is also a significant word order \times animacy interaction, $F(4,36) = 3.42$, $p < .05$, reflecting an effect of animacy primarily in NNV (Figure 3), where there is a tendency toward an OSV interpretation when both nouns are animate. As we shall see, this is the only point in the entire study in which American children show some sign of the strong OSV and VOS strategies that Bates et al. (1982) report for American adults. The fact that an OSV pattern occurs only in the youngest group and only with reversible sentences is an anomaly that we must consider in more detail later in this paper.

Among the youngest Italian children, the only significant effect is a main effect of animacy, $F(2,18) = 5.04$, $p < .05$. This effect is in the predicted direction: children are more likely to choose the animate noun on non-reversible items, regardless of word order. In short, *from the very first age group there is already a language-specific difference between American and Italian children.* American children rely primarily on word order (although there is an interaction with animacy in NNV sentences); Italian children

rely primarily on animacy as a lexical semantic cue. Whereas the most important effect in English at this time is word order, which accounts for 3.5% of the variance, the most important effect in Italian is animacy, which accounts for 17.5% of the variance (see Figure 4).

Three-year-olds.—By this age, the word order main effect among American children is quite a bit larger than it was at age 2 (17.3% vs. 3.5% of the variance), $F(2,18) = 26.37, p < .001$. The word order x animacy interaction that was significant at age 2 is no longer significant at this age.

Things look quite different for the 3-year-old Italians. There are now significant main effects for both word order, $F(2,18) = 14.15, p < .001$, and animacy, $F(2,18) = 13.28, p < .001$, but the animacy effect is much larger (34% vs. 5.5% of the total variance—see Figure 4). The word order effect is in the same direction as the one we find for American children at every age—a first-noun strategy with NVN items, with performance around chance on the other two orders when

summed across conditions. Finally, there is a significant order x stress interaction, $F(4,36) = 3.59, p < .05$, among 3-year-old Italians, with stress having its effect primarily in the interpretation of noncanonical (VNN and NNV) orders. However, this stress effect runs in the opposite direction from stress effects reported by Bates et al. (1982) for Italian adults. In the adult study, listeners tended to avoid choosing the stressed noun as subject (presumably on the assumption that the subject is usually old information, whereas contrastive stress indicates new information). Children, instead, tended to choose the stressed noun as subject. We suggest that this is essentially a nonlinguistic strategy; "If you don't know what else to do, pick the one that the experimenter says loudest." Such an interpretation is compatible with a report on stress effects in older American children by MacWhinney and Price (1980). In that study, second graders were asked to point to the picture that corresponded to a sentence. They tended to point to the picture that contained the object that was stressed in the sentence. Seventh graders, like the adults in

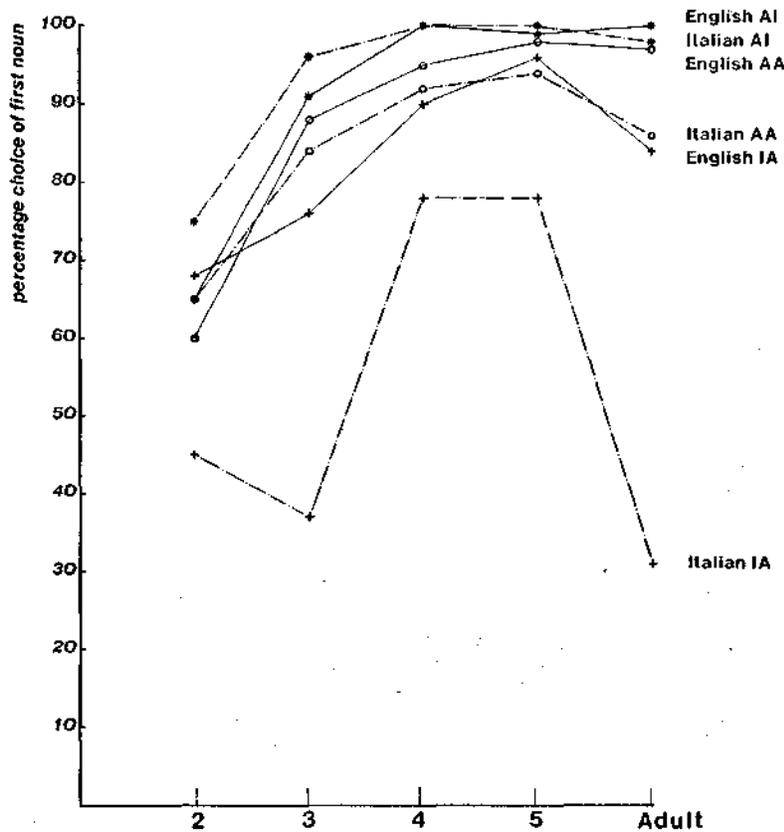


FIG. 1.—Animacy effects in noun-verb-noun items

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Bates et al. (1982), pointed at the picture that did not contain the stressed item.

Four-year-olds.—Among the American 4-year-olds, all three main effects reached significance: word order, $F(2,18) = 29.03$, $p < .001$; animacy, $F(2,18) = 16.57$, $p < .001$; and stress, $F(2,18) = 3.78$, $p < .05$. These three factors account for 30.7%, 6.4%, and 1.0% of the variance, respectively. The interaction of word order with animacy was also significant, $F(4,36) = 5.87$, $p < .01$, accounting for 5.0% of the variance. This interaction reflects a tendency for animacy to have its effect primarily on NNV items (see Figure 3). Children tended to pick the *first noun* on NNVs when the animate was first or when the items were reversible. They tended to pick the *second noun* on NNVs when the second noun was animate. By contrast, performance on VNN items was essentially random at this and all other age levels in English. This interaction is entirely different from the one found at 2. At 2, children picked the second noun as the subject in reversible sentences. At 4, they have shifted to a first-noun strategy

in NNV and pick the first noun in reversible sentences. This shift in strategies is reflected in a significant three-way interaction of word order \times animacy \times age, $F(12,144) = 2.95$, $p < .01$, in the four-way ANOVA for English. This complex pattern of responses on NNV sentences seems to be evidence for a developmental shift between word order strategies. Rather than using the cue of the relative position of the noun before the verb as they did at 2, 4-year-olds are using the absolute cue of position at the beginning of the sentence. Such a transition could be represented in formal terms as the movement from a loose system of positional patterns (MacWhinney, 1982) to a more organized parsing system (Marcus, 1980).

Among the 4-year-old Italians, there are significant main effects of animacy, $F(2,18) = 13.00$, $p < .001$, and word order, $F(2,18) = 25.46$, $p < .001$, along with a significant word order \times animacy interaction, $F(4,36) = 7.10$, $p < .001$. Animacy accounts for 31% of the variance, word order for 9.0%, and the interaction for 4.0%. The pattern that emerges here is

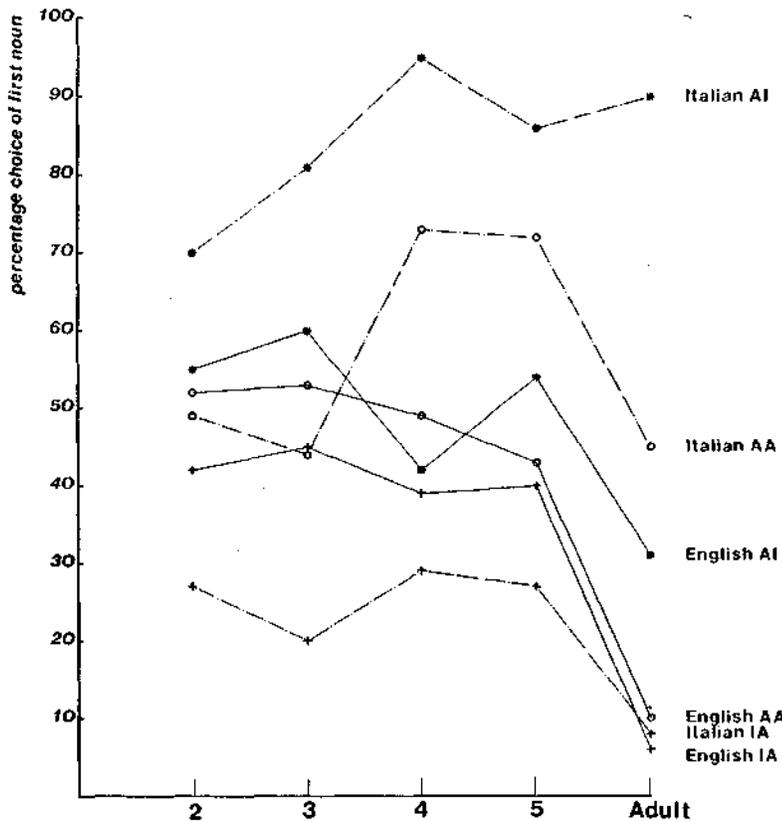


FIG. 2.—Animacy effects in verb-noun-noun items

the most surprising finding in the study. Although word order remains a secondary strategy (i.e., it accounts for less variance than animacy), there is nevertheless more evidence here for overgeneralization from SVO than we have in any English-speaking group. In particular, Italian children seem to have developed a strategy of taking the first noun as the agent. As can be seen in Figures 1-3, Italian 4-year-olds actually make more use of word order than Italian adults. First of all, they tend to choose the first noun on VNN and NNV orders (although this tendency is much smaller when there is conflicting information from animacy). Since this pattern does not correspond to any clear SOV or VSO bias in the adult model, it seems fair to conclude that children are overgeneralizing from the canonical SVO word order. Unlike their age mates in English, the Italians seem to have overgeneralized in a way that takes the first noun as the agent even when that noun is not sentence-initial. A second piece of evidence for overgeneralization from SVO order is

and word order. On improbable NVN items such as "The pencil kicks the cow," word order "wins" over animacy in this age group whereas animacy clearly "wins" over word order in the adult sample. This diminution of role of animacy in NVN sentences that emerges at 4 is reflected in a significant age x animacy x word order interaction, $F(12,144) = 1.87, p < .05$, in the four-way ANOVA for Italian. Between the ages of $3\frac{1}{2}$ and $4\frac{1}{2}$, these Italian children seem to have developed an overgeneralization from SVO order at least as strong as that observed by Bever (1970) and replicated by Maratsos (1974). Of course, Bever's overgeneralization data were based on performance with English passives, and there were no passive sentences in our study. But it is interesting that analogous patterns of overgeneralization occur in both language groups, at the same age level. This is particularly striking since a first-noun strategy on improbable NVN items runs directly counter to the Italian adult pattern.

Finally, there is no main effect of stress

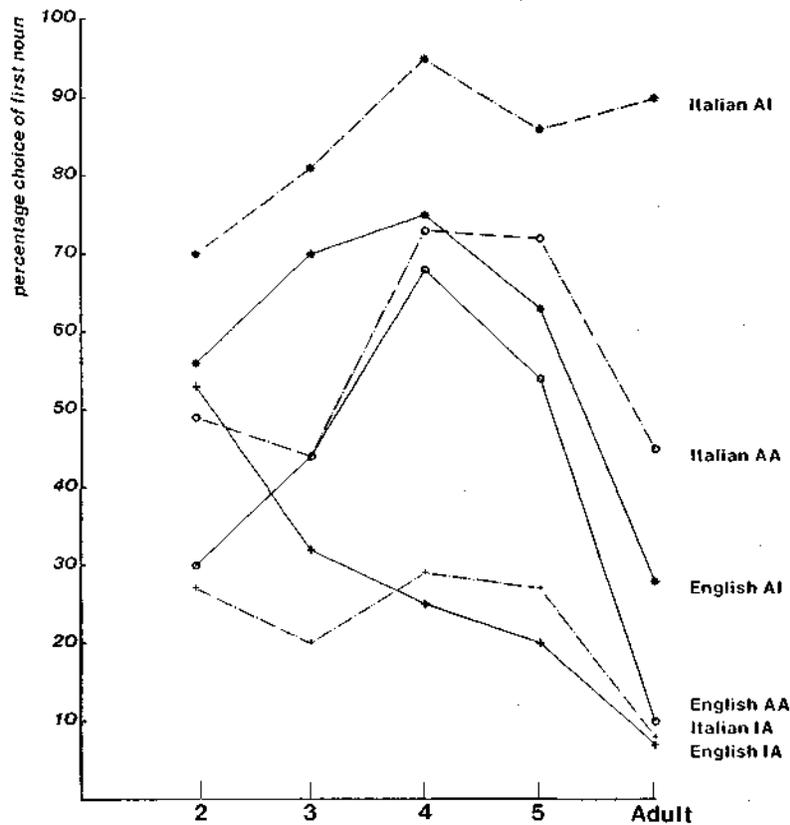


FIG. 3.—Animacy effects in noun-noun-verb items

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in these 4-year-old Italian children, nor are there any interactions with stress. The fact that the 3-year-old stress strategy has disappeared in this group supports our view that the earlier stress effect was an immature, nonlinguistic strategy at odds with adult use of the same information. The disappearance of this use of stress between 3 and 4 is reflected in a significant age x stress x word order interaction, $F(12,144) = 2.05, p < .05$, in the four-way ANOVA for Italian.

Five-year-olds.—In both language groups, performance was essentially the same at 5 as it was at 4. In English, all three main effects again reached significance: word order, $F(2,18) = 18.78, p < .01$; animacy, $F(2,18) = 4.65, p < .05$; and stress, $F(2,18) = 3.74, p < .05$. There was also a significant order x animacy interaction, $F(2,18) = 5.73, p < .001$.

The only change compared with the preceding age level is that the tendency to generalize a first-noun strategy to NNV items has begun to drop (Figure 3). This may mean that 5-year-olds are beginning to adopt the

second-noun, OSV strategy that is so clearly evidenced by American adults.

In Italian, we also find the same patterns that operated at 4: a strong animacy effect, $F(2,18) = 19.05, p < .001$ (30.5% of the variance); a weaker word order effect, $F(2,18) = 13.71, p < .001$ (9.7% of the variance); and a significant order X animacy interaction, $F(4,36) = 5.16, p < .01$ (reflecting that order effects are greatest when there is no conflict with animacy). The only way the 5-year-olds differ from the 4-year-olds is in the increased use of the first-noun strategy on reversible NNV items. This indicates that the strategy of selecting the first noun as agent is still strong, but has become coordinated with the animacy strategy.

To summarize, from the earliest age group we have evidence of differentiation between American and Italian children in the direction of the respective adult models. Word order accounts for more variance than any other cue in English, at every age. Animacy is the largest effect in Italian, at every age. These facts are reflected in the fact that,

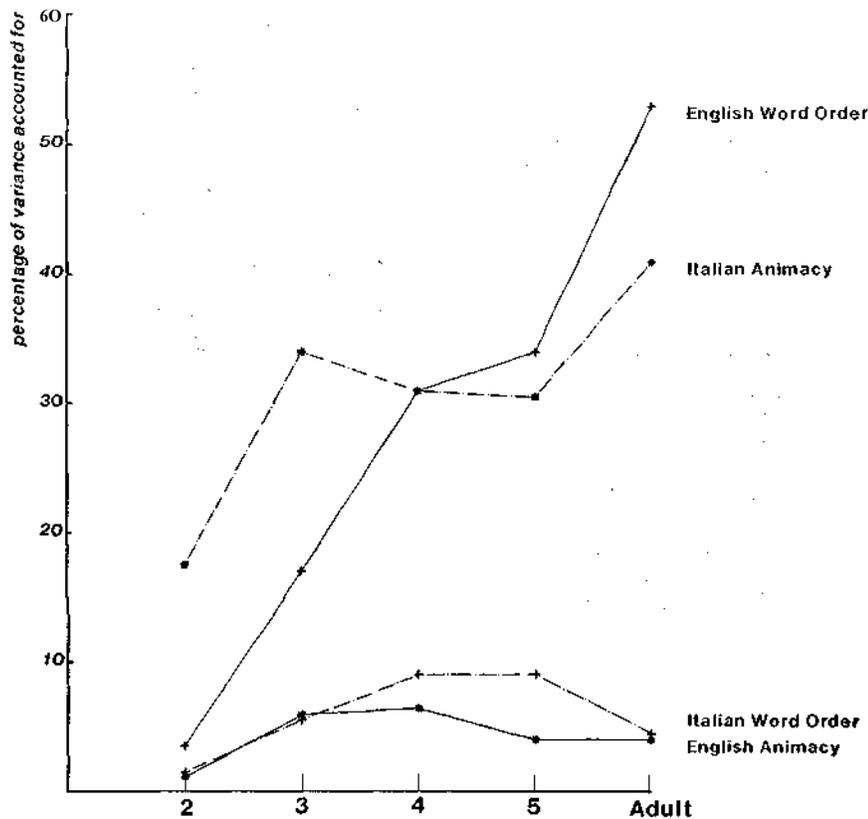


FIG. 4.—Variance resulting from main effects

in the five-way ANOVA, the interactions of language X word order and language x animacy are both clearly significant. However, a more surprising finding is the overgeneralization of SVO by 4- and 5-year-old Italians—a much larger reliance on word order than we find in educated Italian adults. What we have here is a constant reliance on animacy at every age, tempered by a temporary resurgence of word order in the 4-5-year-old range. We also have evidence that children in these two languages are formulating word order strategies of several different types. It seems that American 2-year-olds use simple positional relations in processing of NNV. Later, English-speaking children develop initial noun strategies. In Italian, however, children formulate their word order rules in terms of the first noun being the agent, particularly when that noun is animate.

The main conclusion from this experiment is that *children are sensitive from the beginning to the information value of cues in their particular language*. Moreover, this sensitivity seems to be the most important single factor accounting for the development of sentence comprehension. This result is particularly clear in Figure 4, where the absolute magnitude of word order and animacy effects is plotted without regard for direction. Word order is the most important cue to sentence interpretation in English, at every age level. Animacy is the major cue to sentence interpretation in Italian, again at every age level.

We should stress that the animacy manipulation in this experiment requires mastery of an abstract semantic contrast between animate and inanimate. There are no local, high-probability relationships in the children's experience to connect pencils and cows, erasers and zebras. From this point of view, our results are compatible with Chapman and Kohn (1978), who report that American children rely exclusively on word order, unless items involve highly probable relationships such as those connecting "baby," "feed," and "Mommy." From the same point of view, the consistent behavior of Italian children is all the more impressive. Their performance in this experiment must necessarily involve use of an abstract semantic contrast that has very little effect on American children. Any attempt to view this contrast as based on nonlinguistic strategies must fail, since there is no evidence for the use of any such strategy even at the youngest ages in so closely related a language as English.

Although the results of this study do not fit well with approaches that attempt to emphasize the separation between syntax and semantics, they are entirely compatible with the functionalist approach to grammar articulated in Bates and MacWhinney (1982). According to that approach, languages and children can integrate abstract semantic cues directly into the parsing process. The results of the current study are also quite compatible with models that account for order of acquisition in terms of cue validity such as the one presented in MacWhinney (1978) and MacWhinney et al. (in press).

Remaining Issues

There remain three results of this study that defy a straightforward explanation in terms of cue validity alone: (1) the non-adult-like use of stress in Italian 3-year-olds, (2) the overgeneralization of SVO order that emerges in Italian 4-year-olds, and (3) the failure of English-speaking 4- and 5-year-olds to adopt the second noun strategy used by English-speaking adults. We believe a single account can provide an explanation of each of these three phenomena, along with a variety of related phenomena in the language development literature.

We begin by noting that, below the age of 7, children seem to have difficulty with those aspects of language that serve an inter-sentential, discourse function in the adult grammar. For example, Karmiloff-Smith (1982) has noted certain reorganizations that take place around 7 years of age in the use of pronouns and determiners by French children. She argues that children begin with a sentence-level grammar that is designed to convey information about individual events. Hence, they may appear to use pronouns and determiners correctly, but only in the service of "local" functions. For example, the use of pronouns and articles in her preschool sample was constrained primarily by "exophoric factors"—that is, whether the referent was actually in the room or not. After 7 years of age, children seem to be sensitive to the cohesion of texts and narratives, so that pronouns and determiners come under the control of new, anaphoric constraints. From this point of view, there is one thing that all the deviations and omissions by the children in our sample have in common: they are avoiding those aspects of word order variation and contrastive stress that are under discourse control in the adult languages.

To trace out the impact of the emerging

attention to discourse function on the use of stress in Italian, we repeated our experiment with a sample of 10 7;2-year-old Italian children and analyzed the results in another repeated-measures analysis of variance (order X animacy X stress). The order, animacy, and order x animacy effects were identical to those obtained with 5;6-year-olds in the main experiment; the overgeneralization of SVO that we have reported here does not disappear by 7;2. However, among these older children, stress had begun to function as in the adult speaker with the stressed noun being chosen as the subject. This exactly replicates the findings of MacWhinney and Price (1980) who had also argued that adult use of contrastive stress involves rules that operate above the level of the individual sentence, since they involve intersentential coordinations within a discourse grammar. Although preschool children do use stress in a "local" way to mark emphasis at the sentence level, complete mastery of the discourse functions of stress may take years to develop.

The second result that seems at first to defy a straightforward explanation in terms of cue validity is the overgeneralization of SVO by Italian children. We believe that this overgeneralization occurs because these children do not yet understand the pragmatic/discourse function of word order variations in their language—or at least they do not understand them well enough to apply consistent discourse strategies, out of context, in an experimental setting. When Italian adults were presented with the same stimuli, they used discourse as well as semantic cues to disambiguate word order. When there was no contextual information of any kind, adults performed at nearly random levels on the noncanonical orders and were not even particularly consistent on the NVNs (presumably because OVS interpretations still "sounded right" on some items). Perhaps Italian adults do *not* overgeneralize SVO the way children do because they know better, even at the price of random performance. If Italian children do not have this additional discourse knowledge, there is nothing to block them from the simplifying assumption (based on the distribution of SVO orders in the adult language) that the first noun is usually the subject.

Overgeneralization of SVO in sentence production during this period has also been reported for Italian by Bates (1976) and for Slavic by Radulovics (1975) and Slobin (1966). It is also interesting that the onset

time for overgeneralization of order in comprehension coincides with Bever's (1970) report on the emergence of the SVO word order strategy in American children. Of course, Bever's data involved overgeneralization of a first-noun strategy to the English passive, and we have no passive constructions in this experiment. Nevertheless, it is at least possible, in the light of the English-Italian comparison, that children are able to reflect on basic word order in a new way somewhere in the period from 4 to 7 years of age.

Third, the English word order data also point out the fragmentary, nonintegrated nature of early comprehension. Although the American children controlled SVO from 2 years of age onward, we had very little evidence in this study for the kind of second-noun strategies we find in American adults. The adult second-noun strategy for NNV sentences may be based on use of the OSV structure of object relative clauses. There was a similar tendency to OSV interpretation in the 2-year-olds, but it makes little sense to view this pattern as the acquisition and subsequent loss of a pattern for interpreting OSV topicalizations. Rather, it appears that English-speaking children first acquire SVO word order in terms of its component pieces: SV order and VO order. In the NNV sequence, only the SV pattern is satisfied. By age 3;6 children have already begun to go beyond this fragmentary approach to sentence processing.

More surprising than the disappearance of a second-noun strategy is that American children show very little evidence for an overgeneralized first-noun strategy. The only place where such generalization occurs is on reversible NNV items at 4 years—a tendency that has already begun to diminish by 5. In fact, there was less overgeneralization from SVO to other word orders in English than there was in Italian—even though American children rely more on word order overall. It is possible that, after 3, children have knowledge of both a fragmentary SV pattern and a general first-noun strategy, which cancel each other out in NNV orders. This interpretation is bolstered by the fact that 4-5-year-olds were very likely to choose the second noun as the actor on IAV constructions. Evidently, in this case, they are supported by the convergence between topicalization structure, OSV structure in object relative clauses, and animacy. Note also that the only evidence for English overgeneralization of SVO in Bever's (1970) original studies occurred on passive

sentences. Since passives do follow an NVN order, they would presumably not be "canceled out" by children's sensitivity to adult right and/or left topicalization.

To summarize, we have found that, from the age of 2Yz, child speakers of English and Italian are remarkably attuned to the interpretive cues provided by their respective languages. Thus, the major determinant of the development of sentence processing strategies appears to be cue validity. Yet, there are certain cues that seem to be inadequately processed by the young child. These lead to errors and overgeneralizations that can be explained if we assume that, before the age of 6 or 7, children do not have control of the discourse functions that "make sense" out of pragmatic word order variations.

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