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Some Steps in the Acquisition of Factive and Implicative Sentences*
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There are many kinds of linguistic properties, both syntactic and semantic that play an important role in the interpretation of a sentence or a proper sub part of a sentence. Frequently such properties are not contained in the sentence or the relevant sub part. For example the linguistic properties of a matrix verb or predicate often play a major role in determining how one interprets the predicate complement of a sentence. Consider the sentence pairs (1) and (2) and the effect that the matrix verb has on our interpretation of the predicate complement 'John came for dinner.':

- 1a. John managed to come for dinner.
- b. John didn't manage to come for dinner.
- 2a. John asked to come for dinner.
- b. John didn't ask to come for dinner.

When the main verb belongs to the class of implicative verbs (Karttunen 1970), as for example manage in sentence (1a) we know that if the sentence is in fact true, then John came for dinner. However, if the verb is one like ask, as in sentence (2a), we know nothing about whether John came or will come to dinner, though presumably he wanted to. When implicative verbs like manage are negated, as in (1b), we learn that John did not come to dinner, though apparently he wanted to. But when verbs like ask are negated as in (2b), all we know is that John didn't ask. Additional examples of such complex relations are found in the well known sentence pairs given in (3) and (4):

- 3a. Archie knew that John came for dinner.
- b. Archie didn't know that John came for dinner.
- 4a. Archie thought that John came for dinner.
- b. Archie didn't think that John came for dinner.

When the matrix verb belongs to the class of factive verbs (Kiparsky and Kiparsky 1970), as know in (3a), we understand that the speaker of the sentence has presupposed that John came to dinner. This is not true when the matrix verb is one like think, as in sentence (4a). Here the speaker has not committed himself to any such presupposition, but is merely reporting Archie's positive thought. When factive verbs are negated as in (3b), the presupposition still holds. That is John came for dinner. However, when neg raising verbs (Lakoff 1970) like think are negated, as in (4b), the sentence can be used to report Archie's negative thought. That is, on one reading Archie believed that John didn't come for dinner. This is merely part of the complex system associated with matrix verbs which a child must learn in order to understand sentences with predicate complements.

In light of this diversity we can make two hypotheses about how the child goes about acquiring the relevant semantics of this system.

Hypothesis I: the child treats each predicate as a unique case; his performance with one member of a predicate class is independent of his performance with another member of that class.

Hypothesis II: the child acquires systematic control over certain semantic properties on a class basis.

If Hypothesis II is correct, we would expect it to be reflected in the child's superior comprehension of one class of predicates over another.

METHOD

Participants

The experiment which I will report on here is part of a larger investigation which attempts to address these hypotheses. Four separate tasks were utilized in this investigation. This paper will present one of these tasks in which 23 kindergarten children (mean age 6.1 years), 20 first graders (mean age 7.0), and 21 second graders (mean age 8.1) participated; a total of 64 children. Thirty one of these children were female, thirty three were male. Approximately half the children in each grade were male, half were female.¹ The median family income of the census tract served by the school, which is in the Los Angeles area, is \$17,500.

Materials

The three implicative verbs used in this study are careful, let, and get. The three factive predicates are know, happy, and find out. These items were selected on the basis of their widespread use in first grade reading texts. The assumption being that if these items presented no problem for first grade children in texts, even kindergarten children would have control of them in simple sentences. The materials consisted of 36 sentences:² 12 implicative sentences and 24 factive sentences. The 12 implicative sentences consisted of the three verbs with two different subordinate clauses, with each one of these six sentences having a positive and negative version. The 24 factive sentences are divided into 3 groups. One group of 12, I will call major factives, the second group of 6 I call minor factive sentences, and the final group of 6, filler factives. The major factive sentences consisted of the 3 factive predicates with two different subordinate clauses. Each of these 6 sentences had a positive and negative version. Thus there were 12 of them. The minor factive sentences were the 6 factive sentences with a positive matrix and a negative subordinate clause. The 6 filler factives consisted of the 3 factive predicates with a new set of predicate complements.

Design

The sentences were presented to the child in the following format: 'If Jane knows that Flap ate the cake, did Flap eat the

cake?' The child answers Yes or No. The implicative and factive sentences were presented in separate sessions to the child on different days. Half of the children had the implicative sentences first, half the factives first. Each child had 6 training items before each task. A random sequence of the implicative and factive sentences were drawn up. It and its reverse were presented to approximately the same number of children in each grade.

RESULTS

The comparison of children's responses to the implicative and factive sentences supports the hypothesis that children gain control over the relevant semantic properties on a systematic basis as determined by predicate class membership. We will consider the results from the implicative sentences first. Out of a total of 768 items, there are 95 errors, or 12% of the responses were incorrect. More important, 36% of the children made no errors at all and 78% of the children had two or fewer errors as we can see from Table I.

Table I

No. of errors	0	1	2	3	4	5	6
% of children making no more than x errors	36	55	77	91	97	97	100

Cumulative Implicative Error Distribution

I will refer to children who make 2 or less errors as children who have control over the implicative relation that is being tested. There appears to be some difference in ability between grade as presented in Table II but this is not statistically significant ($\chi^2=2.6689$, $df=2$).

Table II

	K	1	2
Children with 0-2 errors	15	17	17
Children with 3+ errors	8	3	4

Grade by Error Group Comparison of Implicative Sentences

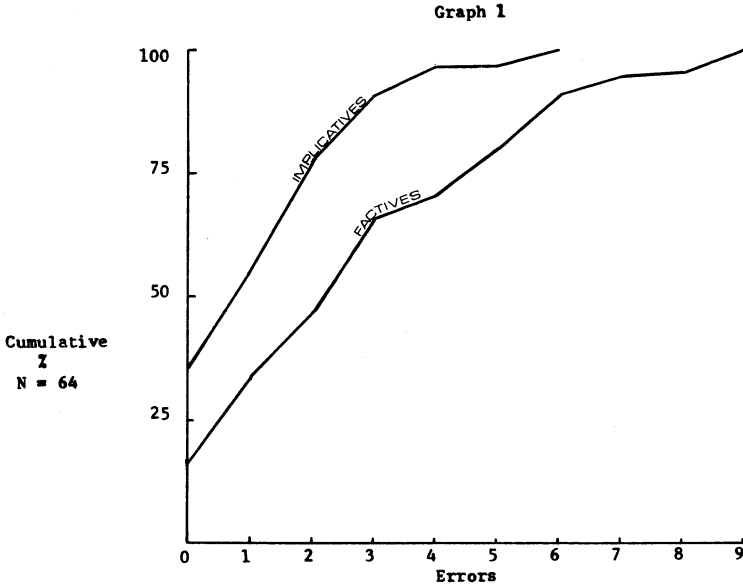
Turning to the results from the factive sentences, let us consider the major factive group first. Out of a total of 768 items there were 198 errors or 26% of the responses were incorrect. Sixteen percent of the children made no errors at all and 47% had two or fewer errors.

Table III

No. of errors	0	1	2	3	4	5	6	7	8	9
% of children making no more than x errors	16	33	47	66	70	80	91	94	95	100

Cumulative Major Factive Error Distribution

As with implicatives I refer to children who make two or less errors as children who have control over the factive relation that is being tested. Graph I compares the childrens' performance on implicative and major factive sentences. We see that for any maximum error level, up to the implicative ceiling of 6, the implicatives include a greater percent of children than the factives.



Cumulative Percentage Distribution of Errors

It is clear that as a group children do much better on the implicative sentences than on the major factive sentences. This difference cannot be attributed to one particular factive verb being unusually difficult, since no pair of implicative sentences has more errors than any factive pair. The number of errors for each of the implicative pairs are 24, 32, and 39. The errors for each of the factive pairs are 61, 65, and 69. As for the factive competence distribution by grade, it appears that there is even less of a between grade difference for the factive sentences than with the implicative sentences ($\chi^2=0.4237$, $df=2$).

Table IV

	K	1	2
Children with 0-2 errors	12	9	9
Children with 3+ errors	11	11	12

Grade by Error Group Comparison of Factive Sentences

Turning to the minor factive sentences, out of a total of 384 items there were 175 errors or 46% of the responses were incorrect. Only 11% of the children make no errors and only 22% make zero or one error. Recall that there are only 6 items in this group. Table V presents the cumulative percentage breakdown for minor factives.

Table V

No. of errors	0	1	2	3	4	5	6
% of children making no more than x errors out of maximum possible 6 errors	11	22	39	69	89	97	100

Cumulative Minor Factive Error Distribution

It is clear that the children's performance on minor factive sentences is much worse than either implicative or major factive sentences. Let us now consider the filler factive sentences. Out of a total of 384 items there were 57 errors or 15% of the responses were incorrect. Fifty percent of the children made no errors and 77% made zero or 1 error. Only eight children had three or more errors. Recall that there are only 6 items in this group. Table VI presents the cumulative percentage breakdown for filler factives.

Table VI

No. of errors	0	1	2	3	4
% of children making no more than x errors out of 6 possible errors.	50	77	87	97	100

Cumulative Filler Factive Distribution

As we can see from Table VII, these are relatively easy, as compared to the major and minor factives.

Table VII

	<u>% of incorrect responses</u>
Implicatives	13
Major Factives	26
Minor Factives	46
Filler Factives	15

Comparison of % Incorrect Responses for the Four Sentence Classes

DISCUSSION

The basic results of this study support the hypothesis that in regards to sentential negation, children acquire systematic knowledge about the semantic properties of classes of predicates. It also seems to be the case that children through grades K to 2 have better control of the semantics of implicative sentences

than factive sentences. However, neither the data for implicative sentences nor factive sentences demonstrate a significant increase in comprehension on the part of the older children. This is curious since one would normally expect at least a rough correlation between increased proficiency and higher grade level.

I will attempt to account for this apparent absence of learning through a more detailed investigation of the implicative and factive data. First the implicative sentences. There is some difference between the kindergarten and higher grade children (Table II) but this difference is not statistically significant. This difference shows up again in the percent of correct responses for each grade: K=65%, 1st=85%, 2nd=81%. A more interesting difference between kindergarten and the other grades occurs within the distribution of errors for positive and negative sentences with children who make three or more errors.

		Positive sentence errors	Negative sentence errors
	K	7	19
Grade	1	6	8
N=15	2	8	7

Grade by implicative sentence error distribution (children making 3 or more errors).

Even though these differences do not reach statistical significance ($\chi^2=2.9848$, $df=2$) they suggest that older children who have difficulty with the implicative sentences, do so on a random basis, in contrast to the kindergarten children who have much more difficulty with the negated implicative sentences. An analysis by child of the kindergarten group reveals that 12 of the negated sentence errors are made by four children who have no errors for the positive sentences and three errors with the negated sentences. None of the first and second graders demonstrate such a pattern, i.e., zero errors on the positive sentences and a high number of errors with the negated sentences. This suggests that an early approach for responding to implicative sentences is to adopt a strong YES strategy under which the response to a positive sentence is 'yes' and the response to a negative sentence also tends to be 'yes'. If these four children are removed from this group, the remaining three kindergarten children make a total of seven errors with the positive sentences and seven errors with the negated sentences. Thus we find the random pattern of errors that characterize the first and second grade children. What I am suggesting is that children develop through the following sequences in their responses to implicative sentences: first, a strong YES strategy which may be somewhat influenced by the value of the sentence; second, partial control over the semantics of implicative sentences with a random YES/NO response strategy when they are not sure of the meaning of the sentence; third, response on the basis of the meaning of the sentence. Under this hypothesis

the absence of a strong between grade difference is explained by the following factors 1) the first stage in this sequence takes place before kindergarten for most children, 2) some children may be in the second stage at least as late as second grade.

The across grade pattern for the major factive sentences is even more curious than that of the implicative sentences. There is a slight indication of increased difficulty in the higher grades (Table IV). This is consistent with the percent of incorrect responses by grade: K=25%, 1st=25%, 2nd=27%. A partial explanation for this phenomenon may lie in the positive/negative sentence error distribution with children who make three or more errors. Even though it is not statistically significant ($\chi^2=1.6497$, $df=2$) the higher grade children make more errors on the negative sentences than the kindergarten children.

		Positive sentence errors	Negative sentence errors
Grade	K	24	29
	1	24	31
	2	21	40

Grade by major factive sentence error distribution. N=34
(children who make 3 or more errors)

This difference is clearer in Table X where it is presented in terms of percentage of error with positive and negative sentences.

		Percent of positive sentence errors	Percent of negative sentence errors
Grade	K	45%	55%
	1	44%	56%
	2	34%	66%

In contrast to Table X, we would have expected that the negative sentences would be more difficult for the kindergarten children than for the second graders. An explanation for this may be that some kindergarten children are utilizing a YES strategy which tends to ignore the value of the sentence. This would result in many correct responses to the negative factive sentences. The second graders could be taking more into account the value of the sentence and therefore giving a higher proportion of incorrect responses to the negative sentences. These strategy differences would make it appear like there is no learning among the older children. What may be happening is that there are three stages in acquiring control over the major factive sentences: first, a YES strategy which is sometimes influenced by the value of the sentence; second, a response strategy largely influenced by the value of the sentence (similar to the implicative strategy); third, response in terms of the semantics of the sentence.

Even if the above set of hypotheses in regards to strategy differences for implicative and factive sentences are correct, they do not in themselves provide a basis for explaining why over half the second graders have difficulty with the major factive sentences. The answer to this problem may lie in the general semantics of implicative and factive sentences. The activity of an implicative root verb or predicate directly effects the activity expressed by the subordinate clause. The relation between the implicative verb and subordinate clause is not accidental or peripheral, but causal. On the other hand, in factive sentences there is no such necessary effect between the activity or state of the factive predicate and the activity expressed in the subordinate clause. These two activities are independent.³ The child must establish through his understanding of the semantics of factive predicates the necessary presuppositions that hold between the main predicate and subordinate clause. This would appear to be a more difficult relation to master than the causal - like relation that holds between implicative verbs and their subordinate clauses. It would then follow that the older children continue to have difficulty with major factive sentences in part because they have not yet mastered the general semantics of factive predicates.

A crucial hypothesis which evolves out of the above discussion is the claim that children gain control over implicative sentences before major factive sentences. Do the data support this hypothesis? That is, are the children who do well on the major factive sentences a subset of the children who do well on the implicative sentences? There are 49 children who make two or less errors on the implicative sentences. There are 30 children who make two or less errors on the major factives sentences. These two sets have 23 children in common. This means that there are 7 children who appear to understand the factive relation but not the implicative relation and 8 children who seem to understand neither. This distribution is presented in Table XI

		Table XI Factives	
		+	-
Implicatives	+	23	26
	-	7	8

Four way assignment of children to apparent comprehension states

The differences between these frequencies do not reach significance ($\chi^2=0.0045$, $df=1$). However, before we reject the hypothesis that children who understand the factive relation necessarily understand the implicative relation, it is worth undertaking a detailed examination of the responses of some of the children who make up this 7 member cell. Recall that the filler factive sentences proved to be quite easy for a majority of the children and that only 8 out of the 64 children tested made 3 or

more errors on these sentences. Five of these 8 children are in this crucial 7 member cell. The unique feature of the filler factive sentences is that the correct response to these sentences is "no" even though they contain no negative element. One hypothesis which would account for the performance of these 5 children on the filler factive sentences is that when unsure about how to respond to a question they function under a strong YES bias. If this hypothesis is correct, it would also account for the apparent understanding that these children show in their responses to the major factive sentences. The correct response to both the positive and negative major factive sentences is "yes". Therefore, their apparent comprehension of the major factive sentences may only be a function of the strong YES strategy which they employ.

Further support for this hypothesis comes from the fact that 3 out of these 5 children are the kindergarteners discussed earlier who seem to be using a YES strategy with the implicative sentences. They made three errors with the negated implicative sentences, but had no errors with the positive sentences. Thus they may be using the same strategy for both implicative and factive sentences. The remaining two children from this group of five are one first grader and one second grader. The first grader's 12 responses to the major factive sentences are all correct; but his six responses to the minor factive sentences were incorrect. That is, he consistently answered "yes" to these 18 sentences. This suggests that he may be utilizing a strong "yes" response bias for factive sentences. The second graders responses are not quite as uniform. He has only five incorrect responses to the minor factive sentences and an incorrect positive sentence response and an incorrect negative sentence response for the major factive sentences. This response pattern is also consistent with a strong "yes" response bias. If it is the case that at least four or five of the seven children who seem to understand major factive sentences before implicative sentences do so only because they utilize a strong "yes" response strategy, then these children do not constitute counter examples to the crucial acquisition order hypothesis. The remaining two or three children who are not consistent with this hypothesis are not sufficient grounds for necessarily rejecting it. Sixty one out of the 64 children fit the order acquisition hypothesis. There may be a satisfactory explanation for the two or three exceptions.

An unexpected result of this study is the fact that nearly all children have a great deal of difficulty with factive sentences that contain a negative subordinate clause. This raises the question of whether this phenomenon extends to sentences utilizing other classes of matrix verbs and other types of complex sentences. The childrens' performance with the sentences which I have called filler factives indicates that it is not the case that they ignore some of the content in the complement clause. One explanation for the children who know both major factives and

implicatives is that they have the strategy of processing negation in the complement as if its scope includes the matrix verb. However it is not possible to explore this hypothesis here.

MATERIALS

Implicative Sentences

Mike let Flap go in the house. Did Flap go in the house?
 Mike did not let Flap go in the house. Did Flap go in the house?
 Mike let Flap get the ball. Did Flap get the ball?
 Mike did not let Flap get the ball. Did Flap get the ball?
 Flap got the cat to run away. Did the cat run away?
 Flap did not get the cat to run away. Did the cat run away?
 Jane got Flap to sit up. Did Flap sit up?
 Jane did not get flap to sit up. Did Flap sit up?
 Mike was careful to color inside the lines. Did Mike color outside the lines?
 Mike was not careful to color inside the lines. Did Mike color outside the lines?
 Mike was careful to put the cup on the saucer. Was the cup on the saucer?
 Mike was not careful to put the cup in the saucer. Was the cup in the saucer?

Major Factive Sentences

Jane found out that Flap ate the cake. Did Flap eat the cake?
 Jane found out that Flap took the shoe. Did Flap take the shoe?
 Mike is happy that Jane broke the piggy bank. Is the piggy bank broken?
 Mike is happy that Jane threw the ball. Did Jane throw the ball?
 Jane knows that Mike took the doll. Did Mike take the doll?
 Jane knows that Flap buried the ball. Is the ball buried?

Minor Factive Sentences

Jane found out that Flap did not eat the cake. Did Flap eat the cake?
 Jane found out that Flap did not take the shoe. Did Flap take the shoe?
 Mike is happy that Jane did not break the piggy bank. Is the piggy bank broken?
 Mike is happy that Jane did not throw the ball. Did Jane throw the ball?
 Jane knows that Mike did not take the doll. Did Mike take the doll?
 Jane knows that Flap did not bury the ball. Is the ball buried?

Filler Factive Sentences

Jane found out that Flap ate her cookie. Does Jane have the cookie?
 Jane found out that the bird fell out of its nest. Is the bird in its nest?
 Mike is happy that Flap dropped the bone. Does Flap have the bone?
 Mike is happy that Jane hit the ball. Did Jane miss the ball?

Mike knows that Jane closed the door. Is the door open?
 Jane knows that Mike lost his money. Does Mike have his money?

Practice Sentences

Mike gives a bone to Flap. Does Flap have the bone?
 Mike does not give the bone to Flap. Does Flap have the bone?
 Mike sees the turtle. Does Mike know where the turtle is?
 Mike did not see the turtle. Does Mike know where the turtle is?
 Jane saw Mike shut the window. Is the window open?
 Mike heard Flap bark at the cat. Did Flap bark?

FOOTNOTES

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¹In kindergarten there were 12 females, 11 males; in first grade 9 females, 11 males; in second grade 10 females, 11 males.

²A partial list of these sentences is included at the end of the text.

³This seems to be the semantic basis for the claim that factive predicates presuppose their complements, but implicative verbs entail their complements.

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