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Young children's difficulty with adjectives modifying nouns[*]

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ABSTRACT

In two experiments we tested the hypothesis that children have a basic problem in mastering the attributive relation. In Experiment 1, 170 Hebrew-speaking children (1;6-4;4) were tested for their comprehension of attributed nouns. The stimuli were 12 pages showing 4 pictures each in a 2-by-2 noun-adjective design, e.g., big teddy, small teddy, big leaf and small leaf. The words were highly frequent. The average correct score was only 59%. Experiment 2 checked the children's noun and adjective vocabulary. Thirty children (1;9-4;11) were tested with 12 pages containing only two pictures per page, as well as in the original 4-picture condition. The children, and in particular the lowest 1/3 of the sample, did significantly better in the 2-pictures condition. The results suggest that young children below 4 do possess basic noun and adjective vocabularies and can use them in simple discriminations, but have a considerable difficulty in interpreting the combination of noun and adjective in an attributive referential expression.

INTRODUCTION

It seems that the acquisition of adjectival attribution poses an unusually difficult developmental task for young children. The difficulty is manifested in at least two types of linguistic skills involving attributive adjectives: the production of word-combinations with an adjective modifying a noun; and the use of the syntactic framework in which a novel adjective is presented in order to infer that the adjective word refers to a property and not, for example, to a kind of object.

First, children are late in producing attributive noun-adjective word combinations in their spontaneous speech, relative to other types of word combinations. The mastery of adjectival attribution lags behind the expression of other kinds of grammatical relations such as predication and complementation, including predication with adjectives. This delay has been commented on in many discussions of children's early multiword speech. For example, Braine (1976:76) commented that his subjects' early adjective-noun combinations were not used attributively but in all probability, predicatively. He said Jonathan's attributive-like expressions such as *big stick* or *little stick* were comments on properties of indicated objects, and were used to predicate size. Formally, they were equivalent to sentences, and did not create noun-phrases consisting of modified nouns. He suggested that for utterances like *hurt plane* or *old stick* the best paraphrase is with a copular sentence: `the plane is hurt', `the stick is old'.

Similarly, Tomasello (1992) reported that his subject Travis did not incorporate modified nouns into her initial three-word combinations, and that there were virtually no adjective-modified nouns in her longer utterances for a considerable period. This was rather surprising as Travis did produce adjective-noun combinations in her two-word stage. However, a close inspection of the relevant utterances in the corpus revealed that in all probability these expressed a relation of predication by the adjective and not a relation of modification. For example, the sentence *Good beer*, said on her stealing a sip from a bottle at 1;7.04, seems much more likely to be a claim that the beer was good or tasty than a claim that the beer she sipped was of a good rather than a bad kind. In fact, none of Travis' two-word combinations with an adjective, whether pre- or post-nominal, functioned contrastively, to refer to a

specified alternative out of two or more possible referents for the common noun.

Evidence for the developmental lag of attribution also comes from two studies explicitly dealing with this subject, in which children's spontaneous productions with adjectives were classified into predicative and attributive uses. Nelson (1976) found that adjectives in the speech of 24-30 month-olds were mostly predications. She based the classification into predicative vs. attributative adjectives mainly on the placement of the adjective relative to the noun -- i.e., postnominal placement was classified as predicative. In addition, she classified adjectives appearing by themselves as single-word utterances as predicative. Children in the early stages of generating word combinations, with an MLU of 1.0-2.5, produced mostly predicative utterances; attributative uses increased in frequency as MLU increased. In the more advanced group (MLU 2.5 - 4.5) their frequency rose to about 60%. Nelson summarizes (1976: 28-29) that at first, adjectives are used to comment on transient states of objects, not as a mode of classification.

In a second study (Hasman, 1995; Ninio, 1995) the focus was on children's multiword utterances and single-word uses of adjectives were not included in the analysis. The spontaneous speech of Hebrew-speaking children was examined for the use of adjectives. The speech corpora were collected in a staggered longitudinal study of the acquisition of Hebrew (Ninio, 1984) in which 24 children were observed once every two months, third of the sample each between the ages of 1;0-1;10, 1;6-2;4 and 1;10-2;8. There were no modified nouns in the children's spontaneous speech before 1;10, and in fact 8 of the children never produced a single utterance of the relevant kind before the observations ended. By contrast, the earliest age at which predicative uses of adjectives were observed was 1;6, and the majority produced their first exemplar at 1;10 or before. Predicative uses of adjectives emerged significantly earlier than attributative uses (in 15 of 16 children, $p<0.001$ by binomial sign test). In addition, by the time the first exemplar of attributive uses of adjectives appeared, all the children had already produced multiword combinations involving other kinds of predicate words, and it is clear that attributive word-combinations lagged behind predication and valency-complementation in children's spontaneous productions.

The second kind of evidence for young children's difficulties with adjectives in general and

the syntax of attribution in particular comes from experimental studies in which children are presented with novel words (nonce words or rare words) in syntactic frames appropriate either for nouns or for adjectives, and they are tested for their success in inferring the category membership of the novel word on the basis of the syntactic clues. For example, Smith, Jones & Landau (1992) showed two groups of 3-year-old children an unfamiliar geometrical object coated with random spatters of red, green, blue and white paint, and introduced it by a sentence using a nonce word (e.g. *dax)* either as a noun (*This is a dax*) or as an adjective (*This is a dax one*). Subsequently, the children were presented with a set of 5 other objects, 4 of which differed from the target either in shape or color, and they were asked for each test item in the Noun condition, *Is this a dax*? or, in the Adjective condition, *Is this a dax one?*. Success in correctly inferring the form class of the novel word was measured by the children extending it to same-shaped, differently colored test objects in the Noun condition and to same-colored, differently shaped test objects in the Adjective condition. Namely, the sentence-frame *This is a dax one* was supposed to lead children to infer that the nonce-word *dax* refers to a property and not, for example, to a kind of object.

In this study, children indeed treated nonce-nouns and nonce-adjectives differently. When interpreting novel nouns, they systematically attended to shape. With novel adjectives, interpretation was chaotic. Smith *et al*. (1992: 279) summarize that 3-year-olds "disagree considerably about the potential meaning of a novel adjective", some extending them by shape, some by coloration, some by overall similarity and so forth. There was less extension of words presented as adjectives by shape, to similar objects, than for words presented as common nouns, showing that children have some feeling these words are not nouns; however, there does not seem to be a clear understanding on their part that the words necessarily refer to a property.

In some other studies of the same general paradigm (Au & Markman, 1987; Heibeck & Markman, 1987; Markman & Wachtel, 1988), 2-, 3- and even 4-year old children made no use of the attributive syntactic frame in which novel adjectives were introduced, in extending their use to novel referents. Instead, novel adjectives were given object interpretations as if they were count-nouns. Such shape-bias for novel adjectives was found also by Hall,

Waxman & Hurwitz (1993) for 2-year olds, and for 4-year-olds presented with unfamiliar objects (e.g., tongs, napkin ring, garlic press, etc). When, however, 4-year-olds were presented with familiar objects (plate, cup, spoon, hat, basket, etc), they differentiated between a word introduced as a noun vs. as an adjective: in the latter condition, they chose not by shape but by property. There was no such familiarity effect on 2-year-olds; they chose by shape in all conditions, making no use of the syntactic frame in which the words were presented. Hall *et al*. (1993: 1663) interpret their findings as showing that young children have a basic shape-bias for novel words, and older children also a mutual exclusivity bias, bringing them to reject the object-interpretation if they already possess a word for the relevant objects. The results imply that young children might rely on shape and mutual-exclusivity biases in interpreting new words, and that they may not be willing or able to make use of the syntactic frames in which they had heard the words presented, if these involve attribution.

Another batch of studies demonstrate that children initially interpret novel adjectives as marking properties of objects within a familiar basic-level object category, and only later extend them across different basic-level object categories (Taylor & Gelman, 1988; Waxman, 1990; Waxman & Markow, 1998; Klibanoff & Waxman, 1999; Klibanoff & Waxman, 2000). For example, Waxman & Markow (1998) showed that 21-month-old infants successfully extend novel adjectives from one object to another if and only if they are all drawn from the same basic category, but not if drawn from different ones. In this study, rare adjective words like `citron' for yellow were used, instead of the nonce-words employed in the other studies. Children did not succeed to extend the novel adjectives when the target and the test objects differed in their basic category, such as finding "*another citron one*" when the word was initially introduced for a yellow spoon and was to be extended to a yellow key, choosing between it and a green key. They only succeeded when the test objects belonged to the same basic category as the target object, as in the condition when the same word *citron* was introduced by a yellow car, and in the test situation the child had to chose between a (different) yellow car and a green car as being "*another citron one*". In the different-category condition, they chose randomly between the two alternative test objects. Similar results were achieved in the other studies for 3-year-old children, while 4-year-olds appear to have mostly

outgrown the same-category requirement (e.g., Klibanoff & Waxman, 2000).

In a recent study by Klibanoff (2001) it was found that having a common category label for the target and the test items brings about more consistent property-based choices for novel adjectives in 3-year-olds. This was true for perceptually dissimilar items which were called by their shared basic-level category label (e.g., `hats'), showing that the possession of a shared label might be one of the reasons for the success of the within-basic-category property interpretation of adjectives. In addition, the label-effect was also found for category-labels which named not basic-level but superordinate shared categories, such as *tools* for saws and hammers. In control conditions when the same objects were called either by their basic-level (and hence different) names, or no nouns were used to label them, children performed at chance level. Apparently, the preparatory step in which all objects, target and test, were called by the same name (e.g., *Look at all of these tools!*), replicates some crucial factor that enables children to make property-based choices for novel adjectives in the simplex case when the target and test objects are identical but for the contrastive attribute in one of the test objects (as for example in Klibanoff & Waxman, 1999). As the shared superordinate label obviously does not change the degree of perceptual similarity among the objects, it seems that labeling all the objects by the same name provides an implicit instruction to the children to ignore the OBJECTS and concentrate on the PROPERTIES when choosing the test object which is (more) similar to the target object. This turns the situation, functionally, into an analogue of the simplex case when all the objects are identical.

Why is attribution complicated?

The results reviewed above suggest that young children may have a basic difficulty interpreting attributive adjective-noun combinations.

The question to ask is, why would the attributive adjective-noun relation be especially difficult in acquisition? The answer, in all probability, is to be found in its complicated logical structure. It has been pointed out by Montague (1974: 211-213) and others that attribution is not an intersection function but rather, consists of the definition of a subset within the set defined by the common noun. An attributive adjective (with a few exceptions) generates a subkind of the referents of the noun. If we translate logical linguistics to

psycholinguistic processing, it follows that the meaning of a referential expression consisting of an attributed noun is to be computed in two stages: First, the noun is to be interpreted, creating a category of kinds of objects; then, the adjective is to interpreted relative to the noun, creating a subset of the object category, consisting of such objects that also possess the property designated by the adjective. It is possible that the integration of information involved in the generation of a subset is the source of the difficulty children experience when faced with adjectival modification.

The hypothesis of the study to be tested in the present experiment

It is the hypothesis of this study that the cognitive processing involved in interpreting an attributed noun poses a serious difficulty for young children, and especially below the age of 4. Under this hypothesis, it is expected that children younger than 4 will do poorly in a comprehension experiment in which they have to interpret adjective-noun pairs, even if the nouns and the adjectives are familiar and ordinary.

The goal of Experiment 1 was to answer the question, are children bad at interpreting attributive adjective-noun combinations because they have a problem with the components (nouns, adjectives) or -- as the hypothesis claims -- because they have a problem with their integration (i.e., the syntax and semantics of attribution)? We presented children with color photographs of extremely familiar everyday objects with varying natural attributes. We described one of the pictures in an adjective-noun combination using extremely familiar nouns and adjectives. The task of the child was to chose the picture described, from among four alternatives.

The strategy was to make the task as easy as possible in order to eliminate, a priori, as many as possible of the alternative explanations to a basic syntactic difficulty. To reduce the possibility that the problem is lexical, we used not nonce words or rare adjectives and nouns, but, rather, extremely familiar ones. In addition, all the depicted object-attribute combinations were natural ones (white and black shoes, long and short dresses and the like) and not arbitrary ones like rough hats, spotted purple snakes, yellow spoons and so forth. In addition, the syntax of attribution used was the easiest one possible, involving a definite common noun with a prenominal adjective, and not like the awkward formats used in many

of the syntactic-bootstrapping experiments: we asked the children to point out "*the big teddy*" and not "*another dax one*"; or "*another tool that is blickish*"; nor did we introduce objects as "*a very blickish one*", etc. Lastly, the task was straightforward identification of a verbally specified picture, rather that finding one similar to a previous one. If in these circumstances the children fail to chose the correct referent, it will be difficult to blame the odd attributes, the ambiguous syntactic frames or the unfamiliar vocabulary of the experiment.

EXPERIMENT 1

METHOD

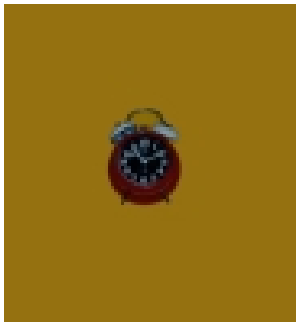
Subjects

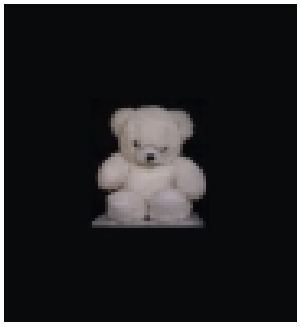
In Experiment 1, 170 Hebrew-speaking children (1;6-4;4) were tested for their comprehension of attributed nouns. The children were recruited in the most part through kindergartens and other daycare establishments, both urban and rural. Parents completed a short demographic questionnaire describing the child's gender, birth date, birth order and number of siblings; the languages besides Hebrew spoken at home, as well as the parents' level of education. The first 70 children (reported in Ninio, 1995) were between 1;7-4;4, half of them male, half female. The other 100 (51 male, 49 female) fell into 5 age-groups (1;6-1;11; 2;0-2;5, 2;6-2;11, 3;0-3;5, 3;6-4;0), 20 per group, with an approximately equal number of males and females. The mean age of the children in the complete sample was 2;8 (*S.D.* 8.3 months). The sample was heterogenous with respect to children's number of siblings and birth orders and the parents' educational level.

The procedure and stimulus materials were pretested on 12 children, 1;8-3;7, of the same background as the actual sample.

Stimuli

The stimuli were 12 big cardboard pages (28cm X 38.5cm) showing a square array of 4 color photographs (10cm X 15cm) each, in a 2-by-2 design of two objects crossed with two attributes, e.g., a big teddy, a small teddy, a big clock and a small clock. The placement of the pictures in the square was randomized.



Children were asked to point to one of the pictures, referred to by an adjective-noun combination such as `Show me the big teddy'. Table 1 presents the stimulus nouns and adjectives used. All the nouns and adjectives were highly familiar. They were culled from the words most frequently produced in early Hebrew mother-child conversations, as observed in naturalistic home observations (Ninio, 1984).

TABLE 1. *Stimulus nouns and adjectives used in the 4-picture comprehension experiment*

	Nouns		Attributes	
	Hebrew	Gloss	Hebrew	Gloss
1	*naal, gerev*	shoe, sock	*levana, shora*	white, black
2	*yeled, lecan*	boy, clown	*sameax, acuv*	happy, sad
3	*regel, naal*	foot, shoe	*nekiya, meluchlechet*	clean, dirty
4	*dubi, shaon*	teddy, clock	*katan, gadol*	small, big
5	*ima, yalda*	mommy, girl	*era, yeshena*	awake, asleep
6	*sukariya, kubiya*	candy, block	*aduma, khula*	red, blue
7	*yalda, buba*	girl, doll	*aruma, levusha*	naked, dressed
8	*kapit, simla*	spoon, dress	*kcara, aruka*	short, long
9	*tapuax, avatiax*	apple, watermelon	*shalem, hatuch*	whole, cut
10	*bakbuk, sal*	bottle, basket	*male, rek*	full, empty
11	*iparon, makel*	pencil, stick	*kacar, aroch*	short, long
12	*limon, ale*	lemon, leaf	*yarok, cahov*	green, yellow

PROCEDURE

The experiment was conducted in individual sessions. The experimenter and child sat facing each other at a table. The experimenter placed the cardboard pages one by one before the child so that the photographs were oriented at the child, and asked the child to point to one of the pictures, using the Hebrew version of the format `Show me the AN', e.g., `Show me the big teddy' or a

where-question, e.g., `Where is the big teddy?'

The questions were randomized with respect to the pictures, so that for a particular stimulus page, a quarter of the sample was asked to point out each of the four alternative pictures. In addition, the order of the pages was randomized, and two different orders were used, each for half of the sample. In total, there were 8 different design conditions differing by page order and the pictures asked about, to which the sample was randomly allocated.

The experimenter recorded children's choices of picture and any non-trivial utterance. Children were not given feedback on the correctness of their choices. Spontaneous corrections were recorded but not commented on. There was no time pressure on the children and a particular cardboard page was removed and a new one placed before the child when it was clear that the child finished dealing with the old page. If a child did not respond, the experimenter asked the same question again, not varying the wording of the request. A few children refused to complete the test, and they were not included in the sample. Children who did not answer some of the questions after attending to the relevant pictures but who then continued to cooperate on the test were included in the sample, with their unanswered questions counted as failures. In the whole sample, there were a total of 6 unanswered questions.

RESULTS AND DISCUSSION

Success rate

The average correct score was 7.08 out of a possible 12, namely, 59.0% (*S.D.* 21.1). Checking the individual results, it appeared that the vast majority of the children failed at one or more of the 12 items of the comprehension task. Only 10 children of the 170 tested got a perfect score of 12. Their ages were between 3;0-4;4, mean 3;8 (*S.D.* 5.3 months). There were 48 children in the sample who were 3:0 or older; this means that even at this older age range only about a fifth of the children managed to achieve a perfect score.

The correct score had a significant correlation with age ($r = 0.58$, $p < 0.01$). The correlation, although significant, is not a very good predictor of the success of individual children as it explains only 34% of the variance in the scores.

Analysis of the errors on the task

The next set of analyses were aimed at explicating why the children erred in the comprehension

task. The first analysis is of the errors children committed. The 4-picture task is built so that one distractor (or incorrect alternative) shows the same object as the correct picture but with a different attribute; the second distractor shows a different object but with the asked-for attribute; the last distractor shows a different object with a different attribute. The analysis thus can reveal if the children's erroneous responses nevertheless satisfy the identity of the object asked for, the identity of the attribute, or neither. Table 2 presents the distribution of responses in the sample.

TABLE 2. *Distribution of responses in the 4-picture comprehension experiment (n=170)*

Response	Mean # (SD)	Mean % (SD)	Percent of all errors
Correct noun and correct adjective	7.1 (2.5)	59.0 (21.1)	
Errors:			
Correct noun and wrong adjective	2.8 (1.9)	23.0 (15.6)	56.2
Wrong noun and correct adjective	1.2 (1.1)	10.4 (9.1)	25.3
Wrong noun and wrong adjective	0.9 (1.0)	7.6 (8.8)	18.5
Total	12		

Table 2 shows that the most frequent error was pointing to the picture that showed the same object as the experimenter asked for, but which had a different attribute (56.2% of all errors on the average). The mirror-image error in which the attribute requested was correct, but the object was wrong, was much less frequently made (25.3% of all errors). In fact, the latter response was barely more frequent than the choice of the all-wrong distractor which was correct neither on the object nor the attribute (18.5% of all errors).

In order to explore more closely the relation between the different kinds of errors and the rate of success, we plotted the average number of different errors as a function of the number of correct choices out of 12. Figure 1 presents the results.

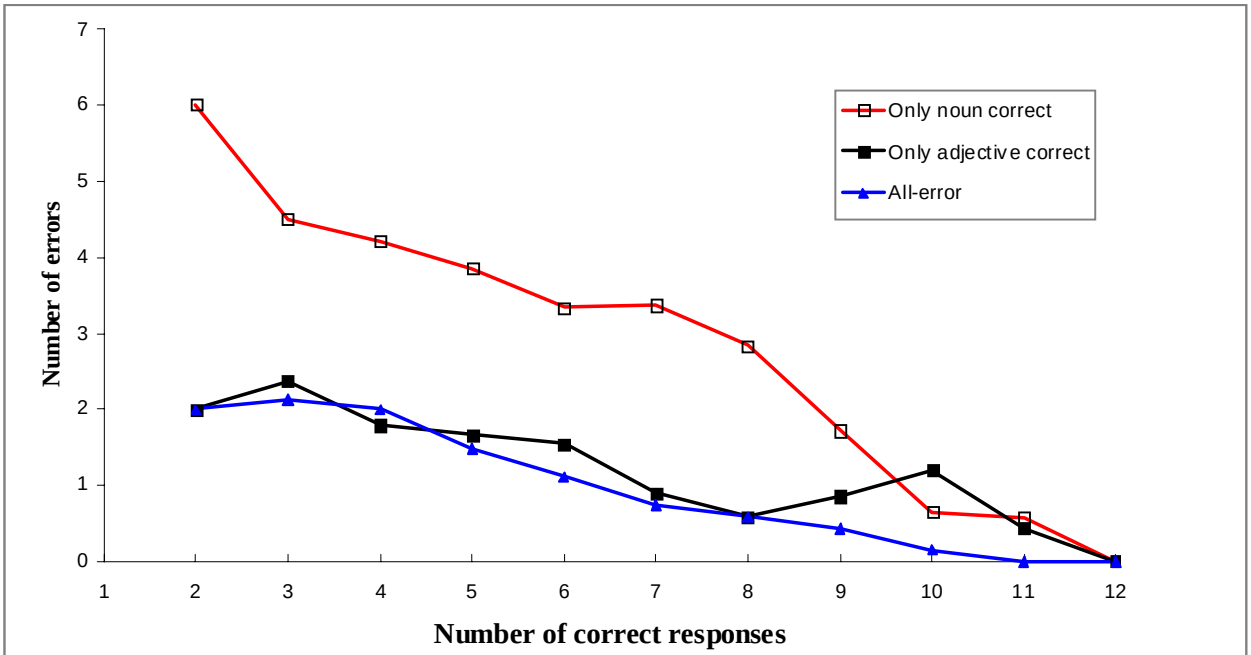


Fig. 1. Errors as function of number of correct responses

Throughout the scale and with one small exception in the higher scores' range, the tendency to pick the picture with the correct attribute but the incorrect object was not higher on the average than the tendency to pick the completely incorrect distractor. These alternatives each accounted for 2 answers or less (out of 12), the tendency to chose them decreasing slowly to zero as the correct score increases from 2 to 12. By contrast, the tendency to pick the distractor in which the correct object was depicted but with the wrong attribute, accounted for a full half of the answers in the weak end of the developmental scale, decreasing linearly towards the all-correct end of the scale. It is evident that a higher number of correct answers is strongly associated with a lower number of incorrect answers of the correct-object-only type. This possibility will be followed up in the next section.

Using adjective information vs. noun-information in the choice of pictures

The frequent choice of pictures showing the correct object but with an incorrect attribute by the

less successful children in the sample raises the hypothesis that the children who do poorly in the comprehension task, do so mostly because they base their answers solely on the processing of the noun. These children seem not to pay attention to the adjective, either because they do not know the adjective, or, possibly, because they are unable to combine the adjective-information with the noun-information while picking a picture that matches the one referred to in the request.

The first way to test this hypothesis is to compare children's overall success in picking a picture showing the object referred to by the noun, with their overall success in picking a picture showing the attribute referred to by the adjective. We expect that correct-noun choices will outnumber correct-adjective choices, at all levels of task performance except for the perfect one.

For each child, we computed two new scores: a Noun score which is the percent of correct choices of the object asked about by the noun, whether or not they are also correct on the attribute; and an Adjective score, which is the percent of choices correct on the attribute asked about by the adjective, whether or not they are also correct on the object. In the whole sample, the mean percent of Noun choices was 82.0% (*S.D.* 13.9), while the mean of Adjective choices was 69.4% (*S.D.* 18.9). The difference was tested using a Wilcoxon signed ranks test and found to be highly significant ($z = -7.196$, $n = 136$, $p < 0.001$).

The mean difference in the mastery of nouns and adjectives exhibited in the children's responses was accompanied by a difference in the variance of the two scores. More precisely, there was a floor effect for the Noun scores: There were no children who picked less than 5 pictures where the object was the correct one, so the minimum was a 41.7% correct rate. By contrast, the range of Adjective scores was much larger, from a minimum of 2 pictures correct on the attributes to the maximum of 12. We might summarize that at the age range tested (1;6-4;0) children are much more successful in identifying the object referred to by a noun than picking out a property referred to by an adjective.

Second, on the hypothesis that attention to adjectives is crucial to correct performance of the comprehension task, it is expected that the proportion of Adjective choices will strongly predict the success rate. This was found to be correct: the tendency to make correct Adjective choices explained 82% of the variability in the comprehension task; the correlation coefficient was $r = 0.90$ ($p < 0.001$). By contrast, correct Noun choices explained only 45% of the variability in the

comprehension task (r =0.67, $p < 0.001$).

Figure 2 presents the average Noun and Adjective choices as a function of total correct scores.

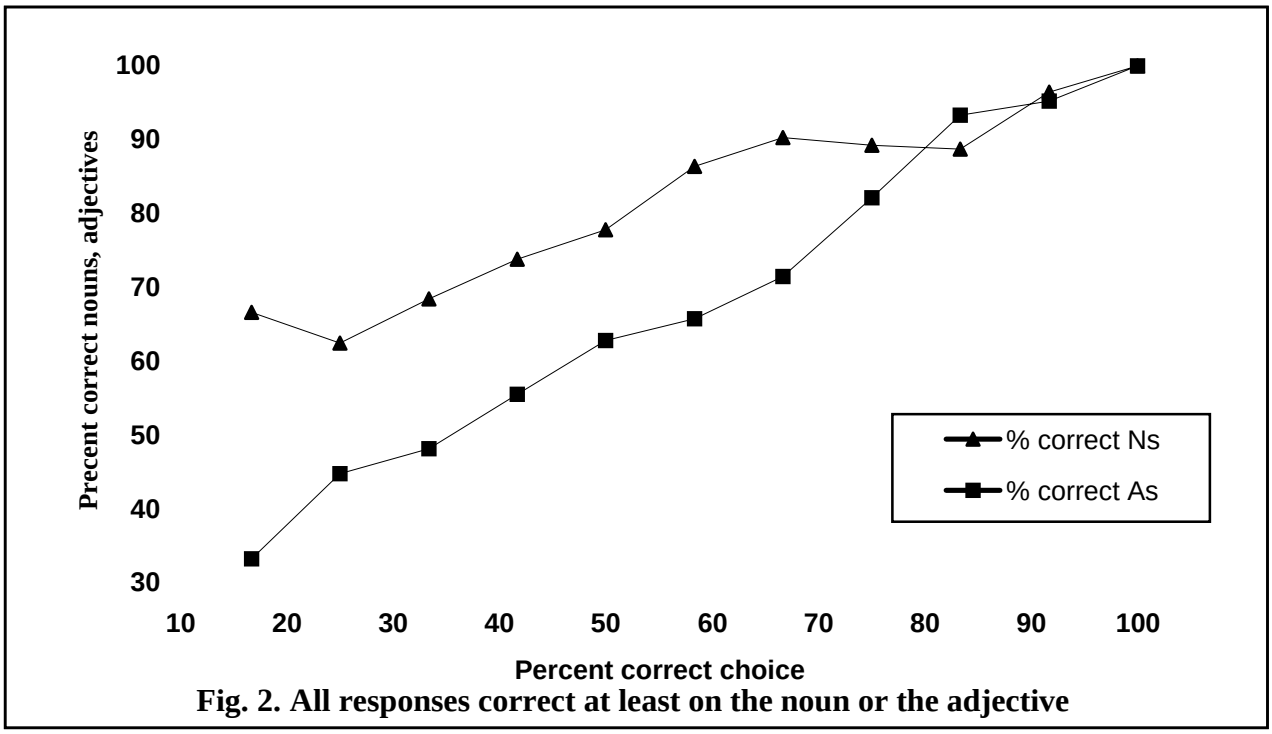


Fig. 2. All responses correct at least on the noun or the adjective

Figure 2 shows that the children with very low correct scores fail at the task not because they do very badly on the nouns but because they perform extremely badly on the adjectives. This is, of course, expected on the basis of the correlation coefficients presented above. The difference between the success rate on nouns and adjectives becomes smaller as the children succeed better on the comprehension task (r = -0.41, $p < 0.001$).

It seems that the factor restricting children's ability to answer the comprehension request correctly is their failure to identify the referent of the adjective. Indeed, the results suggest that at the start of development, initially children IGNORE the adjective and base their answers solely on the noun of the request. Increased success in the comprehension task appears mostly to be due to increased attention to the adjective-word, taking it into consideration when choosing between the correct picture and the one showing the same object but with a different attribute.

To further test this possibility, we estimated the conditional probability of choosing the correct attribute given that the child has chosen the correct object, as well as the parallel conditional

probability for correct objects. In order to make it possible to focus on the weakest performing children, we divided the sample into thirds, according to the total number of correct choices out of 12. The average success rates in the 3 thirds were 37.0%, 56.6% and 83.8%. Table 3 presents the results.

TABLE 3. *Conditional probabilities of correct attribute and correct object in three thirds of the sample in the 4-picture comprehension experiment*

Sub-sample	N	Probability of correct attribute given correct object	Probability of correct object given correct attribute
Lowest 1/3	57	0.53	0.72
Middle 1/3	57	0.68	0.86
Upper 1/3	56	0.91	0.93

In the lower 1/3 of the sample the discrimination between the correct picture and the alternative with the same object but a different attribute was RANDOM. In the same subgroup, the conditional probability of the correct object being picked given the correct attribute was higher by 20%. The difference was tested using a Wilcoxon signed ranks test and found to be highly significant (z = -5.13, n =48, $p < 0.001$). Similar results were obtained when comparing the conditional probabilities in the middle 1/3 of the sample (z = -5.46, n =51, $p < 0.001$). However, in the highest 1/3 of the sample there were no significant differences between the conditional probabilities of the adjective and the noun (z = -0.67, n =37, $p > 0.05$). These results support the possibility that poorly-performing children base their answers solely on the noun in an attributed-noun expression, ignoring the adjective. Mid-performing children increase their reliance on the adjective, but still much less than on the noun. Only the high-performing children equate their

attention to the noun and the adjective.

The analysis of spontaneous self-corrections

The results up till now suggest that development of the comprehension of attributed nouns consists of children's increasing the probability of the adjective influencing the choices of referents for the adjective-noun expression.

Further evidence for this model of development comes from analysis of children's spontaneous self-corrections. Of the 170 children of the sample, 118 changed their initial response to one or more of the questions, producing 292 self-corrections in all. Children's second and further choices were mostly an improvement on their original responses (75%), whether in terms of the object, in terms of the attribute, or in terms of both, but there was also quite a significant percentage (21%) of self-corrections which worsened the quality of the match between the question and the picture chosen. Only a few self-corrections (4%) switched between two partially correct responses. Table 4 presents the detailed data. It is worth noting that even when self-corrections are also taken into account, the percent correct score in the sample was only about 65% on the average.

TABLE 4. *Self-corrections by children in the 4-picture comprehension experiment (n=292)*

Change	Element changed	Number of corrections (%)	Number of Children
Improving the match		**219 (75.0)**	
Noun-correct to All-correct	attribute	133 (45.5)	79
Adjective-correct to All-correct	object	36 (12.3)	29
All-wrong to Noun-correct	object	12 (4.1)	11
All-wrong to Adjective-correct	attribute	18 (6.2)	17
All-wrong to All-correct	object and attribute	20 (6.8)	17
Spoiling the match		**61 (20.9)**	
All-correct to Noun-correct	attribute	39 (13.4)	35
All-correct to Adjective-correct	object	10 (3.4)	9
Noun-correct to All-wrong	object	3 (1.0)	3
Adjective-correct to All-wrong	attribute	6 (2.1)	6
All-correct to All-wrong	object and attribute	3 (1.0)	3

No change in degree of match		**12 (4.1)**	
Noun-correct to Adjective-correct	object and attribute	7 (2.4)	6
Adjective-correct to Noun-correct	object and attribute	5 (1.7)	5
TOTAL		**292**	**11**

*Number of children making at least 1 change of any kind.

Of all spontaneous self-corrections which brought about an improvement in the match of the chosen picture to the request, 178 were corrections of an error in the attribute, 73 were corrections of an error in the object, so that of a total of 251 improvements, 70.9% were related to the attribute. This is not, by itself, surprising, as the original choice of an attribute was worst than that of the object, so there were more incorrect attribute-choices to correct in the first place. However, the proportions recur when we look at the negative changes that spoiled an originally correct choice: of a total of 76 worsening changes, 53 or 69.7% were self-corrections in attribute, and only 23 in the object. Obviously, we cannot use the same frequency explanation as for positive changes, as now there were LESS originally correct attribute responses to spoil. It is more likely that the stronger tendency to change the responses with respect to the attribute, both positively and negatively, reflects a lower confidence in the correctness of the original choice based on the adjective than on the noun.

The most frequent move of self-correction, 133 or 45.5% of all changes, was to replace a response which was correct on the noun but incorrect on the attribute, with a response which was correct on the noun and also correct on the attribute. Other types of self-corrections were much less frequently made. The fact that this was the favorite self-correction is not an artefact of the high frequency of the response which was being replaced, namely, the choice of a picture only correct on the noun. This response could have been replaced by two other possible choices but very seldom was: the move from the Noun-correct to an all-wrong choice was made only 3 times, and the move to a picture which was wrong on the object but correct on the attribute, 7 times. In other words, the favorite spontaneous change of response apparently represents a voluntary and non-random self-repair process, consisting of remedying an initial error in the choice of the

adjective which the child is capable of correcting.

The mirror-image of this type of self-repair is the one in which a child initially picks a picture showing the correct attribute but with an incorrect object, then repairs the error of the object in a subsequent move. Such corrections were made in 36 cases, i.e., in 12.3% of the time. Namely, this route of arriving at a correct answer is much less often observed in the sample than the object-first, attribute-later one discussed above.

Summary

The results of Experiment 1 show that young children under 4;0 indeed have difficulties in comprehending adjective-noun attributive combinations, even when they are tested with a basic, highly frequent noun and adjective vocabulary and with color pictures showing everyday objects. The results suggest that the difficulty is specifically in the interpretation of the modification grammatical relation, namely, in the syntax, and not in the lexicon. It appears that children have a specific problem with integrating the noun-information with the attributive-adjective information.

The pattern of results supports a model of performance in which children, when faced with a referential expression consisting of an attributed noun, initially ignore the modifying adjective and concentrate on matching the noun of the question with a picture showing the referred-to object. Moreover, the self-correction results suggest that in many cases, children who base their answer solely on the noun, do possess the adjective-information necessary for a correct answer but are unable to utilize it at the same time that they generate the noun-based response. They apparently can make a correct choice based on either the noun or the adjective, but not on the two simultaneously.

Moreover, their favorite initial responses and favorite self-repairs show that they can actually perform the correct identification of the referent but only if it is done in two successive steps. Namely, they can narrow down their original choice, based on the noun, to the correct alternative, in a subsequent step in which they choose between two pictures showing the same noun-named object, on the basis of the adjective. Their difficulty, then, can be narrowed down to the need to make these two steps simultaneously and covertly, as part of a single schema of interpretation of the attributed-noun. The adjective by itself would not cause a processing difficulty, and the reason why it is so much less well represented in children's responses to the 4-picture comprehension task

is that they have a preference to base their initial answer on the noun and not on the adjective.

If this conclusion is correct, this means that children should do well in choice situations in which they are presented with attributed nouns but in which they can base their choice on the adjective alone, without having to integrate it with the noun. Such a situation occurs when the choice is among identical objects, differing only in their attributes. Under our analysis, when children are shown a big teddy and a small teddy and asked to point to the big teddy, they can safely ignore the noun of the request and concentrate on the property conveyed by the adjective. Their success rate in this situation should be much higher than the correct-rate for adjectives in the 4-picture situation, because the task allows treating the adjectives as individual referential terms and does not require them to combine the adjective with a noun in an attributive relation. In addition, the success rate in this condition should be identical to the success rate in the mirror-image condition in which two stimuli differ only on the object but not on the attribute. If we concluded in Experiment 1 that children do much better on the nouns than on the adjectives, this difference should disappear in the two-picture conditions.

These binary choices should be easy for children even if the elicitation question uses an attributed noun as before: They seem to make single-component choices anyway, ignoring the other word even when this leads to errors. Their difficulties should be manifested only in situations when the task calls for bona fide and unavoidable processing of the adjunct relation, as in the 4-picture, two-object choice task of Experiment 1. In order to test this possibility, a second experiment was carried out.

EXPERIMENT 2

The goal of Experiment 2 was to determine whether children's poor performance on Experiment 1 was indeed due to their problems with combining the adjective and noun information, or whether they were due to their not having the adjective words in their vocabulary. Under the hypothesis that their problems are syntactic and not lexical, we expected them to perform better in a simple binary choice task requiring either the identification of the noun alone (with attribute controlled) or the identification of the adjective alone (with the noun controlled). Such tasks can be performed without having to actually interpret the attributed noun expression.

In Experiment 2 we placed the children in two conditions. The first was the same situation as

in Experiment 1, requiring a choice among 4 pictures. In addition, we also presented them with a series of comprehension tests using only pairs of the original pictures, differing either on the object or on the attribute. In the two-picture condition, we used exactly the same elicitation request as in the 4-picture condition, e.g., `Show me the big teddy', so that to equate the apparent processing requirement to interpret a modified noun. However, here the processing of the adjunct relation was avoidable, so that if children indeed tended to try to solve the 4-picture comprehension experiment without it, this strategy can actually succeed in the 2-picture condition.

METHOD

Subjects

In Experiment 2, 30 Hebrew-speaking children (1;9-4;11) were tested for their comprehension of attributed nouns. The sample was similar in demographical characteristics to the earlier sample, except that the children were 4 months older on the average (M= 3;2, *S.D.* 9.8 months).

Stimuli

The stimuli were cardboard pages (28cm X 38.5cm) showing 4 or 2 color photographs each. A complete stimulus set to be presented to each child was composed of 12 pages with 4 pictures each, and 12 pages with 2 pictures each. In 6 of the latter, the two pictures showed the same object but with a differing attribute (e.g., yellow leaf, green leaf); in the other 6, the pictures showed two different objects with a shared property (e.g., yellow leaf, yellow lemon).

The 4-picture set were the 12 pages which had been used in Experiment 1. They showed 4 pictures each in a 2-object X 2-attributes design. (For details see Table 1.) The 2-picture stimuli were derived from the 4-picture set, using copies of the same photographs. 24 pages showing two pictures each were prepared, derived from the same-object and same-attribute pairs of the 4-picture pages, so that each original page generated either two pairs of same-object couples or two pairs of same-attribute couples, without using the same picture twice. For example, from the 4-picture page showing a yellow leaf, a green leaf, a yellow lemon and a green lemon, we generated two 2-picture stimulus pages differing on the attribute, one showing a yellow lemon and a green lemon, the other a yellow leaf and a green leaf. Table 5 describes the pictures used in the 4-picture condition, and the two 2-picture stimuli derived from them. For each derivation the table

gives the contrast between the derived pairs of pictures in terms of the differing adjective or the differing noun of the elicitation question. The derived picture-couples generated two sets, each used with half of the sample.

TABLE 5. *Two-picture stimuli of Experiment 2 derived from the 4-picture stimuli*

	Four-picture stimuli pages	Two-picture stimuli pages		
	Original pictures	Derived Set 1	Derived Set 2	Contrast
1	white shoe, white sock, black shoe, black sock	white shoe, black shoe	white sock, black sock	adjective
2	happy boy, happy clown, sad boy, sad clown	sad boy, sad clown	happy boy, happy clown	noun
3	clean foot, clean shoe, dirty foot, dirty shoe	clean foot, dirty foot	clean shoe, dirty shoe	adjective
4	small teddy, small clock, big teddy, big clock	small teddy, big teddy	small clock, big clock	adjective
5	wakeful mommy, wakeful girl, sleeping mommy, sleeping girl	wakeful girl, sleeping girl	wakeful mommy, sleeping mommy	adjective
6	red candy, red block, blue candy, blue block	red candy, red block	blue candy, blue block	noun
7	naked girl, naked doll, dressed girl, dressed doll	naked girl, naked doll	dressed girl, dressed doll	noun
8	short spoon, short dress, long spoon, long dress	short spoon, short dress	long spoon, long dress	noun
9	whole apple, whole watermelon, cut apple, cut watermelon	cut apple, cut watermelon	whole apple, whole watermelon	noun
10	full bottle, full basket, empty bottle, empty basket	full basket, empty basket	full bottle, empty bottle	adjective
11	short pencil, short stick, long pencil, long stick	short pencil, short stick	long pencil, long stick	noun
12	green lemon, green leaf, yellow lemon, yellow leaf	green leaf, yellow leaf	green lemon, yellow lemon	adjective

Randomization Two versions of 4-picture stimuli were prepared, and two versions each of the two 2-picture sets described in Table 5. The versions differed in the target picture asked about for

each page, as well as in the order of the pages, which was randomized for each version. The combination of one of the 4-picture versions with one of the 2-picture versions comprised a complete stimulus set. The combinations were constrained so that a child was never asked an identical question (on an identical picture) in the 4-picture and the 2-picture parts of the experiment.

Procedure

The children were tested in two conditions in a randomized order. One condition consisted of 12 pages of 4-picture stimuli, the other, 12 pages of 2-picture stimuli. The procedure was identical in all other respects to the one of Experimental 1.

Results and Discussion

Comparison with the results of Experiment 1

The children of Experiment 2 did better on the 4-picture task than the children of Experiment 1 (Experiment 2: $M = 68.9$, *S.D.* =20.9; Experiment 1: $M = 59.0$, *S.D.* =21.1). The reason is probably the older age of the second sample. As in Experiment 1, the correct score on the 4-picture task had a significant correlation with age ($r = 0.72$, $p < 0.01$). A comparison of the scores by age-group showed that the two samples are compatible in their average success rates.

The pattern of correlations predicting the 4-picture correct score was almost identical to that achieved in Experiment 1: the tendency to make correct Adjective choices correlated very highly with the scores of the comprehension task ($r = 0.92$, $p < 0.001$), while the correct Noun choices had a more moderate correlation with them ($r =0.63$, $p < 0.001$). The respective correlation coefficients in Experiment 1 were 0.90 and 0.67. The similarity in these patterns of correlations shows there is a good replication of results of the first experiment, and that in the sample of Experiment 2, as in Experiment 1, the correct interpretation of the adjectives is the crucial key to the development of the comprehension of attributed nouns.

Differences between the 4-picture and the 2-picture conditions

Table 6 presents the detailed results of Experiment 2, including the results of Wilcoxon signed ranks tests of the significance of the differences between conditions (1-tailed), and the difference between nouns and adjectives (2-tailed).

TABLE 6. *Results of Experiment 2: Percent correct responses in the two conditions and the results of Wilcoxon significance testing of differences*

Condition	Percent Correct (SD)	% Ns correct (SD)	% As correct (SD)	Difference %N-%A correct	Wilcoxon
2-picture	86.9 (10.6)	88.9 (12.6)	86.1 (15.8)	2.8 (18.6)	W=-62, N=17 $p > 0.05$, NS
4-picture	68.9 (20.9)	86.7 (11.9)	77.5 (19.8)	9.2 (19.2)	W=-72, N=24, $p < 0.05$
Difference 2pct-4pct	18.6 (15.3)	2.2 (13.3)	8.6 (14.8)		
Wilcoxon	W=-9, N=25 $p < 0.005$	W=-63.5, N=19 $p > 0.05$ NS	W=-30, N=20 $p < 0.005$		

Children did much better in the 2-picture condition than in the 4-picture one: there was a significantly higher success rate (87% vs. 69%). Only 3 children achieved a perfect 12 score on the 4-picture task. By comparison, 7 children, or about a quarter of the sample, achieved a perfect score on the 2-picture task. This result supports the hypothesis that children who make mistakes in the 4-picture comprehension task, may still be able to operate with adjectives if the task does not rely on understanding the attributive grammatical relation.

The higher success rate by itself is not conclusive evidence that there is something specifically problematic in the processing demands of the 4-picture condition to do with the computing of the attributive grammatical relation. The 4-picture condition involves a choice of one out of 4 alternatives, while the 2-picture condition requires a choice only between two alternatives. The random choice baseline is 25% in the 4-alternative condition and 50% in the 2-alternative one; this by itself can account for the higher success rate in the latter.

However, there are good reasons to discount the alternative explanation that the difference between the two conditions is in the higher chance of random success in the binary choices, or in

some other crude processing differential which is unrelated to the issue of adjectives and attribution. The pattern of results as a whole is highly supportive of the hypothesis that the 4-picture condition is difficult for children because its processing demands are qualitatively different, not just quantitatively more difficult.

First, there were significantly different results achieved with respect to the nouns and the adjectives of the experiment: There were no differences between the two conditions on the success rate of nouns while there were significant difference on the success rate of adjectives. Namely, the different demands of the two conditions selectively lowered the performance rate on the correct choice of attributes, but did not affect the rate of correct choice of objects in the 4-picture condition relative to the 2-picture one.

Second, the success rates of nouns and adjectives were significantly different in the 4-picture condition (with nouns being better), but did not differ in the 2-picture condition. Namely, the lower identification rate of adjectives relative to nouns was specific to the 4-picture condition, and did not recur in the 2-picture control condition. It is important to remember that the 4-picture and the 2-picture stimuli used the same pictures and the same nouns and adjectives; all the differences have to do with the number of alternatives only.

Taken together, the results show that there is an interaction between number of alternatives and type of information (noun or adjective) in their effect on the success rate: Children did much better on the 2-picture task, and the locus of the effect is in the better performance with regard to adjectives.

No such differential effects are expected on a model of brute processing-difficulty making for the differential overall success rate, as nouns and adjectives are completely parallel in their a priori probabilities in this experiment. It is important to press that all the difference between the 4-picture and the 2-picture conditions and between nouns and adjectives is accounted for by the interaction between part-of speech and experimental condition, and there is no leftover main effect for either. Instead of a simplex processing difficulty, these results strongly support the hypothesis that children have some specific problems with combining noun and attribute information.

Similar conclusions are reached from the differential effects of performance level on the results of the two tasks. Table 7 and Figure 3 present the results of the experiment in the lowest, middle

and highest thirds of the sample, defined according to the total score they received on the two conditions of the experiment, namely, the total of the 4-picture and the 2-picture correct scores. In addition to the means, standard deviation and differences, Table 7 also presents the results of Wilcoxon signed ranks test of the significance of the differences between conditions (1-tailed), and the difference between nouns and adjectives (2-tailed).

TABLE 7. *Results of Experiment 2 in the lowest, middle and highest thirds of the sample*

Condition	Percent correct (SD)	% Ns correct (SD)	% As correct (SD)	Difference %N-%A correct	Wilcoxon
			Lowest third of the sample		
2-picture	76.7 (9.5)	81.7 (12.3)	71.7 (15.8)	10.0 (21.1)	W=6 N=7 $p > 0.05$ NS
4-picture	46.7 (12.5)	75.8 (12.1)	59.2 (15.9)	16.7 (21.5)	W=-5.5 N=9 $p < 0.05$
Difference 2-4picture	30.0 (9.8)	5.8 (14.2)	12.5 (15.3)		
Wilcoxon	W=0 N=10 $p < 0.005$	W=-7 N=7 $p > 0.05$ NS	W=-3.5 N=8 $p < 0.025$		
			Middle third of the sample		
2-picture	89.2 (5.6)	90.0 (11.6)	91.7 (11.8)	-1.7 (19.9)	W=15.5 N=7 $p > 0.05$ NS
4-picture	69.2 (9.7)	90.0 (8.6)	76.7 (14.0)	13.3 (20.9)	W=-7.5 N=9 $p > 0.05$ NS
Difference 2-4picture	20.0 (13.1)	0.0 (13.6)	15.0 (14.6)		
Wilcoxon	W=0 N=9 $p < 0.005$	W=-8.5 N=6 $p > 0.05$ NS	W=-1.5 N=8 $p < 0.01$		
			Highest third of the sample		
2-picture	95.0 (7.0)	95.0 (11.2)	95.0 (8.1)	0.0 (13.6)	W=-3.0, N=3 $p > 0.05$, NS
4-picture	90.8 (8.3)	94.2 (5.6)	96.7 (5.8)	-2.5 (7.9)	W=-15.0 N=6 $p > 0.05$ NS
Difference 2-4picture	4.2 (15.3)	0.8 (12.7)	-1.7 (8.6)		

Wilcoxon	W=-5, N=6 $p > 0.05$, NS	W=-6, N=6 $p > 0.05$, NS	W=6.5, N=4 $p > 0.05$, NS

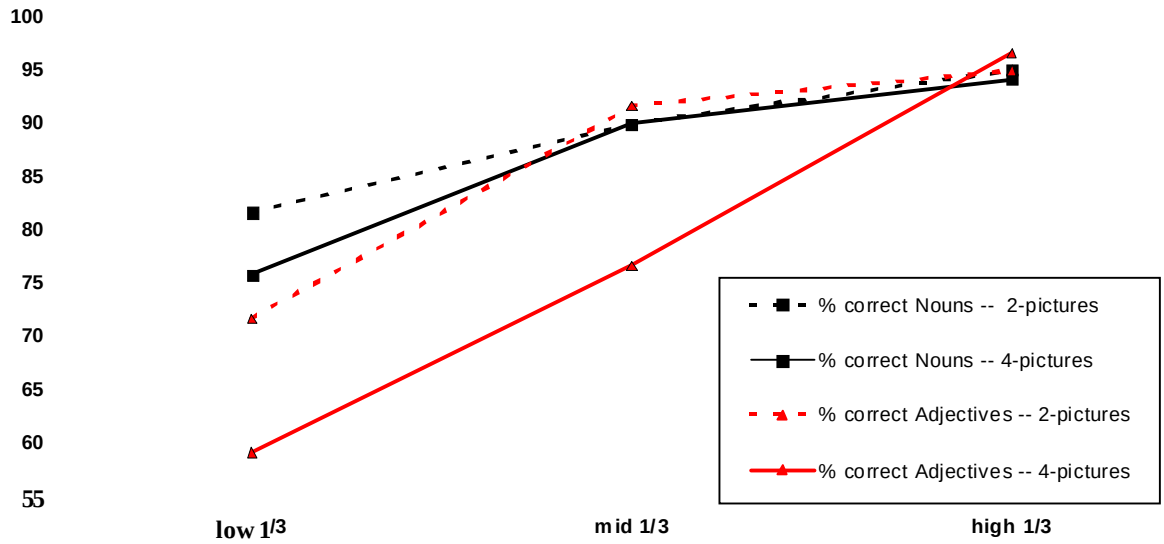


Fig. 3. Correct nouns and adjectives in 4-picture and 2-picture conditions

The results show that the locus of the difference between the correct scores of the 2-picture and the 4-picture tasks is the lower and middle thirds of the sample, whereas in the highest third there was no difference in the rates of success in the two conditions. Similarly, the locus of the differences in the correct Adjective scores between the 2-picture and the 4-picture conditions is the lower and middle thirds of the sample, whereas in the highest third there was no difference in the rates of success in the two conditions. There was no difference in the correct Nouns in any of the sub-samples.

The difference in the success rates of Nouns and Adjectives in the 4-picture condition was confined to the lowest third of the sample. There was no difference between these rates in any of the sub-samples in the 2-picture condition.

To summarize, the detailed analysis of the results in the three thirds of the sample revealed that the interactive effect of condition and part of speech applies mostly to poorly performing children. These children did much better on the two-picture task than on the 4-picture one; and the core of their improved performance is in the adjectives rather than, non-selectively, in both the adjectives

and the nouns.

These results strengthen the conclusion reached on the basis of the analysis of the performance of the complete sample, namely, that the pattern of results cannot be accounted for in terms of simple processing differentials between the 2-picture and the 4-picture tasks. The results only agree with an interpretation that ties the poorer performance in the 4-picture comprehension task to the specific difficulty it poses in requiring the combination of noun and attribute information.

Self-correction

A further support for this conclusion is provided by the self-correction data. Children in Experiment 2 made a total of 26 spontaneous changes, 21 in the 4-picture condition, and 5 in the 2-picture condition. The most frequent type of self-correction was the one most favored also in Experiment 1, namely, to replace a response which was correct on the noun but incorrect on the attribute, with a response which was correct on the noun and also correct on the attribute. This accounted for 15 or 57.7% of all self-corrections, similar to the findings of Experiment 1. The self-correction data imply that a choice which is correct on the noun but incorrect on the attribute is one that children are often capable of remedying in a further move, hence suggesting that the initial error represents a problem of integrating the noun-information with adjective-information rather than a lack of knowledge of the adjective word.

Young children's strategies for solving comprehension problems

It seems that children initially solve both cognitive tasks -- the two-picture one and the 4-picture one -- by focussing on a single word to base their choice on. This is a highly successful strategy in a two-picture situation when the alternatives contrast either on the noun-information or the adjective-information but never on both. Apparently, their knowledge of adjectives is sufficient in order to perform adequately when they can chose between two identical objects differing only on the attribute denoted by the adjective.

However, the same single-dimension selection strategy does not serve the children well when they are faced with stimuli differing on two dimensions, both in the objects shown and in the properties of these objects. In order to perform correctly in this 4-choice situation, the children should combine the noun and the adjective information of the question, and thus compute the value of the referential expression consisting of the attributed noun. Apparently, poorly

performing children cannot switch to an integrative comprehension strategy but, rather, continue to base their choices on a single dimension/word, either on the adjective, or, more often, on the noun alone.

This could be the reason why, according to the studies by Waxman & Markow (1998), Klibanoff & Waxman (2000) and others, children first succeed in interpreting novel adjectives as marking properties of objects only within a familiar basic-level object category, and only later extend them across different categories. It seems that when both the target and the test-items belong to the same object-category, the situation resembles our two-picture choice situation, as it functionally reduces to one with contrast only on a single dimension. In these circumstances, children do succeed in matching the adjective to the residual contrast among the items. When, however, the target and the test-items belong to different object-categories, the situation resembles our four-picture choice situation, as now there exists a contrast both in the objects and in the properties. In these conditions, correct comprehension of the syntax of the introductory sentence demands the more difficult integrative interpretation. According to the findings of Klibanoff (2001), the same reducing effect can be achieved even when the object-categories involved are not basic-level ones but superordinate categories like `tools', as long as the experimenter labels all the items in the task, target as well as test items, by the same label. This, apparently, creates the functional equivalent of the two-picture situation, namely, allows the child to ignore the noun (and the specific identities of the objects) as irrelevant to the task. It seems relatively easy for children to chose correctly on the basis of an adjective when the same object is involved or even when the objects are physically different but in referring to them, the same noun is used. The label is enough to turn the task into a non-syntactic, single-element choice situation.

SUMMARY AND CONCLUSIONS

The results of the two experiments suggest that young children below 4 years do possess basic adjective vocabularies and can use them in simple single-dimensional discriminations, but have a considerable difficulty in interpreting the combination of noun and adjective in an attributive referential expression. It appears that this difficulty is syntactic-semantic, or maybe even logico-syntactic, and does not follow from a problem in the acquisition of adjective terms per ce.

On the basis of the findings, it was possible to further narrow down the nature of the problem

with attribution. A very frequent pattern observed in the study was making a first choice based entirely on the noun and not taking the adjective at all into consideration. Many of the children however subsequently corrected themselves by adding the adjective-information. Logicians tell us this is indeed the sequence of operations involving adjectival modification. It is tempting to speculate that the complete mastery of modification involves the AUTOMATIZATION of this process. Adults and better-performing children no longer go through an overt two-step procedure, first identifying the group of objects referred to by the noun, then restricting the reference to the objects having the correct attribute; rather, they perform the two steps as one, instantly and without awareness. It seems that learning how to fuse the two-step procedure to a single-step one is a major developmental task along the way to the mastery of attribution.

The automatization of the two-step process as a one-step procedure marks the emergence of a new logical operation, that of subtype-formation. What were originally two independent choices sequentially ordered so that the noun-based choice came first (probably because of a basic shape-bias) and the adjective-based one, second, now turns into a single integrated choice based on both the noun and the adjective, in the correct logical relationship of Head and its modifier. The mastery of the syntax of attribution emerges intervowen with the mastery of its logic.

REFERENCES

Au, T. K. & Markman, E. M. (1987). Acquiring word meaning via linguistic contrast. Cognitive Development **2,** 217-236.

Braine, M. D. S. (1976). Children's first word combinations. Monographs of the Society for Research in Child Development **41,** (1, Serial No. 164).

Hall, D. G., Waxman, S. R. & Hurwitz, W. M. (1993). How two- and four-year-old children interpret adjectives and count nouns. Child Development **64,** 1651-1664.

Hasman, A. (1995). What came first - "The egg is white" or "The big hen"? Adjectives' acquisition by Hebrew native speaking toddlers -- Do predicative adjectives precede the appearance of attributive adjectives? Unpublished M.A. thesis, The Hebrew University, Jerusalem, Israel.

Heibeck, T. H. & Markman, E. M. (1987). Word learning in children: An examination of fast mapping. Child Development **58,** 1021-1034.

Klibanoff, R. S. (2001). Shared category membership or perceptual similarity: What explains the foundational role of basic-level categories in children's acquisition of adjectives? Paper presented at the Biennial Meeting of the Society for Research in Child Development, Minneapolis, Minnesota, April 2001.

Klibanoff, R. S. & Waxman, S. R. (1999). Syntactic clues to word learning: Initial expectations and the development of flexibility. In A. Greenhill, H. Littlefield & C. Tano (eds), Proceedings of the 23rd Annual Boston University Conference on Language Development (pp. 361-373). Somerville, MA: Cascadilla Press.

Klibanoff, R. S. & Waxman, S. R. (2000). Basic level object categories support the acquisition of novel adjectives: Evidence from preschool-aged children. Child Development **71,** 649-659.

Markman, E. M. & Wachtel, G. F. (1988). Children's use of mutual exclusivity to constrain the meaning of words. Cognitive Psychology **20,** 121-157.

Montague, R. (1974). Formal Philosophy (Edited by R. H. Thomason). London: Yale University Press.

Nelson, K. (1976). Some attributes of adjectives used by young children. Cognition **4,** 13-30.

Ninio, A. (1984). Functions of speech in mother-infant interaction. Final Science Report to the

United States-Israel Binational Science Foundation (BSF), Jerusalem, Israel.

Ninio, A. (1995). Predicting a developmental lag of adjectival attribution in early word combinations on the basis of Dependency Theory. Paper presented at a symposium on Children's Early Word Combinations and Grammar, chaired by M. Tomasello. The Biennial Meeting of the Society for Research in Child Development, Indianapolis, Indiana, March, 1995.

Smith, L. B., Jones, S. S. & Landau, B. (1992). Count nouns, adjectives, and perceptual properties in children's novel word interpretations. Developmental Psychology **28,** 273-286.

Taylor, M. & Gelman, S. A. (1988). Adjectives and nouns: Children's strategies for learning new words. Child Development **59,** 411-419.

Tomasello, M. (1992). First verbs: A case study of early grammatical development. Cambridge: Cambridge University Press.

Waxman, S. R. (1990). Linguistic biases and the establishment of conceptual hierarchies: Evidence from preschool children. Cognitive Development **5,** 123-150.

Waxman, S. R. & Markow, D. B. (1998). Object properties and object kind: Twenty-one-month-old infants' extension of novel adjectives. Child Development **69,** 1313-1329.