"A Critique of the Research on Semantic Memory and Semantic Retrieval in Children"

* Lutfi Ahmad Abulhaija

* Ph.D. Linguistics, University of Pennsylvania, 1981.
Associate Professor, Department of English, Yarmouk University.

Abstract

In this paper, various pieces of evidence have collected been and cited about semantic memory and semantic retrieval processes in children. Sometimes, contrast and comparison will be drawn with some literature related to adults. The main objective will be presenting, commenting on, contrasting and comparing, and criticizing the bits of evidence in literature found relevant to the topic of this paper.

I. Introductory Remarks

It has been traditionally agreed upon by semantic memory investigators that semantic memory material is the fully learned product of life's verbal learning,[1] and that the concern is how this memory is organized,[2] retrieved, and used (Adams, 1976). Apparently, the concern of semantic memory is about the organization of words and their meanings and even sentences as we shall see later.

Along these lines, there have been two main well-observed reflections and influences in children's literature regarding semantic memory and semantic retrieval processes. The first view is the cognitive one where retrieval time is primary in studying how semantic memory is organized. Collins and Quillian (1969) identify this retrieval time as the reaction time used by a subject to ascertain the truth or falsity of a sentence, such as a CANARY CAN FLY. On the other hand, the other view known as the associative view lays emphasis on isolated verbal units where the concern is mainly about semantic features or associations; these semantic features are looked upon as the associations which two words have in common. For instance, the word pair CANARY - BIRD have the feature wings in common. So far, the advocates of each view have tried to assert their points by doing experiments in their fields of interest, whether related to adult or child semantic memory retrieval processes. So, we shall see how these views are reflected on the research relevant to our main topic of semantic memory and semantic retrieval in children.

II. Presentation and Discussion of Relevant Literature

A. Semantic Retrieval in Adults and Children with Special Reference to K. E. Nelson, et al. (1975)

K.E. Nelson et al (1975) explored the question of how college-age adults and 8-, 11-, and 13 year-olds retrieve semantic information long-term memory. They asserted that in order to comprehend and produce sentences, one must access information in long-term memory. How even very young children succeed in processing sentences, K. E. Nelson et al. (1975) found it necessary to assume that these children can quickly and accurately retrieve some detailed information on word meaning from long-term semantic memory. One, at this stage, may raise this question:

What is the extent of developmental similarities and differences in the organization of semantic storage and retrieval?

Many assumptions and conclusions about semantic memory have been based on the variations in the time that adults take to confirm the truth of various utterances (i.e., sentences). K.E. Nelson et al. (1975) claim that "A lion has mane" is verified more rapidly than "A lion has a foot". The assumpion is that systematic differences in the organization of long-term memory make **mane** more accessible then **foot,** when a relationship to lion is verified. Meyer (1970) and Rips et al. (1973) talk about the same thing when they refer to sentence confirmation by adults and possible models of long-term memory. One the other hand, there is little evidence from children that supports semantic retrieval in sentence verification.

In their (1975) study, K.E. Nelson et al. first determined that adults' sentence verification times were systematically related to the nouns in a set of sentences. They then extended the paradigm and same set of sentences to 8-year-olds, 11-year-olds, and 13-year-olds to enable them to determine whether the children at each age level show the same patterns of verification times as adults. At this point, one may raise the issue of age range, i.e., why was the age range chosen between 8 and 13? As a matter of fact, a review of much previous research shows that 7-to 8-year-olds are typically less systematic and accurate than older children and adults in their use of semantic information in a variety of conceptual taske (See Bruner, 1966; Anglin, 1970). K.E. Nelson et al. (1975) timed their subjects as they judged whether sentences describing animals (e.g., mouse, lion, peacock) and their properties were false or true. In this regard, reference to two theoretical conceptions is very significant:

a. Most properties of a noun are associated in memory directly with the noun. What this means is that properties are stored in and retrieved from a list (Anderson & Bower, 1973) or network (Rummelhart, 1972); this list or network is organized so that more strongly associated properties are "nearer" to the noun. Wilkins (1971) and Conrad (1972) have provided evidence to this effect.

b. The specificity of properties is based on conceptual relations between nouns rather than on associative relations. Collins and Quillian (1969, 1972) theorize that semantic memory is hierarchically organized and that properties are stored efficiently at as general a level as possible. For instance, for **lion** the property **mane** (highly specific to lion) might be stored directly with **lion,** the property **fur** with mammal (because it is a general property of all animals). Because their (i.e., Collins & Quillian, 1969, 1972) model assumes nested hierarchies, **skin** would be stored furthest from lion, **fur** would be closer and **mane** would be closest. This model predicts then that when specificity increases, retrieval times

should increase. According to this model, property specificity effects on retrieval times will arise because less specific properties must be retrieved via superordinate categories. Rummelhart (1972) speculate that young children store properties of a noun directly with the noun and that with increasing age there is a "transfer" of property storage to available property. Still, there is not sufficient evidence to indicate whether children rely on a system of this sort (as Collins and Quillians') or not. It remains an open issue.

B. Semantic Memory Development in Children

In their (1971) research, Schaeffer, Lewis, and Van Decar have tried to find out what semantic elements are there behind the children's growth of semantic memory. In their experiments, first and fifth graders' performance on semantic oddity problems supports the position that children learn superordinate elements, **animate** and **inanimate** later than **subordinate** ones, **plant, animal, vehicle** and **utensil.** In other words, it has been clear from their experiments that knowledge of the superordinate elements **developed gradually** over the age range studies; i.e., fifth graders understood them better, and ninth graders apparently understood them almost perfectly[3]. Whereas knowledge of the subordinate elements developed more quickly and was even present earlier. One significant finding of their study concerns the differences in difficulty between Animate - Inanimate problems based on two animate and one inanimate entity, e.g., cow: tree: boat and those based on one animate and two inanimate entities, e.g., cow: boat: spoon. The suggestion thus will be that children learn the element animate before the element inanimate; and what is important is that children use their knowledge of animate entities to infer the characteristics of inanimate entities. This implication or analysis can be supported by Clark's (1969) principle of lexical marking[4]. But we should point out that their data can in no way allow us to exactly determine how superordinate and subordinate information differ; they admit this setback of the data when they point that although first and fifth graders found it easier to deal with animate than with inanimate entities, they could not find it easier to deal with plants and animals than with vehicles and utensils[5]. It should be also noted that they assume the existence of such elements when they discuss the development of the children's semantic memory in terms of the mastery of these suberdinates and superordinate semantic elements. Meanwhile, their data do not allow a determination of semantic organization of subordinate - superordinate elements. This is because we do not know whether the two are hierarchically or associationistically organized, even though subordinate elements were learned earlier than superordinate ones[6].

Along the same line, Harris (1975) found that when children ages 5-7 years were given information of the form "A mib is a bird" they were able to make appropriate inferences regarding the attributes of the "mib" and distinguish it from other members of the class in an interview situation. The child just retrieves the appropriate image, scan it for the attribute and responds appropriately. This, one may argue, sidesteps the issue of hierarchy or association through the process of equative transfer if $X = Y$ then everything about X is derivable from Y and the reverse.

Another primary question is how children remember and retrieve sentences. Or even primarily, is human memory for sentences semantic or syntactic? For this second question, Bransford and Franks (1971) claim that memory for sentences is semantic rather than syntactic by interpreting their experimental findings to mean that. That is, human beings abstract the ideas and store them, rather than the specifics of the sentence. Whatever their claim is, it does not rule out the occurrence of a syntactic storage, I believe, or even phonological one. Coming back to the first question on how children remember and retrieve sentences, one possibility will be that sentences are learned by rote, or if their syntactic structure influences recall, then children should be able to distinguish previously heard sentences from new ones (Hudgins, 1977). (Paris, 1975) presented a series of carefully developed stories to second and fifth-grade children. Children, in both grades, consistently classified the true premises and true inferences as **"old"** sentences, i.e., as sentences they heard before. The obvious prediction or objection is that children may have simply been confused about the whole thing. But Paris refuted this objection by pointing out that even by the second grade children store inferences from sentences in memory, and not just total copies of the sentences. It is quite relevant here to point out that Chomsky (1959) argued that individuals do not store copies, rather they store concepts, framework rules and transformation rules.

C. Semantic Memory Organization in Children

On the question of how semantic memory is organized in children there has been the general viewpoint that changes in performance with age are a result of developmental changes both in: first, semantic knowledge and second, in the ability to devise and carry out appropriate strategies for remembering.

Steinberg and Anderson (1975) employed a picutre recall task using hierarchically related verbal cues. This task was performed by 58 six-year-olds. The results are interpreted as evidence for class-inclusion hierarchies in the lexical structure at this age, contrary to previous

studies. The suggestion is that children employ hierarchical structures as a sign of their capacity to deal with aspects of their ordinary knowledge of the world. They rule out alternative interpretations of the data; for example regarding properties of the words use as retrieval cues, by stressing that concrete words make better cues than abstract ones. (See Paivio, 1969). They also discredit the word association data, sticking to the structural explanation of their data. This view also runs in conflict with the class size hypothesis (as reported by Landauer and Freedman, 1969; Meyer, 1970).

Mervis, Catlin and Rosch (1974) asked subjects in kindergarten, third grazde, and college to select the referents of various color terms from a color array. The foci (centers) of the color categories became established earlier than the boundaries. In connection with this finding, Rosch (1973a) has suggested that **semantic categories are also structured by a focus/ boundary organization.** In support of Rosch's (1973a) findings, K. Nelson's (1974) study suggests a category growth process of the focal type identified by Rosch (1973a). Another study by Carson and Abrahamson (1976) tends to confirm Rosch's (1973b) distincition between focal and peripheral members in natural language categories.

On the other hand, McCauley et al. (1976) may tend to suggest from the results of their experiments that both associative and categorical relationships have become an integral part of this memory system by the second grade. Alternatively, only associative relationships appear to be functionally established by the kindergarten level. Their results thus support the hypothesis that pictorial and semantic representation of a concept are stored in the same memory system.

D. More on Semantic Retrieval in Children

In their (1973) experiment, Loftus and Grober found that like adults, children 72-93 months take longer to produce a category instance to a stimulus like "an animal that's enormous" than to "an enormous animal", suggesting that their semantic memory is organized and accessed primarily by noun categories. One reason is that processing time may be longer string where time is a function of length of unit rather than a correlate of complexity. The claim is made, then, that at least some of the concepts that are learned very early in the semantic development of children are organized into hierarchical structure composed of categories (e.g., food) and instances (e.g., banana). The question of how information is retrieved from such a structure if it exists then will be according to their (i.e., Loftus and Grober) interpretations of their own results, that the process of retrieving information from this store consists of entering the appropriate category as a first step. This study also

provides an estimate of .35 second for children, suggesting, then, that it takes longer for children to enter an appropriate category than it does for adults. They do not explain why that happens. It is quite significant in this respect to suggest that children's poor performances on certain retrieval tasks may be due to children's failure to meet the cognitive demands of the tasks. And this may account for younger children's difficulty and contribute probably to older children's problems as well (Markman, 1976). What is implied is that age groups differ consistently during development

The rest of this section will be devoted manily to the analysis of two papers on semantic retrieval by younger children. The first is by Keith E. Nelson et al.; the second is by Richard Prawat et al.; for one is somehow a response to the other, as I look at it:

In K. E. Nelson et al. (1975), the indication is clear that sentences of the form "A lion has a mane" are verified more quickly for high-salient properties and for low-specificity properties, for subjects at ages 8, 11, 13 and adults, contrary to Collins and Quillian (1969). Noun-property association strength was controlled. So far, the challenge to Collins and Quillian's (1969) assumption that low-specificity properties (e.g., a lion's **skin**) would be retrieved relatively slowly because they would require retrieval via a noun's superodinate (e.g., **animal**) has become quite evident.

On the other hand, Prawat and Cancelli (1977) studied semantic retrieval in kindergarteners and third graders as a function of type of meaning. This study appears to be a validation of K. Nelson's (1974). In the main, they raise doubts about K. E. Nelson's et al. conclusion that semantic storage and semantic retrieval processes do not change across age. At any rate, Prawat and Cancelli's results show that retrieval times for properties high in saliency varied as a function of type of meaning. Kindergrateners were able to verify sentences pairing nouns and high saliency dynamic properties as quickly as third graders, even though they took significantly longer than third graders to verify the static and relational statements. Younger children are as adept as older ones at storing and retrieving a particular type of functional meaning (pages 357-358). But the authors stand still before explaining the absence of an effect for relational properties similar to the effect obtained for the high-saliency dynamic items.

The main point they keep in mind is that Nelson and Kosslyn's conclusion that **"little developmental change" occurs during childhood** in the semantic storage and retrieval process is untrue for (a) Nelson and Kosslyn focused on children 8 years of age and older in their

semantic memory research; (b) Prawat et al., used concepts acquired very early by the child, which could provide a better test of their hypothesis. These last two points raised by Prawat et al., I think, are of importance and are worthy of being taken into account.

III Suggestions

I would like to stress the following points:

1. Much of the theory and research on memory has used adults as subjects. So, a great deal more research is required before we can claim that the semantic memory process in children is comprehended. Many open issues are still apparent. Well-detailed theoretical models with empirical support are lacking for retrieval. The characteristics of semantic memory in very young children remain to be determined.

2. it is my opinion that there are syntactic factors which are so important in getting access to non-syntactic information in memory. We would like to see that the presently active study of semantic storage is complemented by a syntactic study of procedures employed in the retrieval recasting from memory. So, sentence memory can be both semantic and syntactic and not semantic rather than syntactic or even phonological. In other words, it is the combination of both the meaning and structure of the sentence in question that determines or affects the speed of its memory. I may thus, find it safe to suggest that the length and complexity of the structure of a sentence affect the manner and speed of its retrieval.

3. In studying semantic retrieval in children, we should not by any means disregard the associative viewpoint. For we have noticed that both associative and categorical relationships have become integral, and can become, part of this memory system by the second grade.

4. Finally, across-cultural studies are lacking in this area. I believe that some research in this area should be done to consolidate or invalidate many views that only deal with subjects oriented to one-culture.

Notes

(1) Some would argue that semantic memory is not exclusively the product of verbal memory. (See Paivio, 1969, 241-262).

(2) Lashley (1929) concluded that memory is widely and equivalently distributed throughout large brain regions. Squire (1986) indicated that information storage is localized in specific areas of the cortex.

(3) "Perfectly", one may argue, over-extends the point that children acquire these later in life and that age helps to approximate higher levels of superordination.

(4) This principle states that the senses of certain "positive" elements, such as **good, long, animate** are stored in memory in a less complex from than the senses of their oppoosite "negative" elements, **bad, short, inanimate.**

(5) Adults have difficulties with the problem when faced with robots and computers. One may argue that the problem, too, is one of philosophical interest so it is no wonder that children should be noted as having difficultes.

(6) Olson (1970) claims that superordinate elements distinguish between larger classes of intended referents than do subordinate ones.

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