JOURNAL OF EXPERIMENTAL CHILD PSYCHOLOGY 52, 99–116 (1991)

Children's Recall of Script-Based Event Sequences: The Effect of Sequencing

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Preschool and first-grade children's recall of script-based event sequences was studied in relation to four different instruction conditions. In the first condition children were asked to put in the correct order and then to describe two picture sequences presented in a jumbled order; in the second condition children were asked to describe the same sequences presented in a correct order. The third condition was similar to the second, except that children were given a second trial to describe the sequences. In the fourth condition the sequences were presented in a jumbled order and children were only asked to describe them. After a week all children were asked to recall the sequences. Differences in sequencing ability were observed in relation to age and sequence. The worst recall was observed in children who described the misordered sequence. Sequencing led to more acts recalled and to fewer intrusions than the other three conditions. When sequencing level was also included in the analysis of recall, children with low level sequencing still showed comparable recall to that of children who described the ordered sequences. These findings indicate that at both ages the effort involved in sequencing aids semantic processing of the material, enhancing recall, and offsetting the initial drawback of being presented with a misordered sequence. Findings are discussed in relation to the children's ability to use script knowledge strategically as well as automatically.

Research has shown (Nelson, 1986) that when children are asked questions like "Tell me what happens when . . . (you go shopping with your mother, you get dressed in the morning, etc.)" they do not refer to specific events but instead tend to report the events' actions in general and abstract terms. Assuming that verbal accounts reflect the organization of the underlying event representation, children can be said to possess well-organized representations or scripts of familiar events even at the age of 2 or 3.

Hudson and Fivush (1983) and Hudson and Nelson (1983) report that

Thanks are due to Silvia Reinhold for drawing the sequences as well as for her help, together with Susanna Busnelli, in collecting data. Thanks also to Stefano Draghi for his statistical advice. Please address correspondence to Patrizia Catellani, Department of Psychology, Catholic University of Milan, Largo Gemelli 1, 20123 Milano, Italy.

0022-0965/91 $3.00

preschool children perform well even in recalling simple stories as long as they are script-based, that is, based on event sequences with which they are familiar. More recently, event recall has been examined in even younger children, by replacing verbal reports with other procedures such as asking children to reenact events. Using such procedures, investigators have shown that even 2 year olds have accurate event recall (Bauer & Shore, 1987; Fivush & Hamond, 1989).

That preschool children have good knowledge of events does not, however, mean that they are able to use it strategically. Hudson and Fivush (1983) observed that 3 year olds had a well-organized recall of event sequences but, unlike the 5 year olds, their performance did not improve over successive recall trials. Hudson and Nelson (1983) found that 4 and 6 year olds organized recall in a similar way when sequences were presented to them in the correct order, but their performance differed when the order of presentation deviated from that laid down in the script. When recalling misordered sequences, 6 year olds were able to report acts in the correct order or to adapt them to some meaningful sequence; 4 year olds tended to omit the acts which had been presented out of order. The internal representation of events in the younger children therefore seems to be more rigid and less adaptable to reality.

Clear-cut differences between preschoolers and older children have also been observed in sequencing tasks. When sequences referred to familiar events and "strong" scripts (i.e., scripts with tightly knit temporal and causal connections between acts) the 5 and 6 year olds performed well. The 4 year olds, however, had greater difficulty, even if the sequences were familiar (Fivush & Nelson, 1982; Fivush & Mandler, 1985; Catellani, 1986; Anolli, Catellani & Bertetti, 1988). The fact that young children's reports have an accurate temporal–causal sequence does not imply that they are able to use temporal and causal connections explicitly; it simply means that their internal representation of the event is well-organized (Fivush & Slackman, 1986).

The findings of past research suggest therefore that preschool children can only perform tasks that enable them to activate their representation of events automatically, that is, tasks which require them "to read off" their internal representation without thinking about it or manipulating it in any way. They find it difficult to use their knowledge explicitly when asked to do so (Fivush & Nelson, 1982; Fivush & Slackman, 1986). These findings also indicate that control over the schematic knowledge of events is acquired gradually, in a way resembling categorical knowledge (Hudson & Fivush, 1983; Mandler, 1983). Nevertheless, the relationship between schematic knowledge and the ability to use this knowledge explicitly in cognitive tasks deserves further investigation.

Studies of categorical knowledge addressed the way that automatic knowledge develops into strategic knowledge. Research has demonstrated

that children can be induced to use organizational strategies that improve recall. Huttenlocher and Newcombe (1976), for example, observed that recall improved with categorically blocked presentation of items. More recent research has shown that involving children to sort items into categories based on semantic relations also improves recall (Naus & Ornstein, 1983; Ornstein & Corsale, 1979; Sodian, Schneider, & Perlmutter, 1986; Worden, Mandler, & Chang, 1978).

Few studies, however, have examined the effects on memory of manipulating event representation. The aim of the present study was to investigate the effect of event sequencing on recall. A sequencing task might lead to schematic organization of the material by requiring children to search actively for the links which are at the basis of such knowledge.

The effects of the sequencing task on recall seem to call two apparently conflicting components into play. First, the presentation of events in an order other than the correct temporal–causal sequence may have a negative effect on recall, because it clashes with the subject's internal representation of those events. Thus, being presented with a misordered sequence in the sequencing task should, at least at the onset, make recall harder than being presented with a normally ordered sequence. At the same time, however, the request to reorder the sequence should aid semantic processing of the material, thereby enhancing recall and offsetting the initial drawback of the misordered sequence. Semantic analysis of an event requires the subject to identify the relations that connect the acts. Thus, a sequencing task, by requiring the search for relations, should trigger semantic encoding and thus lead to better recall. A relevant factor is the completeness of the child's sequencing. If sequencing is only partially successful, the child would not have the correct sequence even at the end of the task. Yet, the child would have carried out a semantic analysis of the material.

In our study, the sequencing task was compared to a task which simply required the description of an ordered sequence. It might be objected that, if the sequencing task led to better memory, its advantage might be traced not to semantic encoding, but rather to longer exposure to the material. Two additional controls were therefore included. In one, children were given two successive trials to describe the ordered sequence, thus providing as much time with the material as the children in the sequencing condition. In the second, children were asked to describe the misordered sequence without having to reconstruct it.

Our hypothesis was that semantic encoding takes place in the sequencing task, and that this process enhances recall. The semantic aspect was expected to play a minor role when an ordered sequence was presented, even when the children had the opportunity to describe the ordered sequence twice. The worst recall was expected from children who described the misordered sequence without having the chance to reorder it. The

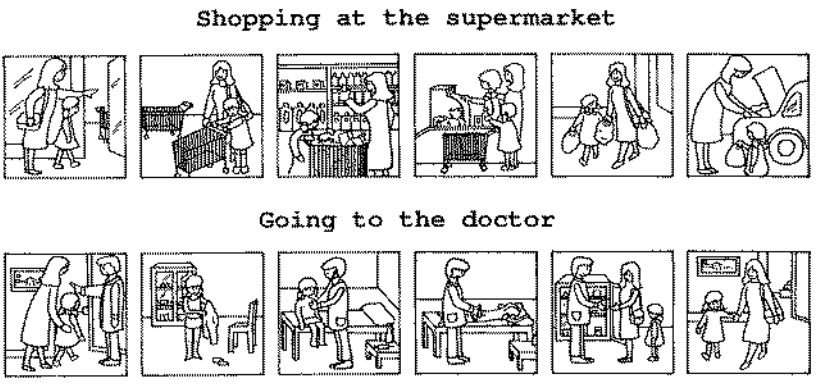

FIG. 1. Picture sequences.

older children were expected to be most favored by the sequencing task. Although preschool children generally experience greater difficulty in event sequencing tasks (Fivush & Mandler, 1985; Fivush & Nelson, 1982), we aimed to verify whether even their partial sequencing might have a positive effect on recall.

Also examined were the linguistic features of children's verbalizations that followed the different tasks to determine whether there was any correlation with the task itself and with subsequent recall.

We studied the questions outlined above using two different scripts. Past work has shown that children's performance in the production of scripts seems to be influenced by such features of the event as greater or lesser familiarity, degree of emotional involvement, presence of causal links between acts, and salience of the child's role (Slackman, Hudson, & Fivush, 1986). Salience and emotional involvement usually elicit longer scripts, while familiarity and the need for causal links lead to more consistent scripts, i.e., less variability both in the same child over time and across children (Nelson & Gruendel, 1986).

In our study, children were presented with two different familiar events: shopping at the supermarket and going to the doctor. The former is frequently experienced by the children, does not involve them as the main protagonists, does not involve them emotionally, and is characterized by a restricted number of routine actions. The latter has a less frequent occurrence, with the child in the leading role, characterized by strong emotional involvement, and with a greater degree of variability in the component actions: for example, the difference between a routine check-up and a visit prompted by trauma or illness.

Our aim was to verify whether there was any correspondence between differences found in the length and variability of the scripts, obtained a priori by means of a spontaneous production task, and differences in the

children's ability to sequence and recall sequences of images constructed from the two scripts.

METHOD

Subjects

Thirty children divided into two groups (4 and 6 year olds) participated in a preliminary stage of the study. The study itself included a sample of 240 different children (115 males and 123 females) equally divided into two groups, one of preschool children (mean age: 4 years, 6 months; age range: 4 to 5 years) and the other of first-grade children (mean age: 6 years, 6 months; age range: 5 years, 11 months to 7 years). The children attended state schools in Milan and came from a middle class background.

Materials

The preliminary stage of the study envisaged a script production task relating to two events: "shopping at the supermarket" and "going to the doctor."

The acts most frequently mentioned in the children's scripts were then calculated. The acts were subsequently used to construct two sequences relating to the same events and each comprising six color pictures drawn on 6-cm square cards (see Fig. 1). In some cases two propositions which were separate in the script but which had a similar meaning were summarized in a single picture in the sequence: for example, "we go to the cashier" and "we pay."

The order of the pictures corresponded to the order the children mentioned the actions in the script production task. The sequences were designed in such a way that the temporal–causal connections that linked the actions would only allow one correct sequencing of the pictures.

Pretesting was carried out on a group of children who were not part of the sample to determine whether the pictures in the sequences gave rise to any problems in perception.

Procedure

All the data were collected by two interviewers who had previously spent some time at school with the children. The interviewers saw children individually in a quiet room outside the classroom.

Script production. In the preliminary stage of the study, 30 children were assigned a script production task. The instructions were similar to those of past work (Nelson & Gruendel, 1986), namely: "I know you sometimes go to the supermarket; tell me what happens when you go to the supermarket"; and ". . . when you go to the doctor." No further indications were given to avoid influencing the children's responses, other

than: "And then . . . ," "Does anything else happen?" or "What else do you do?".

Instruction conditions. The picture sequences were constructed on the basis of the acts most often cited in the scripts. The actual study was carried out in two successive phases. In the first phase 120 children were assigned to two different experimental conditions (30 4 year olds and 30 6 year olds in each condition). In the first condition, the pictures were presented in a misordered sequence and the children were asked to reorder them; the misordered sequence was the same for all the children. The instructions were as follows: "I'm going to show you some pictures; they are not in the right order; look at them all carefully and then put them in order." Children were then asked to verbalize the sequence they had constructed, thus: "Now tell me what is happening in each picture." In the second condition, the pictures relating to the two sequences were presented in the correct order and the children were asked to describe the sequence verbally. The instructions were as follows: "Look at these pictures carefully and tell me what is happening in each of them, starting from the first one and going on to the last."

A control sample of 120 other children were then studied in two further conditions (30 4 year olds and 30 6 year olds in each). The first was similar to the above condition, except that the children were given a second trial to describe the sequence. The instructions were: "Now have another look at the pictures and tell me again what is happening in each of them, starting from the first and going on to the last one." In the second control the sequences were presented in a jumbled order and the children were asked to describe them in the same way as the ordered sequence. If children asked which picture they had to start from, the picture to the left of the row was pointed to. This was not necessary in the other conditions.

The two sequences were presented to the subjects in all cases in a counterbalanced order.

Recall. A week later all the children were again interviewed singly and were asked to recall the sequences presented. The instructions were as follows: "Do you remember the stories we showed you last time? Try and tell me them again, starting from the one you like best." No mention was made in the request of the content of the stories and it was acceptable for the children to initiate recall from the sequence they preferred. Again the children were given no further cues. All the responses were recorded and transcribed.

RESULTS

Script Production

The typical features of scripts reported in past studies were found in the verbal production of children of both ages: all the children followed

TABLE 1
PERCENTAGE OF CHILDREN MENTIONING ACTS IN SCRIPT REPORTS (N = 30)

Acts			
Shopping at the supermarket	%	Going to the doctor	%
We buy	57	He examines me	70
We take something	53	He gives me an injection	40
We pay	43	He gives me medicine	40
We go home	37	I get undressed	23
We go out	33	We go home	23
We get a trolley	23	We go out	20
We go to the cashier	17	He looks at my throat	17
We load up	17	We go in	13
We go in	13	I wait	10
We push the trolley	10	I am ill	7
We put things in bags	7	I lie down on the couch	7
We take things home	7	I get up from the couch	7
		I get dressed	7
		He listens to my heart	7
		He tells me to breathe	7
		He treats me	7

Note. Only acts mentioned by at least two children are reported in the table.

the temporal–causal connections that linked the acts and used the present tense; over 90% of the children used terms that indicate reference to a general representation of the event and not to a specific episode; only 10% made reference to a marginal act or one that was not characteristic of the event described; a high degree of agreement among children as regards the ordering of acts was observed.

The number of acts mentioned by children was calculated for each event, considering all the propositions with predicates indicating an action or a change in state. The children produced elaborate scripts of both events (4 year olds: M = 2.9, SD = .6 for the "supermarket," and M = 3.2, SD = 1.1 for the "doctor"; 6 year olds: M = 3.9, SD = .8 for the "supermarket," and M = 4.3, SD = 1.6 for the "doctor"). A 2 (age) × 2 (event) mixed-model analysis of variance with age as the between-subjects factor and event as the within-subjects factor was carried out on the number of acts mentioned. Age was significant [$F(1, 28) = 12.01$, $p < .005$]: the older children produced longer scripts than the younger ones. Type of event was not significant.

A ranking of the acts mentioned showed that children's responses in both events tended to cluster around certain acts (see Table 1). Most often mentioned were the core acts of "we buy" for the supermarket and "he examines me" for the doctor event. In the "supermarket" event,

however, there was a greater concentration around the acts mentioned most often: the 5 most frequently mentioned acts made up 67% of the responses produced by the children as compared to 51% in the "doctor" event. The latter event included more acts which were mentioned by only a few children or which were idiosyncratic. These were mainly specific acts, pertaining to the central phase of the event, which indicated either acts that a doctor might carry out while examining a patient (e.g., "He listens to my heart") or, in some cases, the emotion experienced by the child (e.g., "I am afraid").

Sequencing

To evaluate the accuracy of picture sequencing the order of pictures produced by each child was matched up with the correct order. The absolute value of the sum of the differences between ranks was calculated (e.g., a comparison between the sequence 145623 and the correct sequence 123456 gives $|1 - 1| + |2 - 4| + |3 - 5|$, etc. = 12). This value, inversely proportional to the accuracy of the response, was transformed into a directly proportional scale, by subtracting it from the maximum value of the index (19 − 12 = 7 in this case). A continuum was thus obtained ranging from 1 for a totally mistaken sequence to 19 for a correct sequence.[1]

An analysis of variance 2 (age) × 2 (sequence) with the second factor manipulated within subjects was carried out on the scores obtained. Both the factors were significant: age [$F(1, 58) = 28.36, p < .001$] and sequence [$F(1, 58) = 16.26, p < .001$]. There were no effects of interaction.

The sequencing ability of the older children was decidedly superior to that of the younger ones in both the "supermarket" (4 year olds: $M = 10.6$, $SD = 4.5$; 6 year olds: $M = 16.1$, $SD = 3.6$) and the "doctor" sequence (4 year olds: $M = 7.8$, $SD = 4.6$; 6 year olds: $M = 12.8$, $SD = 6.1$). However, 4 year olds were also able to construct part of the sequences. The "supermarket" sequence appeared distinctly easier to sequence than that of the "doctor" both for 4 and 6 year olds. The sequences were logically structured in both cases so that only one correct sequencing of the pictures was possible. Although the children had an elaborate script of both events, they appeared to find it easier to make the temporal–causal connections between acts in the "supermarket" sequence. This

[1] The analysis could also be based on the children's ability to group the pictures in pairs, threes, fours, and so forth. In this type of coding, already used by us in a previous study (Anolli et al., 1988), the assessment criterion takes account of any connection the child has been able to make between the pictures. Even if a child has missequenced some acts by placing them at the end he still receives a partially positive score, since he has created some correct groups of pictures (as in the example 145623 reported above). This criterion was also used as a cross-check. The data were similar in both the analyses although this second scale was found to be less sensitive.

sequence corresponded to the event which showed less variability in the children's spontaneous reports.

Verbalizations

At the end of all the experimental conditions children were asked to verbalize the sequence of pictures in front of them. There were no notable differences in the two successive descriptions by children who verbalized the ordered sequence twice. The group of subjects who had been assigned the sequencing task responded in different ways to the request for verbalization. The verbalizations of children who had sequenced the pictures correctly ("doctor" sequence: 3% of the 4 year olds and 40% of the 6 year olds; "supermaket" sequence: 10% of the 4 year olds and 50% of the 6 year olds) coincided with the content of the pictures. Three of the 6 year olds corrected one sequence after verbalization and these were included in all the analyses among those who had produced correct sequencing.

Incorrect sequencing produced different age-related behavior. The majority of 4 year olds who made sequencing mistakes simply described the pictures as they appeared (86% for the "doctor" and 63% for the "supermarket" vs 39 and 33% in 6 year olds): for example, the order 3*5*1246 for the "supermarket" sequence: "They do the shopping. *They go out. They go in.* They get the trolley. They pay. They put the things in the boot." Six year olds gave an interpretation of the single pictures which was at times incorrect but which tended to maintain an accurate logical structure (56% for the "doctor" and 60% for the "supermarket" vs 14 and 37% in 4 year olds): for example, the order 123*546* for the "supermarket" sequence: "They go to the supermarket. They get the trolley. They take things. *They go out. They leave the trolley. They load anything into the car.*" Besides, some 6 year olds gave correct verbalizations despite the fact that their constructed sequence was incorrect (5% for the "doctor" and 7% for the "supermarket"); for example, the order 123465 for the "doctor" sequence: "They go to the doctor. The girl gets undressed. The doctor examines her. Then he gives her an injection. *Then he gives her some medicine and they go away.*"

Even though children often simply "read" the pictures one after the other, they used links like "first," "and," or "then" to connect the actions. The number of links used was not significantly related to age or experimental conditions.

The number and types of errors observed in the children's verbalizations in the four experimental conditions were also compared. Two types of errors were identified: "mistaken descriptions," that is, incorrect description of acts represented in the pictures, and "missing descriptions," that is, omissions of one or more pictures from the description and generic "reading" of the pictures (i.e., cases in which children merely repeated

TABLE 2
TYPE AND MEAN NUMBER OF ERRORS IN VERBALIZATIONS BY AGE, INSTRUCTION CONDITION, AND SEQUENCE

	Sequence							
	Shopping at the supermarket				Going to the doctor			
	4 years		6 years		4 years		6 years	
Condition	Mean	*SD*	Mean	*SD*	Mean	*SD*	Mean	*SD*
	Mistaken description							
Sequencing	1.47	1.00	.60	.77	2.17	1.23	1.23	1.36
Ordered sequence	1.10	1.09	.33	.55	1.80	1.63	.97	1.07
Repeated ordered sequence	1.07	1.05	.53	.97	1.93	1.46	.70	1.20
Misordered sequence	3.23	1.13	1.63	1.01	3.00	1.39	2.47	1.01
	Missing description							
Sequencing	.37	.61	.13	.35	.33	.55	.00	.00
Ordered sequence	.77	.93	.27	.58	.67	.80	.20	.41
Repeated ordered sequence	.67	.96	.30	.40	.77	1.16	.10	.30
Misordered sequence	.43	1.07	.10	.40	.73	1.01	.36	.73

the title or the central element of the event with expressions such as: "He's at the doctor's, he's still at the doctor's . . ."). An analysis of variance 2 (age) × 4 (instruction condition) × 2 (sequence) with repeated measures on the last factor was carried out for each type of error. The "mistaken descriptions" error was more frequent in younger children [$F(1, 232) = 63.20$; $p < .001$] and in the "doctor" sequence [$F(1, 232) = 31.94$; $p < .001$]. Condition was also found to have an effect [$F(1, 232) = 40.13$; $p < .001$]. Newman–Keuls post hoc tests showed that children who described the misordered sequences gave the most mistaken descriptions (all comparisons $p < .001$). There were no significant differences, however, between sequencing and the ordered sequence conditions (see Table 2). Younger children tended to make the "missing descriptions" error more frequently [$F(1, 232) = 36.02$; $p < .001$]; condition was again found to have an effect [$F(1, 232) = 2.74$; $p < .05$]. Post hoc comparisons showed that children who had the sequencing task made fewer omission errors than those who described the sequence once ($p = .001$) or twice ($p = .01$).

Surprisingly, children who were given the ordered sequence also made a number of errors in describing the sequences. These were mainly of the omissions type, and therefore differed from those made by children in the sequencing task.

TABLE 3
NUMBER OF ACTS RECALLED BY AGE, INSTRUCTION CONDITION, AND SEQUENCE

	Sequence							
	Shopping at the supermarket				Going to the doctor			
	4 years		6 years		4 years		6 years	
Condition	Mean	*SD*	Mean	*SD*	Mean	*SD*	Mean	*SD*
Sequencing	3.10 (30)	1.27	3.97 (30)	1.27	3.17 (30)	1.23	3.90 (30)	1.21
Low sequencing	2.78 (23)	1.20	3.75 (8)	1.28	2.96 (23)	1.26	3.33 (12)	1.07
High sequencing	4.14 (7)	1.34	4.04 (22)	1.29	3.86 (7)	.90	4.28 (18)	1.18
Ordered sequence	2.77 (30)	1.33	3.43 (30)	1.33	3.03 (30)	1.52	3.23 (30)	1.30
Repeated ordered sequence	2.57 (30)	1.55	3.63 (30)	1.56	2.90 (30)	1.18	3.23 (30)	1.91
Misordered sequence	1.47 (30)	1.14	2.37 (30)	1.24	1.13 (30)	1.28	2.00 (30)	1.41

Note. Number of children belonging to the groups in parentheses.

Recall

Children's verbalizations were analyzed by means of three different indices: number of acts recalled, number of acts recalled in the correct sequence, and number of acts mentioned by the child but not present in the two sequences.

Quantity of recall. Data regarding recall according to the four different modes of presenting the sequences are shown in Table 3. Data on sequencing include findings on the sample as a whole and those observed in the two groups subdivided on the basis of sequencing quality.

The first comparison made was among all the conditions, regardless of the level of sequencing and therefore on the whole sample of children. An analysis of variance 2 (age) × 4 (instruction condition) × 2 (sequence), with sequence as a within-subjects factor, was performed on the quantity of recall (maximum recall = 6). Age was found to be significant [$F(1, 232) = 21.71$; $p < .001$]: older children remembered better than younger ones. Condition also had an effect [$F(1, 232) = 26.55$; $p < .001$]: the Newman–Keuls post hoc tests showed that describing sequences in a jumbled order had a worst effect on recall than all the other conditions (for all comparisons $p < .001$). Most importantly, the sequencing task produced better recall than the presentation of an ordered sequence

whether it was described once ($p < .05$) or twice ($p < .05$). There were no effects of interaction.

A further comparison was made between the two sequencing levels. These two levels correspond to a distinction between children who had sequenced the pictures correctly, in whole or in part, and those with a low or zero level sequencing: the cut off limit chosen was taken as the median of the sequencing scores. The groups which emerged were not equal in number since sequencing abilities are much more developed in the older children. The chosen criterion was considered preferable, despite the obvious statistical difficulties, because it enabled the two age groups to be compared.

Subjects with high level sequencing tended in general to remember a larger number of acts (see Table 3). The difference between high and low level sequencing was, however, only significant, at the Student t test, in two cases: 6 year olds' recall of the "doctor" sequence [$t(28) = 2.23$, $p < .05$] and 4 year olds' recall of the "supermarket" sequence [$t(28) = 2.55$, $p < .05$]. The same statistical differences were observed between high level sequencing and ordered sequence: sequencing improved 6 year olds' recall of the "doctor" sequence [$t(46) = 2.78$, $p < .01$] and 4 year olds' recall of the "supermarket" sequence [$t(50) = 2.44$, $p < .05$]. Results did not change substantially when the ordered sequence described twice and the high level sequencing were compared ["doctor" sequence for 6 year olds $t(46) = 2.09$; $p < .05$; "supermarket" sequence for 4 year olds $t(35) = 2.48$; $p < .05$].

Therefore, when only the high scorers were taken into consideration, the sequencing task was seen to be more effective than the presentation of the ordered sequence even in 4 year olds. The significant difference observed solely for the "supermarket" sequence may be accounted for by the difficulty 4 year olds had with the "doctor" sequence. The advantage of 6 year olds in the sequencing task was restricted to the "doctor" sequence, which was the more difficult one to construct. These data seem to indicate that endeavor is crucial to recall: sequencing enhances recall when the task requires the child to make a cognitive "effort" to reorganize the material. Children probably made less effort when the task was too simple but also when it was so difficult as to appear almost impossible, as in the case of 4 year olds with the "doctor" sequence.

No significant differences in recall were found between single or repeated description of an ordered sequence on the one hand, and low sequencing on the other. This seems to indicate that effort in reorganizing the material offsets the initial drawback of the misordered sequence.

Correlations between correct verbalizations that followed the different conditions and recall were significant ($p < .001$) both for 4 year olds (.48 for the "doctor" sequence and .49 for the "supermarket" sequence) and for 6 year olds (.43 for the "doctor" sequence and .36 for the "super-

market" sequence). The number of links found in the verbalizations was not significantly correlated to the actions recalled, but only to the number of links present in recall and only for 6 year olds (.28 and .37 for the two sequences, respectively).

Sequencing in recall. 91.7% of the children recalled the acts in the right order. Even if the percentage of children who made sequencing errors in recall was low, an analysis of the variance was carried out on the percentage of actions recalled in the correct order out of the total number of acts recalled (following arcsine transformation). The variables considered (age, instruction condition, and sequence) were not found to have a significant effect. The tendency to report acts in the right order, even when at times these had only been seen in a misordered sequence, suggests that semantic integration, and thus script, played an important role in recall.

Intrusions in recall. Since the sequences presented referred to script-related events, we wondered to what extent the acts mentioned by children resulted from recall of the specific sequence and not simply from their script of the event. The number of acts recalled which did not occur in the presented sequence was therefore calculated. These acts comprised those generally encountered in scripts pertaining to such events but not included in the subset of acts chosen to construct the sequences. We expected the difference between recall of an ordered sequence and of a reordered sequence to be more clear cut if we used an index which enabled us to identify the presence in recall of elements belonging to a general knowledge of the event (script) rather than to the specific sequence proposed.

The index used for the analysis was the percentage of intrusions out of the total number of acts recalled. A mixed factorial design 2 (age) × 4 (instruction condition) × 2 (sequence), with repeated measures on the last factor, was performed on these measures converted by an arcsine transformation. The results of the three-factor analysis of variance showed a main effect of condition [$F(1, 116) = 7.04$; $p < .01$]. Newman–Keuls post hoc tests showed that the misordered sequence determined the highest number of intrusions in recall (for all comparisons $p < .001$), but, above all, that the percentage of actions alien to the sequence was higher in children who described the ordered sequence once or twice as compared to those who sequenced it (in both cases $p < .01$) (see Table 4).

Thus, children tended to substitute the acts of a specific event with script-related factors more often when recalling ordered sequences.

DISCUSSION

Children of both age groups produced quite elaborate scripts of the two events presented to them although those of older children were longer. The scripts related to the two events did not differ in length but only in

TABLE 4
MEAN PERCENTAGE OF INTRUSIONS BY AGE, CONDITION, AND SEQUENCE

	Sequence			
	Shopping at the supermarket		Going to the doctor	
Condition	4 years	6 years	4 years	6 years
Sequencing	8.3	5.7	3.7	8.4
Ordered sequence	7.6	14.7	16.5	14.3
Repeated ordered sequence	9.3	13.2	7.8	20.1
Misordered sequence	21.7	31.5	36.1	28.7

consensus observed among children on single acts: in the "supermarket" event children of both ages produced more uniform and generalized responses than in the "doctor" event, which showed a larger number of idosyncratic and specific responses.

Differences between the events emerged in children's sequencing task. Although both sequences were based on the acts most cited in the scripts and were logically structured, the "supermarket" sequence was reordered more easily than the "doctor" sequence. Thus the event which had the most consensus in children's spontaneous reports was the easiest to reconstruct. The differences found in the events may depend either on the two specific events used or on one, or more, of the factors that characterized each event (child involvement, act variability, etc.). Our results need to be substantiated by further studies, on a larger number of events, aimed at distinguishing the effects of the various factors, before any viable generalization can be made.

Age also appeared to affect sequencing. Six year olds performed much better than 4 year olds. Younger children were able to follow the temporal–causal structure in producing scripts but had difficulty in handling these structures explicitly in the sequencing task. Nevertheless, 4 year olds succeeded in completing, at least partially, the sequencing task, even though faced with a sequence of six pictures. This positive result in such young children is probably due to the fact that the sequences presented in our study corresponded to the acts most frequently mentioned in the scripts (see also Fivush & Mandler, 1985).

The major finding of the study is the positive effect of sequencing on event recall. As expected, instruction condition affected both the number of acts recalled and the percentage of intrusions out of the total number of acts recalled. Children who described misordered sequences had the worst recall; children who were given the sequencing task recalled better than children who were simply asked to describe ordered sequences: this

was found not only when children described sequences once but also when children were given a second try; that is, they had the same exposure time as children in the sequencing condition. The hypothesis that the explicit request to reorganize material on the basis of semantic relations enhances recall, already substantiated for categorical knowledge, seems therefore to be also valid for schematic knowledge.

The behavior of children who only partially sequenced the pictures was particularly noteworthy. Although these children did not see the correct sequence either at the beginning or at the end of the trial, their recall was still comparable to those who did see the ordered sequence, in terms both of number of acts and order of occurrence. Semantic encoding of the material resulting from the use of organizational strategies seems to have triggered a reconstruction process in memory that continued after the sequencing task itself. This was observed above all in older children, which confirmed their greater ability to remember misordered sequences and to reorder them mentally (Hudson & Nelson, 1983).

Further comment on our findings will focus on the encoding phase, the retrieval phase, and the interaction between the two. In the encoding phase the request to put the pictures into the correct sequence induced the child to search actively for the logical relations that linked the acts. The child was engaged in some kind of "mental activity" that enhanced the semantic processing of the material, leading to better recall. This type of processing was clearly less present in the straightforward "reading" of the ordered sequence. Verbalizing the sequence did not suffice to trigger semantic processing of the material. The poor verbalizations of the children in this group seem to support this view: they either omitted descriptions of some of the pictures or repeatedly referred to the central act. Such errors were observed more rarely in the description of reordered sequences. When children failed to complete the sequencing task correctly, they tended to read a different meaning into some of the pictures.

In the information retrieval phase, reference to semantic representation was observed not only in subjects who had been given the sequencing task, but also noticeably in those who had been assigned the ordered sequences, as indicated by the high percentage of intrusions in recall. The presence of some intrusions even among the children with better recall may be accounted for by the ample correspondence of the sequences to the scripts. Because script-based stories contain only one subset of all the possible script actions and subjects activate the whole of a script in the process of understanding a script-based sequence, they may refer in recall to elements of the script which are not present in the actual sequence presented (Hudson, 1988).

The interaction between encoding and retrieval is shown by enhanced recall prompted by the mental activity involved in encoding. The importance of cognitive "effort" seems to be supported by the improved recall

of 6 year olds when they were asked to sequence the more difficult sequence, that is, the "doctor." Sequencing of the easier "supermarket" sequence, which probably required less of an effort, did not prove as useful. A reverse trend was observed in 4 year olds, who only benefited from sequencing the "supermarket" sequence. The other task was decidedly beyond their capacity, rendering any cognitive effort fruitless.

On the whole our study further substantiates the view that ability to use schematic knowledge explicitly improves with age, as does categorical knowledge. Nevertheless, the results of sequencing and recall in 4 year olds bear upon our understanding of preschool children's ability to use their knowledge of events strategically as well as automatically (Hudson & Fivush, 1983; Hudson & Nelson, 1983; Mandler, 1983; Nelson, 1986). When the task is within their capabilities, as was the "supermarket" sequence, even 4 year olds seem to be able to apply their knowledge of events strategically. Furthermore, the effort involved in performing the task helps them to remember the sequence better. The present study suggests further research into the conscious use of memorization strategies in children who are informed in advance of the recall trial. Results on different material (Sodian et al., 1986) suggest that older children might activate more accurate strategies in searching for semantic relations, leading to better memorization, even when simply looking at ordered sequences.

Our findings also led to some interesting observations on the relationship between the representation of an event in general (script) and the representation of a specific event in particular. The former comprises general information on one class of events, while the latter pertains to an autobiographical memory, which includes not only general information but also information specific to a given event (Schank, 1975). Various studies have attempted to identify the extent to which the two types of representation influence each other, with reference also to the relationship between episodic and semantic memory. Research has shown, for instance, that a single experience of an event (episode) may at times suffice to construct a general representation of the event (Fivush & Slackman, 1986). Similarly, the understanding and memorization of a specific event inevitably entails reference to the general knowledge pertaining to that event (or similar events) contained in semantic memory (Ortony, 1978). In our study, reference to a semantic representation of an event in the encoding phase, prompted by a request for sequencing, enhanced recall of the specific event; conversely, a task which failed to activate semantic representation at the encoding phase hindered recall. In the retrieval phase reference to the semantic representation of the event frequently occurred also in subjects who only saw the ordered sequence. It may thus be hypothesized that the script of the event aided memorization of the single

episode in the encoding phase and that it integrated and bridged any gaps in recalling the specific event in the retrieval phase.

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RECEIVED: August 17, 1990; REVISED: January 18, 1991.