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THE UPS AND DOWNS OF 'BEFORE' AND 'AFTER': CONTEXTUAL CONTROLS OF UNDERSTANDING

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THE UPS AND DOWNS OF BEFORE AND AFTER:

CONTEXTUAL CONTROLS OF UNDERSTANDING

by

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ABSTRACT

This research examined the influence of real world knowledge on preschoolers' understanding of *before* and *after*. Three-, four-, and five-year-old children were tested for the comprehension and production of these terms across event sequences that had real world (logical) and arbitrary temporal orders. In the comprehension test, the subjects answered *before*/*after* questions referring to the order of events in sequences they enacted with toys. There was a main effect of age but not of sequence type. The four- and five-year-olds showed clear comprehension, but performance among the three-year-olds appeared to be inflated by context-sensitive but non-linguistic strategies of response. In a second comprehension measure that used pictured events, the three-year-olds were substantially better with logical than with arbitrary sequences. Event knowledge did not support comprehension within the same subjects across tasks, however. Two production measures, *when* questions and sentence repetitions, showed increasingly correct performance with age but failed to demonstrate superior performance with logical sequences. An influence of real world knowledge was reflected in the subjects' response strategies but did not clearly support correct production of *before* and *after*. These strategies were

common among the three-year-olds; the types of strategies and frequency of use changed with age in a developmental direction. Comprehension of before/after was superior to production at age three but converged with age. Four- and five-year-olds made some individual variations in performance across the three tasks, while three-year-olds were highly inconsistent across tasks. It was proposed that a basic understanding of before/after is present during the fourth year, but its use is governed by nonlinguistic constraints. Event knowledge combines with task demands to produce context/paradiam-specific response strategies that control the child's performance with these terms. Event knowledge may thus be necessary to support the early understanding of before and after but insufficient to support the display of this understanding. Therefore, the use of both context-sensitive methods and multiple measures of assessment were encouraged for constructing developmental models for all temporal terms.

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INTRODUCTION

Cognitive developmentalists have expressed an interest in the acquisition of temporal relations since Piaget's 1927 work on The Child's Conception of Time. However, it is only within the past ten or fifteen years that the child's emergent ability to represent time has been given much attention by psycholinguists. During the last decade, psycholinguistic research has addressed the young child's understanding of certain temporal, relational, and conditional words, devoting a major share of attention to the acquisition of the terms before and after. Such work is of particular importance to our knowledge of both language and cognitive development, for, apart from their status in the child's accumulation of lexical connectives, before and after and a few other relational terms intersect language and logic. Knowledge of how these terms are acquired ultimately contributes to our knowledge of the much investigated relationship between language and logic by showing some of the ways in which nonlinguistic representations of temporal and causal sequences are integrated with linguistic knowledge to produce descriptions of logical relationships.

Although the literature on the development of temporal relations in language does not form a cohesive body of work,

most of the research may be divided between two theoretical orientations--the cognitive approaches and the linguistic approaches. The cognitive approaches (Piaget, 1971; Fraisse, 1963; Cromer, 1967, 1971; Bronckart & Sinclair, 1971; Ferreiro & Sinclair, 1971; Friedman, 1978) following Piaget have attributed the acquisition of temporal terms to the development of concrete operational reasoning and decentration. The linguistic approaches (H. Clark, 1970; Donaldson & Wales, 1970; E. Clark, 1971, 1973; Hatch, 1971; Amidon & Carey, 1972, 1976; Barrie-Blackley, 1973; Johnson, 1975; Coker, 1977) based upon or in reaction to E. Clark's (1971) semantic feature hypothesis, have discussed the acquisition of these words in terms of either semantic or syntactic constraints. Proponents of the two paradigms maintain divergent views on the acquisition of temporal terms; however, all have made the claim that preoperational or preschool children have only a partial and limited ability to comprehend and use these words appropriately.

A central problem with the two prevailing orientations is that they overlook the close dependence of language and cognitive development on real world context. Both linguistic abilities and cognitive abilities develop by virtue of the child's real world experiences, and recent research sensitive to this fact has shown much greater linguistic and cognitive organization in young children than has previously been attributed to them, when this organization is

connected with familiar and meaningful information (Bever, 1970; Macnamara, 1972; Bruner, 1975; Nelson, 1974, 1981; Brown, 1976; French & Brown, 1976; Bransford, 1977; Olson, 1977). While the research cited earlier tested preschoolers' comprehension of temporal terms, most notably of the terms before and after, in the absence of supportive context, a recent experiment (Carni & French, 1981) has supported the idea that very young children can understand the meanings of these terms when given appropriate real-world cues. As a model of acquisition, the hypothesis was proposed that children first learning the meanings of before and after with reference to the order of events in familiar event sequences and later learn their function as abstract terms used to relate unordered propositions.

As the study mentioned above established a solid initial groundwork for the contextual hypothesis, it enabled further exploration to be done. In particular, a number of related issues concerning the contextual approach to the acquisition of before and after were considered as the subject of the research investigation reported in the subsequent sections of this thesis.

The first issue addressed the generality of the results of the Carni & French study: How stable is preschoolers' contextually-constrained competence at understanding the meanings of before and after? The question was derived

from the frequent reports of previous research that beginning comprehenders show considerable sensitivity to the demands of experimental tasks (Keller-Cohen, 1974; Johnson, 1975; Friedman & Seely, 1976; Coker, 1977; French, 1981). In a number of studies, inconsistent data patterns were obtained from the same subjects who were tested on a variety of paradigms purporting to measure young children's comprehension of before and after. This implies a certain fragility in the early comprehension of these terms that is not displayed even by only slightly older children. If this is the case, then the contextual model proposed by Carni & French might result in an overestimation of competence. On the other hand, it is possible that contextual clues might facilitate preschooler's comprehension of before and after across different conditions of comprehension.

Another issue addressed the emergent production of the terms before and after: Are before and after first used in reference to real world (henceforth called "logical"), logical event sequences and later used to establish relationships between essentially unordered (henceforth called "arbitrary") propositions? Very little is known about the early production of before and after. A few studies using arbitrarily related sequences (Cromer, 1968; E. Clark, 1970; Ferreiro & Sinclair, 1972; Keller-Cohen, 1974) have reported results indicating that these terms are used appropriately by children around the middle of the fifth year. However,

there is some data from other studies (Nelson, 1981; Carni & French, 1981) indicating the the terms may be used correctly by slightly younger children when conjoining logically related events.

A third issue, concerning the young child's differential response to task demands, was raised with regard to the hypothesized production of before and after in logical sequences: How comparable are the data obtained from young children across various tests of the production of before and after in logical (and arbitrary) sequences?

Finally, a fourth issue addressed the relationship between the acquisition of comprehension and the acquisition of production of the terms before and after. While it has been generally assumed that comprehension precedes the production of temporal terms, it is conceivable that young children may appropriately produce before and after in conjoining logically invariant events prior to comprehending their meanings in essentially arbitrarily related sequences. In order to assess this possibility, the study first examined whether preschoolers' comprehension preceded their production of these terms across logical sequences.

In the beginning sections of this thesis, the past literature on the development of temporal relations is reviewed with respect to the various models of acquisition that have been offered and the various methods that have

been employed to test these models. Following this, the above research, which proposed to test the viability of the contextual hypothesis as an alternative developmental paradigm, is reported and discussed.

Cognitive Approaches

Piagetian-oriented researchers have held that language development depends upon the development of logical abilities. Hence, the child's comprehension of temporal terms has been linked to the child's understanding of the underlying logical concepts involved in time relations. For example, in order to interpret the meanings of before and after, it is essential that the child have a concept of the logical principle of reversibility. This principle states that if A > B, then B < A; accordingly, in temporal relations, if A comes before B, then B comes after A. Understanding the idea of reversibility in time thus entails an ability to move back and forth mentally with respect to the order of events in a succession, e.g. A → B → C, and includes an ability to seriate or to sequence the events in time. The child must know that Event B follows Event A and Event C follows Event B to make up the sequence A → B → C; likewise, the child must know that if B follows A and C follows B, then A precedes B and B precedes C. As reversibility is said to emerge in the child with the general development of concrete operational reasoning

at six or seven years of age, it has been assumed that below this age, children would have difficulty understanding the meanings of such terms as before and after.

Researchers writing within the Piagetian view have supported its claims concerning the development of temporal relations and the acquisition of temporal terms. Fraisse (1963) reported that preschoolers could not trace the causes from the effects of an event and could not infer what logically probable conclusions followed from an initial action. He attributed this to a lack of reversibility of thought, with the consequent inability of young children to move bidirectionally within a sequence. Similarly, he reported (Fraisse, 1963) that four- and five-year-old subjects were unable to sequence pictures representing the flow of liquid from an upper beaker into a beaker below it. This was ascribed not only to a lack of reversibility of thought, but to a more basic inability of young children to form mental representations of event sequences:

> As soon as the order has to be recalled rather than perceived, young children fail because they are not yet capable of reconstituting the sequence in their memories. (p. 263)

Fraisse asserted that,

> It is fairly obvious that children are generally incapable of reasoning based on the facts that they experience...The memories of children are completely jumbled up, for they have not yet learned to reconstruct their past. (p. 254-255)

He concluded that young children are "prisoners of the present" because of a fundamental limitation of thought. It would therefore be impossible for them to understand the meanings of such terms as before and after.

Ferreiro and Sinclair (1971) conducted a more direct study of the acquisition of temporal relation in language, from which they postulated a three-level developmental sequence in the comprehension and use of the terms before and after. Four- to nine-year-old subjects were asked to (1) enact semantically unrelated two-event sequences cojoined by the terms before and after and to (2) describe the order of events in such sequences enacted by the experimenter. For the second task, subjects were required to first give a free description using any order of events and then to tell what happened once more, beginning with the second event. These tasks rquired that the subjects think both unidirectionally and bidirectionally with respect to the sequences. An example of one of these sequences:

> The girl pushes the truck before the boy washes the car.
> Before the boy washes the car, the girl pushes the truck

Subjects in this study were all given Piaget's conservation of liquid quantity task, which is designed to measure reversibility of thought. Performance on the above tasks was then compared with performance on the conservation task. In a first category of response, subjects

(three to four years of age) appeared to understand neither temporal relation and did not pass the conservation test. Furthermore, these subjects were not even able to understand that the return of a liquid to its original state would result in the same configuration in its container, a perceptual phenomenon Ferreiro & Sinclair have called "renversibilité."

In a second response category, subjects (also three and four years of age) appeared to understand the meanings of the concepts before and after with reference to the order of events in the sequences but not to understand their meanings when the demand was to move back and forth within the sequences. These subjects, preoperational by the transformation of liquid task, did, however, understand the principle of renversibilité. In the third category, the oldest subjects performed well on the comprehension and production tasks and succeeded in the conservation test.

Ferreiro and Sinclair proposed that these categories were hierarchically ordered, and thus serve as evidence for a developmental sequence. They claimed that for category (1), subjects were not even able to sequence events. Subjects regarded the two events as separate, but neither could be used to serve as a reference point for the other. For category (2), Ferreiro and Sinclair postulated that the subjects were in a period of "semi-logic" in cognitive

development. This semi-logic consisted of a one-way mapping of events; subjects could establish two separate relations of order, A anterior to B and B posterior to A, but could not deduce one from the other. For the third category, it was put forth that the subjects had both the ability to seriate and the ability to move both ways within sequences, demonstrating a reversibility of thought. Ferreiro & Sinclair thus maintained that the acquisition of the terms before and after paralleled and, presumably, followed from the development of concrete operational reasoning, of which the reversibility principle is a central component.

Cromer (1968, 1971) examined the production and comprehension of temporal markers in young children, from which work he proposed that the understanding of temporal reference was delimited by certain cognitive factors, specifically, by what he called the ability to "decenter" in time. Following Piaget's (1927) concept of spatial decentration, Cromer postulated an analogous idea of "decentration in time." According to the Piagetian prototype, the developing child was said to make a shift from using herself and her own body as a subjective frame of reference for understanding all perceptual and spatial perspectives, to take a more objective account of other people's points of view (Piaget, 1927). This transition from "egocentrism" to the decentered state was tested

through the child's ability to understand the shifting perspective of a doll placed at different positions with respect to three experimental "mountains" and was reported to occur at five years of age. In Cromer's adaptation, temporal decentration was defined as the ability to "take account of varying relations in time from different points of view in time" (Cromer, 1971, p. 98) and was reported in two studies (Cromer, 1968, 1971) to take place at no less than four-and-a-half years of age.

In the first study, Cromer (1968) observed the emergence of reference to time during the acquisition of language by two children. He reported that past and future markers did not appear until four-and-a-half years of age. Along with Fraisse, he concluded that very young children are bound to the present, a temporal restriction he attributed to the preoperational child's egocentric inability to separate her experience of the present from her idea of the present as a continually changing reference point for locating other events in time.

In the second study, Cromer (1971) tested the child's comprehension of temporal relations in language by having four- to nine-year-old subjects identify events in seven-event stories cued only by differences in tense. The stories concerned the activities of a typical local child (going to the zoo; a farm; buying a balloon), but the internal events of the stories all bore an arbitrary relation

to one another. The stories were narrated with horizontal sequences of line drawings, and the subjects were required to choose the correct picture of a statement made by the child in the picture, as told by the experimenter. The results indicated that subjects did not begin to respond appropriately until 4:11 years and did not perform significantly above chance until 5:11 years. As five to six years was the age advanced by Piaget for the period of decentration, Cromer concluded that children below this age could not assume another's perspective in time; hence, their difficulties in understanding tense.

Taken together, the Piagetian approaches circumscribe the child's understanding of temporal relations and temporal language by the constraints of the child's developing logical abilities. The logical competencies presumed to be necessary for temporal understanding have been postulated to emerge at some time during the child's fifth year.

Linguistic Approaches

In contrast to the Piagetian position on the acquisition of before and after, the linguistic approaches did not consider the conceptual relationships underlying these terms. Rather, they primarily addressed the child's understanding of the semantics of the terms with respect to their particular grammatical use, i.e., as prepositions or as subordinating conjunctions (E. Clark, 1971; Amidon &

Carey, 1972; Coker, 1977). Many of the studies falling under the rubric of "linguistic approaches" are, in fact, more or less atheoretical and have served in chief effect to discredit E. Clark's (1971) controversial semantic feature hypothesis of the acquisition of temporal terms (Hatch, 1971; Barrie-Blackely, 1973; Johnson, 1975; Friedman & Seely, 1976; Coker, 1977).

E. Clark (1971) tested three- to five-year-olds' ability to enact with toys semantically unrelated event pairs conjoined by the terms before and after and obtained these results: (1) sentences which preserved the order of events were easier than sentences which violated event order; (2) performance was better on sentences containing the term before than on sentences containing the term after.

Examples:

(1) X before Y: Before preserve
The boy jumped the gate before he patted the dog.

(2) after X, Y: After preserve
After the boy jumped the gate, he patted the dog.

(3) before Y, X: Before violate
Before he patted the dog, the boy jumped the gate.

(4) Y after X: After violate
He patted the dog after he jumped the gate.

These results produced the following order of difficulty: where (1) is the least difficult: (1), (2), (3), (4). Borrowing the semantic feature notion from previous

research on relational terms (e.g., more/less, large/small [H. Clark, 1970; Donalson & Wales, 1970]), E. Clark then proposed a four-stage model of the acquisition of before and after. According to semantic feature theory, linguistic meaning was said to derive from semantic components or features of words. General or superordinate features such as size were said to be learned earlier than specific or subordinate features such as large/small. Presumed positive features such as "large" were said to be learned earlier than presumed negative features such as "small." In Clark's model, the child was said to learn the meanings of before and after by identifying the semantic components of these words; the general time feature of "Priority" (as opposed to Simultaneity) was supposed to be learned before the particular features "before" and"after" and the presumed positive feature of before (+ Prior) was supposed to be learned earlier than the presumed negative feature of after (- Prior).

In line with her data, Clark predicted that children first know neither temporal term and use an order-of-mention strategy with after. That is, they enact events in the order mentioned regardless of the temporal conjunctions. In the second stage, children know before and use an order-of-mention strategy with after. In the third stage, children know before and treat after as before. Finally, children know both before and after.

Clark's Stages of the Development of "before" and "after"

Comprehension Stage	Age	N	Sentence Type[a] 1	3	2	4	Interpretation
A	3:7	21	+	-	+	-	Know neither before nor after. Use order of mention strategy.
B1	4:7	7	+	+	+	-	Know before. Use order of mention for after.
B2	4:3	3	+	+	-	-	Know before. Treat after as before.
C	4:7	8	+	+	+	+	Know both before and after.

+ = correct
- = incorrect
a = see p. 14.

Support for the semantic feature hypothesis using the enactment paradigm depends upon all errors being reversals of the order of the two events and upon comprehension of before preceding comprehension of after. This patterning of the data was found in Clark's study, but subsequent investigators, assessing the adequacy of Clark's theory, failed to replicate these results. Amidon & Carey (1976), testing five- to seven-year-olds' ability to enact two-event commands conjoined by before and after (e.g., Move a blue plane before you move a red plane), found that on 68% of trials, subjects enacted the event in the main clause and omitted the subordinate clause event. These

researchers attributed this to a presumed syntactic difficulty of young children in processing subordinate clauses. A similar result was found in Bever's (1970) research on the enactments of active and passive sentences by two- and five-year-olds; subjects enacted the main clause event and omitted the event in the subordinate clause. In Amidon and Carey's interpretation of their data, subjects were enacting the event in the main clause and were simply ignoring the temporal conjunction. Furthermore, Amidon (1972) found that giving subjects corrective feedback was enough to reduce comprehension errors by a significant degree.

Both Clark's results and Amidon and Carey's results were replicated by Johnson (1975) with a single sample of subjects (4:2-5:2 years). This study suggests that the differences were most probably due to differences in the respective task demands. It seems that in Clark's study, subjects were cued to respond to two events, while in Amidon and Carey's study, they were not. Coker (1977), testing kindergartners, also found that task requirements, rather than the child's knowledge of the temporal terms, seemed to be the critical factor in the response strategies children used on before/after comprehension measures. In Coker's study, subjects who were cued to respond to two events used the order-of-mention strategy more often than the main clause strategy, while subjects

who were not so cued used the main clause strategy more often than the order-of-mention strategy. Furthermore, Coker claimed that Clark's Substage B2 data for 4:3-year-olds could be explained by the previously mentioned primacy of main clause information in young children. Under this interpretation, subjects would have been acting out the event in the main clause and then acting out the event in the subordinate clause. This would predict correct performance on both before sentences (1) and (3) and incorrect performance on both after sentences (2) and (4). So for one response pattern, there are two possible interpretations, one semantic and one syntactic.

The possibility that the subjects in Clark's Substage B2 were utilizing an Amidon and Carey type strategy of always acting out the main clause first in itself is not compatible with Clark's general thesis (i.e., these subjects could be said to know neither temporal term). However, in a sample of 2,800 children, Coker and Legum (1975) found that there were almost as many children performing correctly on sentences with after while using an order-of-mention strategy with before as there were performing correctly on sentences with before while using an order-of-mention strategy on after (Clark's Substage B1). This suggests that some children may learn after first and some children may learn before first, contradicting Clark's principle that the positive aspect of

a feature is learned before the negative aspect.

Moreover, there was no evidence that before was learned earlier than after in Coker's second study (Coker, 1977). Performance was better on after when subjects used a strategy of reporting the next event in time (that is, the event following the first event mentioned) and better on before when subjects used the main clause strategy. Barrie-Blackley (1973), testing six-year-olds with the enactment paradigm, found better performance with after conjunctions than with before conjunctions.

In sum, linguistically oriented research shows no clear data pattern and provides no satisfactory theoretical account for the acquisition of before and after. The semantic feature model is not supported by the results of various studies, nor does the young child's difficulty with subordinate clauses explain the acquisition of temporal terms. Furthermore, a principal difficulty in assessing preschoolers' emergent competence at understanding before and after seems to come from a sensitivity of (so-called) pre-comprehenders to the demands of particular tasks, that is, their response to specific task demands seems to be independent of their knowledge of the temporal conjunctions. Nonetheless, it does not appear that the acquisition of before and after is an all-or-nothing phenomenon, suddenly manifesting itself with the development of reversible thinking in the child's sixth or seventh year. Data

from both the Piagetian and the linguistic sources indicate that preschoolers do have some partial, although fragile, knowledge of these terms.

The Contextual Approach

In spite of the fact that none of the developmental theories described in this review has adequately accounted for the acquisition of temporal terms, specifically of the terms before and after, most of the researchers in this area have not been directly concerned with proposing alternative accounts. The only investigators to have proposed an alternative model of acquisition were French & Brown (1976), who, in accord with the theories of Nelson (1974, 1981), Macnamara (1972), and Brown (1976), argued that the existing theoretical models overlooked the central role of extralinguistic context (i.e. real world information) in language acquisition and cognitive development.

During the past decade, there has been much attention given to the role of "real world" context in the assessment of preschoolers' cognitive and linguistic abilities. It has been reported that when familiar and meaningful materials were used in testing, two- to five-year-olds demonstrated much greater competence than was previously attributed to them in the areas of speech comprehension and production, active and passive relations, and memory (Bever, 1970; Nelson, 1981; Brown, 1976; Emerson, 1979; Olson,

1977). Investigators have postulated that, as neither language nor logic develop in context-free situations, they must first be learned in reference to the child's knowledge of the world and only later understood as abstract functions that may be utilized to assimilate and communicate information in more decontextualized settings (Bever, 1970; Macnamara, 1972; Bruner, 1975; Nelson, 1974, 1981; Brown, 1976; Bransford, 1977).

Event Representation

Nelson (1981) has argued that temporal and linguistic organization derive from children's knowledge of basic events in their lives. Repeated personal experiences such as making cookies, going to a restaurant, having lunch, were said to be cognitively represented by the child from action sequences in terms of their inherent temporal structure, and structured in terms of the linguistic forms necessary to encode their meanings.[1] In a sample of children 2:11 to 5:6 years, who described "what happens" during certain routine activities (Dressing, Birthday Parties, Having Dinner, etc.), subjects were able to abstract and report the correct temporal order of events in each activity, using appropriate linguistic markers.

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[1]Event representations are commonly called "scripts," a term used by Shank & Abelson.

Cookies - 2:11 years

My mommy says I'm a good helper. [How do you help your mommy?] First she gots out the things she needs. [First she gots out the things she needs?] Yeah. She gots something out to bake muffins with. But first, she has to buy some things for muffins.

Dinner - 3:5 years

First my mom makes it [supper], then we eat it. [Anything else?] Then after supper we play a little, then we go to bed. [So that's the whole story of having supper. What do you usually do before supper. Anything special?] When my mom is making the supper, we, my sister and me, play a little while. And when supper's ready, we eat it.

Restaurant - 4:7 years

[Tell me what you do at a restaurant.] You just sit, you come in and sit down. And a waiter comes along. And just, and you order your food. [So you order food. What else happens?] And then the waiter comes back with your food and you eat it. [OK, you eat your food and what else happens?] -- [No reply] -- [Anything else?] You pay and then you go out.

Birthday - 5:6 years

Well, when you have a birthday, ya get up early in the morning, get dressed, and you go to the birthday party, and you play games, and when the cake's ready, you sit down, and you get a piece and you eat it up, and when it's time to go, you go.

In contrast to the previous work (Piaget, 1972; Fraisee, 1963), this research shows that preschoolers are able to represent temporal sequences internally and to reconstruct them on demand.

Furthermore, subjects in Nelson's study corrected their own sequencing errors by making temporal repairs in language:

Birthday Party - 4:1 years

> You know what I do is, I just blow off the candles and eat it. And before I eat it, I just take out all the candles.

This temporal repairing indicates that, at least within the context of personally experienced events which have a more or less set sequence of events, young children do display reversibility of thought.

From a methodological standpoint, the demand on young children to give general accounts of familiar event sequences apparently tapped particular competencies in temporal relations in language that were not seen in other experimental paradigms, or with naturalistic observation (e.g. Cromer [1968]).

Speech Comprehension

Regarding the young child's comprehension of spoken language, Macnamara (1972) made the claim that children first determine, independently of language, the meaning that the speaker intends to convey, and then work out the relationship between meaning and language. Given the sentences

1a Give the book to me	2a The girl struck the boy
1b Give me the book	2b The boy struck the girl

Macnamara claimed that the child's only way of determining that the second set of sentences does not consist of stylistic variants like the first is through direct access to the context in which the sentences are uttered.

Active and Passive Relations

Likewise, there are other examples of the facilitation of comprehension by contextual constraints. Bever (1970) has shown that three- to five-year-olds, who typically have difficulty with active and passive relations, improve in performance when the sentences are about actions that are nonreversible, or improbable if reversed. For example, nonreversible sentences such as The dog is patted by the girl and The cookie was eaten by the dog are better understood (enacted with toys), than are sentences such as John is hit by Mary, which can be logically reversed. Olson & Nickerson (1977) found that the degree of supportive context determined whether five-year-olds could handle the implicational relationships between active and passive sentences. For example:

John hit Mary.
Was Mary hit by John?
Did Mary hit John?

When meaningful characters, stories, and pictures were used in testing, subjects' performance on test questions similar to those listed above significantly improved.

Memory and Temporal Succession

Supporting the findings reviewed above, Brown (1976) investigated the influence of contextual support on preschoolers' memory for order and understanding of temporal succession. In the memory studies, four- to five-year-old

subjects remembered meaningfully ordered narratives and picture sequences better than arbitrarily ordered sequences (Brown & Murphy, 1975). Moreover, their memory for order was substantially improved when a series of to-be-remembered words were embedded within a meaningfully connected narrative.

In an extensive series of studies on the early stages of acquisition of temporal concepts in preschoolers, Brown and co-workers (1976) found that the provision of meaningful connections linking events in a sequence powerfully affected performance enabling young children to (a) reconstitute items viewed successively where the integrity of the sequence was not obvious, (b) maintain a series of events over longer retention intervals, (c) deal with reverse sequentiality when only one series was considered at a time. These researchers asserted:

> Because logical sequences are handled so efficiently even by the younger children, it seems reasonable to conclude that the operations involved in both simple and reverse sequentiality emerge gradually and predate operative concepts of time.
>
> Logical sequences are always easier to regenerate than are arbitrary sequences of events, indicating that even preoperational children have some ability to exploit causal and logical links to infer the most probable order of events.
>
> Furthermore, even very young children have difficulty discriminating actually experienced events from consistent foils that maintain the integrity of temporal succession. Thus the constructive processes of integration and inference are important to comprehension and memory at an early age and considerably predate true operativity. (Brown, 1976, p. 79)

While Brown and co-workers found that true operativity did not appear in young children across logical and arbitrary conditions, there was ample evidence for them to conclude that there is a period of semi-logic in the thinking of preschoolers which represents a transitional stage between pre-operational reasoning and conrete operational thought. This notion contradicts the all-or-nothing principle of previous researchers who have addressed cognitive development (Fraisee, 1963; Cromer, 1971); however, as most of the semi-logic of preschoolers was demonstrated within familiar and meaningful contexts, Brown's position is nonetheless consistent with Piaget's general thesis that logical operations emerge from the child's experience with the world.

Given the abundant evidence, then, that language and cognitive development are dependent upon real-world knowledge, it seems probable that the acquisition of before or after requires similar contextual support. This would not have been apparent, however, from the studies discussed earlier, since previous investigators have all addressed the comprehension of these terms in the absence of nonlinguistic cues. In the standard testing paradigm, the child was required to decode the meanings of before and after conjoining inherently unordered events. Thus, past research was actually centered upon discovering and explaining the child's understanding of these terms in

their most abstract and decontextualized use.

Brown and French (1976) have argued that it would be impossible for children to first learn the meanings of before and after except by hearing them used in contexts where they referred to already known sequences, and have further proposed that these terms would be understood in such contextually supported settings earlier than in settings where they established events. These ideas were supported in a study of three- to five-year-old children's enactment of logically related and arbitrarily related event pairs conjoined by before and after (Brown & French, 1976). For example:

Logical:

Before Raggedy Ann feeds the baby, she fills the bottle.

Arbitrary:

Before the dog runs away, Raggedy Ann fills the bottle.

The superior performance with logical sequences lent support to the hypothesis. However, this finding did not provide unequivocal support, since it is possible that subjects' greater success on logical sequences reflected simply a knowledge of the correct sequence of events, rather than a comprehension of the temporal terms. Under this interpretation, the data would indicate that preschoolers were able to understand the underlying concept of sequence, but would be noninformative as to the central

claim that the temporal terms were first understood in the context of meaningful sequences.

In a second study which eliminated the ambiguity of the enactment paradigm, Carni and French (1981) obtained strong support for the contextual hypothesis. These researchers tested three- and four-year-old subjects' comprehension of before and after questions referring to the order of events in established, and thus knowable, and variable, and thus unknowable sequences. The two types of sequences both described real world activities with which young children could be assumed to be familiar (previous questioning of subjects proved this to be true). Thus, this study enabled a distinction to be made between types of experience, that is, logical and arbitrary, and the comprehension of the temporal markers before and after. This is in accord with the theses of Nelson (1981) and French (1981), who argued that semantic organization appears to emerge from nonlinguistic contexts that are consistently redundant to their (linguistic) meaning.

Five event sequences were read to subjects who were required to respond to before and after questions querying the third event. Following Brown (1976), the availability of picture sequences during testing eliminated the need for subjects to remember event order to respond appropriately. However, in order to respond at an above chance level, it was necessary for subjects to distinguish between

the meanings of the two terms. That is, knowledge of the appropriate sequences of events could not, as it might in the French and Brown study, have compensated for failure to understand the meanings of the temporal terms. In addition, age differences were examined between the three-year-olds and the four-year-olds to look for developmental trends in the comprehension of before and after across the two conditions.

In this study, three-year-olds gave a remarkable 72% correct performance with logical sequences, while scoring at a chance level of 50% with arbitrary sequences. Four-year-olds gave 84% and 78% correct performance with logical sequences and arbitrary sequences, respectively. In contrast to the poor results of the previous context-independent research on preschoolers' comprehension of before and after, these data indicate that children as young as three years of age understand the meanings of these terms when given nonlinguistic cues. Furthermore, the data indicate that when given a sensitive experimental measure, children as young as four years of age can be shown to understand the meanings of the temporal conjunctions even in their abstract use.

In line with contextually oriented researchers, Carni and French proposed that children first understand the meanings of before and after with reference to known real

world event sequences and later learn their function as abstract terms used to relate inherently unordered propositions. Given the clarity of the results of the Carni and French study, and the fact that previous research has failed to account for the development of temporal relations in language on both empirical and theoretical grounds, the contextual hypothesis appears to constitute a viable alternative model of the acquisition of temporal terms.

THE RESEARCH QUESTION

The Carni and French study provided strong initial evidence for a contextual model of the acquisition of temporal terms. It thus introduces an area of inquiry that invites deeper investigation. Of the many questions which may be raised in regard to the contextual hypothesis, two are discussed here which seem to be critical to the corroboration and extension of its primary claim.

The first question concerns the stability of preschoolers' contextually constrained competence at understanding the meanings of before and after. Previous research reported that children in the early stages of acquisition respond variably across different experimental paradigms purporting to measure the comprehension of these terms. Even subtle variations in method have resulted in different types of response patterns and different levels of performance in young subjects.

Johnson (1975), considering the incompatible response patterns in E. Clark's (1971) and Amidon and Carey's (1976) tests of preschoolers' comprehension of before and after (see p. 13), was the first to observe that a single sample of subjects produced both types of response when administered both variations in task. In Clark's task, subjects

were pre-instructed to enact two different actions using a doll as a third person agent. In Amidon's task, the subjects were asked to perform two identical actions in sequence directly through the test command:

> Clark: The boy jumped the gate before he patted the dog.
>
> Amidon: Move a blue plane before you move a red plane.

As a consequence, subjects enacted two events in Clark's test, while in Amidon's test they enacted the main clause event and waited for further instructions. A dramatic difference in error patterns resulted, with subjects reversing event order in Clark's test and omitting the subordinate clause event in Amidon's test. This revealed that the language of the test items was interfering with the subjects' demonstration of their understanding of temporal order information and further showed that children may use a variety of strategies to interpret relational sentence content. These factors challenged the credibility of E. Clark's semantic feature hypothesis of the acquisition of before and after, since these patterns of response could not have been attributed to semantic features of the temporal terms.

Similarly, in Coker's study (1977) of the child's knowledge of before and after used as prepositions, five-year-old subjects gave both different performance patterns on before and after questions and different overall

performance levels with two types of task. In the first task, subjects were shown sequences of three photographed objects and asked to answer the experimenter's question: "What did I show you before [after] the X?" where X referred to objects 1, 2, and 3. In this condition, subjects used a response strategy of consistently reporting the next object following the queried object, and thus performed better on after questions than on before questions. In the second task, three photographs of different objects were shown in sequence and subjects were asked to answer the experimenter's question, "Did I show you the X before the Y or after the Y?" where X,Y referred to the order of two objects in the sequence. In this task, there was no difference in performance between the two temporal terms; however, there was a substantial decrease in overall performance on this task as compared to performance on Task 1. (40% correct on Task 2, 56% correct on Task 1).

Coker concluded that the two methods constituted different orders of difficulty in task demand. However, she then compared subjects' performance on the preposition tasks with their performance on an enactment task of before and after used as subordinating conjunctions:

Coker (1977): Ellie [the elephant] ate the cookie before she stacked the blocks.

Subjects' performance dropped to 33% and Coker proposed that the temporal terms are learned as prepositions earlier

than as subordinating conjunctions. In other words, she attributed subjects' performance on the third task to their (relative lack of) knowledge of the temporal terms. While Coker's basic thesis on acquisition order may indeed be warranted, it is questionable as to why her subjects' performance was so low. Carni and French (1981) tested four-year-old children's comprehension of before and after as subordinating conjunctions in arbitrarily related sequences using a questioning method (p. 25) and obtained 78% correct response. Likewise, Ehri and Galainis (1980) obtained 88-100% correct response after training three- to five-year-old subjects to enact arbitrarily related two event sequences in their most difficult form, i.e., where the order of mention violated event order:

> Order of mention parallels event order:
> The spoon hits the boat before the cowboy stands on the boat.
>
> Order of mention violates event order:
> Before the cowboy stands on the boat, the spoon hits the boat.

Clearly, there is some early competence in the child's understanding of before and after as subordinating conjunctions. This appears to be attributable to the modes of testing and training in the latter two studies. Nelson, using a verbal elicitation paradigm, obtained a competence at temporal understanding in young children which was unobserved even in naturalistic studies.

It seems clear that testing paradigms have the potential to maximize or minimize preschoolers' performance on tests of temporal understanding. Consequently, theoretical claims based upon the results of single experimental measures may either overestimate or underestimate the young child's temporal knowledge. Thus, while the Carni and French study showed unequivocal early competence in the comprehension of before and after in logically invariant sequences, it is still uncertain how far such contextually constrained competence extends. There are at least two possibilities that further research would clarify. On the one hand, it is possible that young children's knowledge of before and after in logical sequences would compensate for any difficulties they might otherwise experience with particular tasks. On the other hand, the young child's performance on particular measures of the comprehension of these terms might vary, in spite of contextual cues. In view of such an alternative, it may be said that preschoolers' understanding of before and after is still quite fragile, and specific to particular conditions of comprehension.

The second issue pertaining to the present research is whether or not the contextual model applies to the production of before and after. The hypothesis in question is whether young children (appropriately) produce the terms before and after with reference to logical sequences

earlier than they (appropriately) produce them in conjoining inherently unordered propositions.

There is a much smaller literature on the early production of before and after than on the early comprehension of these terms. However, a few studies (Cromer, 1968; Ferreiro & Sinclair, 1973; Keller-Cohen, 1974) have indicated that these terms do not appear in the child's productive speech to any appreciable degree until four and a half to five years of age. These studies did not discuss the use of before and after in logical sequences, and recent data from Nelson's script research and from the Carni and French study give some evidence that these terms may be used in logical sequences to a certain extent, and almost always correctly, around the end of the fourth and the beginning of the fifth year. Although methodological factors may account for the general failure of various investigators to elicit productions of these terms in younger children, there is still a possibility that before and after are first used in reference to known or probable event sequences prior to being used to establish relationships between events that bear an essentially arbitrary relationship to one another.

Cromer (1968) conducted a longitudinal study of the emergence of reference to time in the language of three young children and reported that before and after did not appear in their speech until four and a half years of age.

Ferreiro and Sinclair (1972) attempted to elicit these terms from young subjects by enacting with toys arbitrarily related two-event sequences and asking them "when" one of the two events occurred. While specific data were not reported, Ferreiro and Sinclair indicated that subjects began using these terms (correctly) in their responses at about five years of age. Keller-Cohen (1974), using a sentence repetition paradigm and _when_ questions, obtained similar results. Barrie-Blackley (1973) gave a sentence repetition task to five- and six-year-old children and reported consistently high performance. Cromer (1970) indicated that five- and six-year-old subjects had no difficulty repeating propositions conjoined by a variety of tenses and temporal terms.

Data on preschoolers' productions of _before_ and _after_ in logical sequences is much more sparse. In Nelson's (1981) work on young children's descriptions of routine events, nineteen of the forty-three subjects, ranging in age from 3:11 to 5:6, used _before_ and _after_ or both terms appropriately to relate sequentially ordered events. There were substantial productions of these terms by four-year-old subjects, but it is not clear what the distribution of such productions by age is, and there is not enough data to indicate a developmental pattern.

Carni and French tried to elicit the terms _before_ and _after_ by asking the three- and four-year-old subjects in

their comprehension study to respond to questions asking when one of the sequenced events occurred for both the logically related and arbitrarily related sequences of pictures. While about half of the subjects answered by pointing to the picture of the queried event, of the total responses to when questions using the terms before, after, and when, the three-year-old subjects gave 93% correct responses in the logical sequences and 43% correct responses in the arbitrary sequences. Thus, there is some further indication that temporal terms (before, after, when) are first used in reference to logical event sequences at the end of the fourth year. Since the task used by Carni and French did not appear to be particularly effective in eliciting before and after, a question asked by this research is whether the contextual hypothesis applies to the production of these terms.

In view of the sensitivity of young children to the demands of particular tasks, there is also an issue of whether the hypothesized use of before and after in logical sequences would obtain across different measures of the production of these terms. This may be tested by contrasting logical and arbitrary sequences in the production methods used by previous researchers (when questions and sentence repetitions) within a single sample of subjects.

Specifically, the repetition paradigm was selected because it seemed likely to provide a rich source of

information about the acquisition of before and after, since there has been strong indication that repetition and spontaneous production of these terms are closely linked. Keller-Cohen (1974) reported no significant differences between three- and four-year-old subjects' performance on verbal imitations of before and after sequences and their response to when questions through the use of these terms. Maratsos and Kuczaj (1974) reported that three- and four-year-old subjects' competence in elicited imitations didnot surpass their spontaneous productions; Bloom, Hood, and Lightbown (1974) reported a developmental shift from spontaneous imitation to spontaneous production of if, when, and why in children who tended to spontaneously imitate the speech of others.

Furthermore, researchers using the verbal imitation task reported that the form of children's imitations changed with age, implying that the child recodes the stimulus material in attempt to repeat a stated sequence. Keller-Cohen (1975) and Slobin and Welsh (1973) found that once a stimulus sentence exceeded a child's auditory memory, the child's imitation deformed the sentence in agreement with the child's cognitive and linguistic system. Slobin and Welsh, asking 2:5 year-old "Echo" to imitate her own language productions, even found an appropriate use of after in the recoding of a stimulus sentence:

Model: If you finish your eggs, up, Daddy, you
you can have your coffee.

Child: After you finish your eggs all up, Daddy, then you can have your coffee.

Ten minutes later:

Model: After you finish your eggs all up, Daddy, then you can have your coffee.

Child: You can have your coffee, Daddy, after. . . .

The child even reversed the order of events in the order of mention of events!

It would be pertinent to the contextual hypothesis if preschoolers correctly repeated logical sequences of events conjoined by before and after and incorrectly repeated arbitrarily related sequences so constructed. The children could then be assumed to be relying upon prior knowledge structures in imitating the logical sequences. This assumption would be reinforced if the children also reversed the event order of the temporal term in sequences of events which reversed the logical order of events: Raggedy Ann fed the baby before she filled the bottle. If such data patterns were not produced, however, the children might be displaying a sensitivity to the task demand, perhaps combined with a developmental difficulty at using before and after.

Apart from the two main questions of this thesis is the issue of the role of real world constraints in determining the relationship between the early comprehension and the early production of before and after. Keller-Cohen (1975) reported that performance on measures of the

production of before and after was significantly lower than performance on measures of the comprehension of these terms. This result parallels the general opinion of developmental psycholinguists on the relationship of the early production to the early comprehension of speech. However, it is possible that preschoolers appropriately produce the terms before and after in logical sequences while failing to comprehend their meanings in conjoining inherently unordered propositions, thus reversing the typical pattern of language acquisition. Such a possibility might be the result of an interaction between the type of sequences and the demands of a particular situation of production and comprehension. An intrasubject comparison of production and comprehension of before and after across logical and arbitrary sequences would provide information about this possibility. However, it must first be determined whether or not the early comprehension of before and after in logical sequences precedes such production of the terms.

In order to test the various dimensions of the contextual hypothesis discussed here, two experiments were designed and conducted with preschoolers ranging from three to six years of age.

METHODS

The main study consisted of two experiments which included two measures of the production of before and after and one measure of the comprehension of these terms. Within each experiment and each measure, performance on logically related sequences conjoined by the terms before and after was compared with performance on arbitrarily related sequences as conjoined. A single set of 48 subjects, divided into three age groups (three-, four-, and five-year-old children), was administered both tests.

One experiment measured both comprehension and production using a questioning method. The second experiment measured only production, using a sentence repetition paradigm. The repetition task was given first to all subjects over two days of testing, and the question task was given second, in the same manner. This design was intended to obtain complete data for each of the experiments, since pilot data indicated that young children were not likely to respond to different types of task given too close together in time. The completion of one task by all of the subjects left a hiatus between the first and second testings for each group.

A reward system was used in all but one nursery (which did not permit rewards) in which subjects received a

sticker upon completion of each task on each day of testing.

The three-year-old subjects were also given the Carni and French picture task about one month after they completed the repetition task and the toy task. Since a t-test showed no main effect for logical and arbitrary sequences on the toy task, the only way to determine whether this was due to the method of testing or to a subject bias was to test the same subjects on the original test that showed significant condition differences among three-year-olds. A subject bias seemed to be plausible because, due to a difficulty in testing three-year-olds on the repetition task, the subjects on the toy task were already pre-selected for their ability to repeat sentences. The picture task was given over two days of testing, using stickers as rewards.

Age	Task (in order of presentation)						
	Repetition			Toys		Pictures	
	L[a]	LR[b]	A[c]	L	A	L	A
3							
4							
5							

a= Logical
b= Logical Reversed
c= Arbitrary

Subjects

The subjects came from the Broadway Presbyterian Nursery, the Brownstone School, the Columbia Greenhouse Nursery, the Hunter College Elementary School, and the Morningside Montessori School. They were divided into three groups which ranged in age from 3:1 - 3:11, 4:1 - 4:11, and 5:0 - 5:10, with mean ages of 3:8, 4:6, and 5:5, respectively. There were equal numbers of boys and girls at each age. All of the children spoke English as their native language.

Comprehension and Production Task - Toy Sequences

Methods

Comprehension of the terms *before* and *after* was measured by subjects' responses to questions containing these terms. The questions referred to the order of events in four-event logical and arbitrary sequences. The sequences were enacted with toys by both the experimenter and the subjects, and the toys remained in the order of use before the subjects were questioned.

Productions of the terms *before* and *after* were measured by the subjects' responses to questions asking *when* each of three events in the sequences occurred.

Materials

Eight four-event sequences were composed that concerned typical activities and objects in the lives of young children. In four of these sequences, the temporal structure of the actions was logically invariant, while in the rest, the temporal structure was arbitrary. For example:

Logical: First we fill the bottle, then we close the bottle, then we feed the baby, then we put the baby to bed.

Arbitrary: First we feed the frog, then we brush the doll's hair, then we draw a circle, then we close the purse.

Toys. Toys were used to represent persons and objects in the sequences. For the above sequences the materials used were a baby doll, a bottle, a crib, a toy frog, a bowl, a doll, a brush, a notepad, a purse.

Design

There were four before and after questions for each sequence. The questions were of the form "What did we do before/after event X," where X refers to events 1-4. Questions asking "before 2" and "after 3" were not included; thus the subjects had two choices for "before 3" and "after 2" and three choices for "after 1" and "before 4" questions. Overall, there were two before and two after questions for each sequence, making eight before and eight after questions for the four logical and for the four arbitrary sequences. Within each sequence, the before/after questions were randomly arranged with the restriction that

the two before and the two after questions did not follow each other in succession.

There were three questions per sequence of the form, "When did we do X?" where X referred to events 1 - 3. The three questions of this type were randomly arranged for each sequence and followed the before and after questions.

Each subject received two logical (L) and two arbitrary (A) sequences on each of two days of testing. Half of the subjects received the order LALA on day 1 and ALAL on day 2; this order was reversed for the rest of the subjects.

Procedure

The subjects were tested individually. The interviewer began by explaining that she and the subjects were going to play some games with toys and that she would ask some questions about the games. She then enacted the first sequence and had the subject repeat it until it was done correctly. The interviewer then asked the questions and recorded the subject's response on prepared answer sheets. The questions were repeated if there was no response after a few minutes, and the sequence was enacted once more by the experimenter.

The entire procedure was used for all sequences. No negative or corrective feedback was given. The procedure was explained to the subjects on both days of testing.

Comprehension and Production Task - Picture Sequences

Methods

This task utilized the method employed by Carni and French (1981). Comprehension of the terms before and after was measured by subjects' responses to questions containing those terms. The questions referred to the order of events in five-event sequences that had either a logically invariant event order or an arbitrary event order. The sequences were both read aloud and presented in picture sequences.

Productions of the terms before and after were measured by subjects' responses to questions asking when one of the sequenced events occurred. Although most of the subjects in the Carni and French study responded by pointing to the queried event, an interpretation of the when questions as where did the pictured event appear, this method was preserved in an attempt to replicate Carni and French's results.

The subjects were asked to retell a few of the logical and arbitrary stories before the questions were asked as a check on whether they could refer to the pictures as prompts to the events in order of mention.

Materials

Sixteen five-event sequences were taken from the Carni and French study. All were about typical events in the

lives of young children. In eight of the sequences, the temporal structure of the actions was relatively invariant, while in the rest, the temporal structure was arbitrary. The themes of the sequences are listed, as follows:

Logical:		Arbitrary:	
A	Subway	A'	Walk in the Park
B	Morning	B'	Playground
C	Birthday Party	C'	Tricycle
D	Bedtime	D'	Hide and Seek
E	Grocery Store	E'	Visit from Aunt
F	Dressing	F'	Looking for Gloves
G	Restaurant	G'	Playing at Home
H	Cookies	H'	Finding a Dollar

The sequences concerned a boy (George) and a girl (Jane) as central characters. There were four George and four Jane sequences for each of the logical and arbitrary conditions. The sequences varied in terms of vocabulary and sentence structure, but to control the comprehension factor, the logical and arbitrary sequences were paired and matched for sentence structure and repetition of verbs. This matching occurred on an event-by-event basis so that each event of a logical story had a corresponding structure in an arbitrary story. For example:

1	Logical:	Subway	They walked downstairs to the subway.
1	Arbitrary:	Park	He walked through the flower garden.
3	Logical:	Subway	They put tokens in the turnstile and walked through.
3	Arbitrary:	Park	He sat down and ate a candy bar.

2	Logical:	Dressing	He put on his shoes and socks.
3			He put on his pants and sweater.
2	Arbitrary:	Gloves	She looked in the closet.
3			She looked on the kitchen table.

The sequence pairs were also matched for temporal terms such as when, then, and next. For example:

1	Logical:	Bed	They all ate supper together when daddy came home.
1	Arbitrary:	Hide & Seek	Jane crawled under the piano when her sister turned her back.

1	Logical:	Grocery	They got a shopping cart.
2			Then Jane sat in the little seat.
1	Arbitrary:	Aunt	They played with Jane's new doll.
2			Then they colored in coloring books.

There was a mean number of 40 words per logical sequence and of 36 words per arbitrary sequence. Each sequence was introduced by a setting sentence and followed by two questions. One question was of the form "What happened before/after event 3?" The other was of the form "When did X event happen?" where X referred to events 1 - 5 about equally often.

Half of the sequences were followed by before questions and half were followed by after questions. The sequences were given in two lists, which alternated which sequences were followed by before questions and which were

followed by after questions. The subjects were divided into two groups and each group received one list of (all 16) sequences.

Each sequence and question set was typed onto an answer sheet with a scoring system for the experimenter. This consisted of (1) the numbers 1 - 5 to be circled if the subjects pointed to a picture; (2) a space for recording the subjects' verbal responses.

Pictures. Sixteen sets of five individual black and white line drawings (9 by 15 cm) were reproduced from the Carni and French materials. They were pasted a few inches apart in a horizontal array on poster board, one board for each sequence.

Design

The sixteen sequences were randomly arranged with no more than two logical or two arbitrary and no more than two before or two after questions following each other in succession. The sixteen sequences thus arranged were divided in half; the resulting two sets had four logical and four arbitrary stories and were given over two days of testing.

Procedure

The subjects were tested individually. They were told that they were going to be read some stories and shown some pictures. The experimenter read the first story and showed the subject the picture block. She then asked the subject

to retell the story, using the pictures. Corrections were made, but the before and after questions were subsequently asked even if the subject had difficulty retelling the sequences. (The subjects could not always say what they recognized in the pictures.) If there was no response made from the subject, the before/after questions were repeated with the experimenter pointing to the queried events. The when question followed each before or after question and was repeated if there was no initial response from the subject. All responses were recorded on the answer sheets and the procedure was explained on both days of testing.

Production Task - Repetition

Methods

In order to examine whether young children's productions of the terms before and after are learned from prior cognitive representations of event sequences, the subjects were asked to repeat two-event sequences (as told by the experimenter using a puppet), conjoined by these temporal terms. The sequences were composed of logically related and arbitrarily related events and of reversals of the logical sequences. Correct repetitions and error patterns were analyzed as measures of performance.

Materials

Twenty-four two-event sequences were composed from common activities in the lives of young children. Eight

of these activities had a logically invariant order of events and eight had an arbitrary order of events made up from the same events of the logical sequences. Another eight sequences reversed the event order of the logical sequences. This resulted in impossible or improbable orders of action. For example:

Logical: After Simple Simon put on his socks he tied his shoes.

Reversed: After Simple Simon tied his shoes he put on his socks.

Arbitrary: After Simple Simon tied his shoes he went inside.

Half of the sequences contained the term before and half contained the term after. Half of the before sequences preserved the event order in the order of mention and half violated the event order in the order of mention; the same was done for the after sequences. This resulted in four forms for each sequence, e.g.:

After Preserve: After Simple Simon put on his socks he tied his shoes.

After Violate: Simple Simon tied his shoes after he put on his socks.

Before Preserve: Simple Simon put on his socks before he tied his shoes.

Before Violate: Before Simple Simon tied his shoes he put on his socks.

Subjects' verbal imitations were recorded on an audio cassette for half of the subjects and were handwritten onto answer sheets for the other half.

Design

The twenty-four sentences were divided into four lists which differed according to which sentences contained the term before and which contained the term after, and according to which sentences preserved the event order in the order of mention and which sentences violated the event order in the order of mention. Each list thus contained two before-preserve, two before-violate, two after-preserve, and two after-violate sentences for each condition (Logical Arbitrary, Logical Reversed). The subjects were divided into four groups and each group received one list.

The 24 sequences in each list were randomly arranged, with the provisions that (1) no more than two before or two after sequences followed each other in succession; (2) no more than two "preserve" and two "violate" orders of mention followed each other in succession; (3) no more than two sequences from any condition followed each other in succession.

The 24 randomly arranged sequences were divided in half and given over two days for the younger children. Most of the older children, however, were able and eager to sit through all 24 sentences in one session.

Procedure

The subjects were tested individually by the experimenter. Using a puppet called Simple Simon, the

experimenter told the subject that she and the subject were going to play a game called "you-say-what-I-say." (This procedure followed Furnald, 1972). She said the first sentence and asked the subject to repeat it. The sentence was repeated once or twice if the subject did not respond at first. This procedure was used for all sequences. The subjects were reinstructed about the procedure on the second day.

RESULTS AND DISCUSSION

Comprehension of Before and After

Toy Task

The main intent of this task was to test two competing sets of hypotheses: (A1) That three-year-old subjects' responses to before and after questions referring to sequences of events enacted with toys would be superior when the sequences had a logical event order than when they had no inherent order; (2) that differences in performance would converge with age in increasing overall performance. Support for this hypothesis would corroborate the study of Carni and French (1981) in which 1) three-year-old subjects performed significantly better in their responses to before and after questions referring to logically ordered picture sequences than in their responses to such questions referring to arbitrary picture sequences; 2) four-year-old subjects showed equally high performance in response to before and after questions referring to both logical and arbitrary picture sequences. (B1) That three-year-old subjects would perform comparably and poorly across both logical and arbitrary sequences; (B2) that overall performance would increase with age.

Performance on the toy task was measured by the number of correct responses to the questions for each condition (logical/arbitrary). A two (condition) by three (age) ANOVA was carried out on the data. There were no significant differences in performance by sex of the subjects, so this variable was removed from the analysis. The means for each condition by age appear in Table 1. Graphs of these means appear in Figure 1.

There was a significant difference in performance across age, $F(2,45) = 3.64$, $p < .04$; the subjects apparently improved in their understanding of before and after with age and, ostensibly, with their general cognitive and linguistic development. This supports the second prediction of both hypotheses. However, the test failed to show a significant difference in performance across conditions. Since there was a significant interaction between age and condition, $F(2,45) = 3.39$, $p < .04$, though, post hoc tests (Tukey tests, t_{95}) were performed comparing the means within and between conditions for each age.

Age Differences, by Condition

There was no significant difference in performance with logical sequences between the four- and five-year-olds who showed high performances in this condition $\bar{X}_{4L} = .83$, $\bar{X}_{5L} = .90$. There was however, a significant difference in performance between the four- and five-year-olds and the three-year-olds, $t_c = 1.09$, $t_{3-4} = 1.2$, $\bar{X}_{3L} = .68$. Thus, at age four,

Table 1

Toy Task and Picture Task: Proportion of Correct Responses by Age and Condition

Toys				Pictures	
Age	Logical	Arbitrary		Logical	Arbitrary
3	.68	.73		.70	.59
4	.83	.82			
5	.90	.89			

Age: $F(2,45)=3.64$, $p < .04$

Table 2

Toy Task and Picture Task: Proportion of Correct Responses Made to Before and After Questions[a]

	Toys				Pictures			
Age	Logical		Arbitrary		Logical		Arbitrary	
	Before	After	Before	After	Before	After	Before	After
3	.43	.57	.48	.52	.44	.55	.40	.60
	$t(15)=2.12$, $p < .05$							
4	.46	.54						
	$t(15)=3.55$, $p < .01$							
5	.46	.54						

[a] These proportions equal the proportions of the proportions presented in Table 1.

Figure 1: Comparison of Performance with Logical and Arbitrary Sequences - Toys

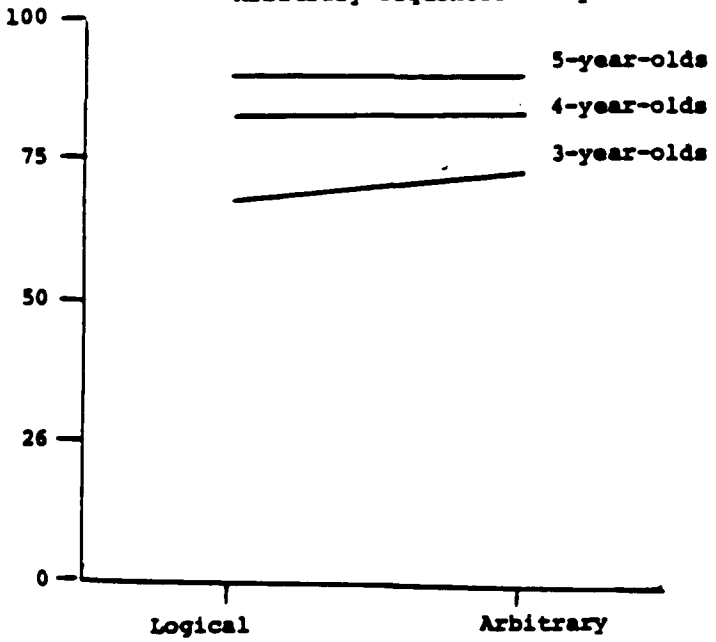
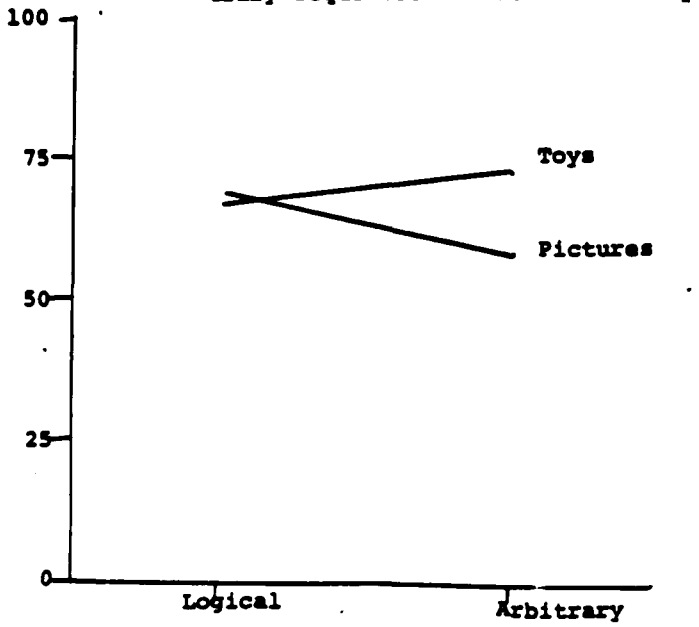


Figure 2: Comparison of Performance with Logical and Arbitrary Sequences - Pictures and Toys - Age 3



there seems to be a significant increase in the understanding of before and after in logical sequences. There was no significant increase in performance with age in the arbitrary condition.

Condition Differences, by Age

There was no significant difference in performance between logical and arbitrary conditions among the four- and five-year-olds. However, contrary to the hypothesis, there was a significantly better performance with arbitrary sequences among the three-year-olds, $t_c = .434$, $t_3 = 1.40$.[2]

Hypothesis B (p. 54) predicted that the three-year-old subjects would show comparable performance across conditions but the means were not expected to be substantially above chance. In this task, the level of chance is based upon the average of the chances of guessing correctly for each question. For questions After 1 (A1) and Before 4 (B4) there was 1 wrong answer (A1 or B4, respectively) and any other choice would be correct. The subject would have a 75% chance of guessing correctly. For questions After 2 (A2) and Before 3 (B3) there were two wrong choices (A1, A2 and B3, B4, respectively) and the other two choices were correct. Thus the chance level for these questions is

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[2]This might be accounted for by the fact that the critical t-value was based upon an error term that included the performance of the other subjects, making the difference in the means of the three-year-olds significant only relative to that of the four- and five-year-olds. A 5% difference in the means is, in itself, not a meaningful difference.

50%. The average chance of guessing correctly on any given question is therefore 62%. If this is so, then the means of 68% and 73% among the three-year-olds are above chance but do not appear to reflect strong competence with before and after.

Individual Strategies

An examination of individual patterns of performance among the three-year-olds seemed to show a natural division of the subjects into "high performers" and comparatively "low" performers. The subjects in the first group (7 subjects) scored above chance across conditions with a median score of .88/.88. The rest of the subjects ("low" group, 9 subjects) scored about chance or below across conditions and showed a distinct pattern of lower performance with logical than with arbitrary sequences, the median score being .56/.69. Only 2 subjects in the "high" group showed this pattern. (A sign test showed a significantly greater performance with arbitrary sequences overall $t(16)=26$, $p < .05$.) It is possible that the subjects either understood the terms across conditions or developed some nonlinguistic strategy of response that favored arbitrary sequences, since there seems to be no justification for the subjects' understanding before and after in arbitrary sequences while failing to understand their meanings in logical sequences.

Previous research (Coker, 1977; Carni & French, 1981) reported that pre-comprehenders frequently use a response

strategy of reporting the "next-event-in-time" following before/after questions referring to events in a sequence. If the central event of a sequence is queried (e.g., 1 2 3 4 5), such a strategy will result in correct answers for after questions but not for before questions, since there will be more choices of events that follow the queried event. This would increase the total number of correct after responses relative to the number of before responses. In the present task, different events were queried, A1, A2, B3, B4. A subject could use the next-event strategy on all but B4, since no event follows event 4. In this case, the subject might choose a previous-event-in-time. This would balance the numbers of correct responses between before and after questions. The number of errors from greatest to least would be expected to fall into the following order: B3, B4, A2, A1. This was in fact the pattern of the three-year-olds' responses.

However, in this study, the subjects often said "I don't know" or "nothing" for "What happened before 4?" questions ("nothing" meaning that nothing follows event 4. This shows a correct understanding of sequence but not of the term before). This response would have increased the number of errors on B4 questions, thereby lowering the total number of correct responses to before questions. A t-test of the differences in performance on before and after questions showed a significantly lower performance

with before questions with logical sequences only for the three- (and also the four-)year-olds. (These data appear in Table 2.) Why should this be? Considering the subjects' knowledge of the natural order of events in the logical sequences, it is likely that when posed with a B4 question in the logical condition, a subject using a next-event strategy would know that choosing a previous event would be wrong. She would therefore say "nothing" rather than make this choice. However, in the arbitrary condition, where there is no logical conclusion to the sequence at event 4, a subject might be more likely or just as likely to choose a previous event, since it could reasonably follow event 4.

Another way of looking at this pattern of responses is that pre-comprehenders or subjects who could not use their knowledge of before and after with this task found a next-event strategy to be more compelling with logically-invariant sequences because of their real-world experience, and so used this strategy in the logical condition while using either or both the next-event and previous-event strategies with inherently unordered sequences.

In either event, it seems to be the case that prior knowledge of event orders served to reduce performance on this task while a lack of knowledge of event order served to increase performance! In contrast to the prediction of the contextual hypothesis, mental representation of

sequences did not help to support competence with before and after in the youngest subjects. Secondly, there is no evidence for how the young child might initally come to learn the meanings of these terms. A reexamination of the task shows that this would not have been possible to determine even if real-world knowledge had supported competence, since the question method provided no means by which the subject could have deduced the meanings of the temporal terms from knowing the order of events in a sequence. Whereas in a statement such as Raggedy Ann took her hat off before she combed her hair, the subject could have deduced the meaning of before from knowing the natural order of events, in a question such as What did Raggedy Ann do before she combed her hair? knowledge of event order in itself provides no clue to which of the two possible meanings of the terms "prior to" or "following" the question referred to. This is critical to interpeting the results of Carni and French's picture task, since, in order for the subjects to have performed so well with logical sequences, they had to already have had some prior knowledge of the term. Then their knowledge of real world sequences would have, in that task, helped them to "read off" the picture sequences to find the correct answer, while a lack of knowledge of sequence apparently made this process more difficult. Thus, real world knowledge can facilitate an early competence with before and after when the child has

some knowledge of these terms. The differences in performance of young subjects on Carni and French's task and the present task of comprehension would presumably be due to differences in the tasks themselves. In order to control for a sample bias, however, and to see whether subjects in the "low" group were truly pre-comprehenders or comprehenders who could not use their knowledge of before and after across tasks, it is necessary to see how the three-year-olds in this study performed on both measures of comprehension.

Picture Task

An ANOVA was carried out on the numbers of correct responses the subjects made to before/after questions. The results supported the Carni and French finding with performance between logical and arbitrary conditions approaching a significant difference in favor of logical sequences, $\bar{X}_L = .70$, $\bar{X}_A = .59$ ($p < .06$). (There were no significant differences in performance with the control variables of list and sex so these were removed from the analysis.) The mean proportion of correct responses for the picture task appear in Table 1. Graphs of the means appear in Figure 1.

Individual Strategies

Of the 16 three-year-olds there were 4 "high" performers (scoring .75 and above across conditions with

means of .90/1.00) and 6 "low" performers (scoring .50 and below, with means of .49/.48). The remaining subjects showed a pattern of high performance with logical and low performance with arbitrary sequences, with mean performances of .75/.35. In contrast to the performance on the toy task, there was significantly better response in the logical condition according to a sign test $t(16) = 16$, $p < .01$. In the picture task, the subjects had 3 possibilities of being incorrect in their choice for every question and the other 2 choices would be correct. Therefore the level of chance is 40%. It appears, then, that in subjects showing distinct response patterns between conditions on this task, real world knowledge strongly facilitated competence with before and after while lack of knowledge of event order resulted in a performance that was little better than chance.

Intraindividual Strategies

Because of the difference in chance levels on the two comprehension tasks, the mean proportions of correct responses to the tasks cannot be directly compared. Therefore, the scores were compared according to how much they differed from the level of chance within tasks. Table 3 presents the proportions of correct responses for each task within subjects along with the difference in these proportions from their respective chance levels. Subjects who performed well across conditions on the picture task tended

Table 3

Three-Year-Olds' Comprehension Scores

(Percent of Correct Responses)

	Picture Task				Toy Task			
Subject	L	A	D_L[a]	D_A[b]	L	A	D_L	D_A
5	100	100	+60	+60	100	100	+38	+38
4	100	100	+60	+60	85	75	+28	+13
14	88	100	+48	+60	56	75	- 6	+13
3	75	100	+35	+60	88	94	+26	+32
13	88	25	+48	-15	88	88	+26	+26
15	75	50	+35	+10	56	69	- 6	+7
12	75	38	+35	- 2	69	56	+ 7	- 6
11	75	25	+35	-15	100	100	+38	+38
10	75	25	+35	-15	56	69	- 6	+ 7
1	63	50	+23	+10	63	63	+ 1	+ 1
7	50	63	+10	+23	46	53	-16	- 9
16	50	50	+10	+10	75	69	+13	+ 7
9	50	50	+10	+10	38	63	-24	+ 1
8	50	38	+10	- 2	69	94	+ 7	+32
6	38	50	- 2	+10	50	69	-12	+ 7
2	38	25	- 2	-15	56	69	- 6	+ 7

a= D_L = Difference from chance level for logical condition
Chance for picture task = 40%
Chance for toy task = 62%

b= D_A = Difference from chance level for arbitrary condition

to perform similarly on the toy task, although they did not do as well as on the picture task. Subjects who performed poorly on the picture task also performed poorly on the toy task. This left 6 subjects, or 38% of the sample, who showed the Carni and French response pattern. Two scored well across conditions on the toy task but the other 4 fell into the "low" group. While 6 subjects are too few on which to make sound generalizations about what the comprehension tasks reflect, it is clear that the Carni and French-type subjects were variable in their performance on the toy task and, secondly, that they could not, for the most part, make use of their demonstrated competence with before and after on the picture task on the second measure of comprehension. In other words, real world knowledge could not facilitate competence with before and after across the two tasks. For the 2 unaccounted for subjects who performed well on the toy task and well with logical picture sequences, it is possible that something about the arbitrary sequences of pictures obscured a demonstrated competence with the temporal terms.

It is not clear which aspects of the toy task were central to the differences in performance between tasks within subjects. Possibly, the greater number of questions in the toy task made this the harder task. Perhaps the mode of representation of sequences, "enactive" (toys) and "iconic" (pictures), to use Bruner's (1966)

distinction, made a difference. Under this interpretation, the "enactive" mode of representation would not have made the toy task easier; rather, the fact that the "actions disappeared" (although the props remained) after the sequences were enacted might have made it more difficult for the subjects to recall the events during the questioning. In the picture task, the actions were portrayed in the pictures and remained as a possible memory aid during questioning. Overall, the comparison of performances between tasks for individual subjects strengthens the position that real world knowledge may not be an overriding support to early comprehension of before and after.

The Production of Before and After and Its Relation to Comprehension: "When" Questions

The question was raised as to whether preschoolers would produce the terms *before* and *after* in reference to logically related events prior to producing them in reference to inherently unordered sequences. The contextual hypothesis proposed that the young child's knowledge of logical sequences would facilitate the use and correct use of these terms in such sequences during the period of acquisition. After mastering these terms, the child would be able to use *before* and *after* to refer to more abstractly related propositions. It was also proposed that the child's production of *before* and *after* in logical sequences would be likely to precede the comprehension of these terms in arbitrary sequences.

In order to elicit the terms *before* and *after*, the subjects were asked to answer questions asking *when* the first three events in the toy sequences occurred,* for both the logical and the arbitrary conditions.

Scoring

Each subject's responses were categorized as follows, for each condition, respectively:

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*When questions were also asked on the picture task, which was given only to the three-year-old subjects.

I.

1) After correct

2) After incorrect

3) Before correct

4) Before incorrect

II.

1)	When correct	When do we fill the bottle? When it's time to eat. When do we put the leash on the dog? When it's time to go for a walk.
2)	When incorrect	When do we pick up the receiver? When we're finished.
3)	When-as-After	When do we feed the baby? When we close the bottle.
4)	When-as-Before	When do we feed the baby? When we put her to bed.

III.

1)	Temporal Markers correct	First, Second, Third, Next, Last, At the beginning, In the middle, In the morning.
2)	Temporal Markers incorrect	See (1), also Yesterday
3)	General Temporal Markers	Now, Just Now, Today, Just a second ago.

IV.

1)	Other incorrect	- pointing to an object - giving an atemporal response - itemizing events in the sequence - saying "here" (rare)
2)	No Response or "I don't know."	

The subjects' responses were pooled into the following response categories, by age: (1) Before, After, and specific temporal markers (First, Last, etc.); (2) When, (A separate category was established for when responses in order to make a comparison with previous reports of preschoolers' use of when questions.); (3) Nonspecific (general) temporal markers such as Now, Today; (4) No Response or Other incorrect responses; (5) Pointing (picture task only). The proportions of responses falling into each category by age were determined as were the proportions of temporal term and when responses used correctly within categories (1) and (2). The relative proportions of Before and After responses and the relative proportions of When-as-After and When-as-Before responses were also determined. These data appear in Table 4.

Condition Differences and Age Differences

There were clear increases in both the frequency and accuracy of the use of before and after with age, but there was no evidence that these terms were used more often or more appropriately in reference to logical sequences, for

Table 4

Responses to *When* Questions in Logical (L) and Arbitrary (A) Sequences

	Pictures Age 3		Toys Age 3		Toys Age 4		Toys Age 5	
	L	A	L	A	L	A	L	A
4.1 Proportion of Total Responses to *When* Questions by Response Category:								
Before/*After*, Specific Temporal Terms	.24	.23	.30	.38	.54	.64	.75	.85
When Responses	.11	.02	.16	.05	.18	.10	.11	.03
Nonspecific Temporal Markers	.08	.08	.09	.11	.00	.00	.00	.00
No Response, Other Errors	.39	.40	.45	.46	.28	.26	.13	.12
Pointing	.18	.27						
4.2 Proportion of Correct Responses by Response Category[a]								
Before/*After*, Specific Temporal Terms	.81	.78	.60	.70	.81	.86	.79	.91
When Responses[b]	.71	.00	.60	.27	.79	.32	.95	1.00
4.3 Proportion of *Before* Responses Relative to *After* Responses	.35	.29	.44	.38	.15	.24	.25	.23
Proportion of *After* Responses Relative to *Before* Responses	.65	.71	.56	.62	.75	.76	.75	.77
4.4 Proportion of Correct *Before* Responses Relative to Total *Before* Responses	.64	.50	.58	.69	.85	.92	.85	.94
Proportion of Correct *After* Responses Relative to Total *After* Responses	.90	.90	.66	.74	.79	.80	.86	.84

a = determined with respect to the total responses per response category

b = represents diminishing numbers of subjects with age

Table 4 (continued)

	Age 3		Age 3		Age 4		Age 5	
	L	A	L	A	L	A	L	A
4.5 Proportion of When Responses in When-as-After	.75	.00	.75	.33	.75	.42	.63	.00
When-as-Before Responses	.25	.00	.25	.67	.25	.58	.37	.00

any age group. Apart from the group means, no individual subject showed a pattern of correct use of before and after in logical sequences only. Furthermore, there were slightly more before and after responses in the arbitrary condition across age. Why this should be so is not clear, unless, contrary to the contextual hypothesis, children who are first mastering the use of these terms are more attentive to the order of events in unordered sequences than in already known sequences.

The proportion of before and after responses substantially surpassed the proportion of when responses at each age. This result stands in contrast to previous research (Ferreiro, 1971; Keller-Cohen, 1975) which claimed that when responses surpassed before and after responses at ages three and four.

Before/After Differences

The term after was used more often than the term before across age and condition. This gives partial support to the contextual hypothesis, since it is reasonable to assume that after is the term used more frequently in reporting sequences of events. It may also be the case that before is a cognitively more difficult term to master, since the child must move backwards within the sequence in order to refer to previous events. In response to "When did Event #1 occur?" the four- and five-year-old subjects often said, "First," "At the beginning," and even "After

we did the last game [sequence]," instead of using the term before (i.e. before events 2, 3, or 4). The numbers of other temporal terms used is given in Table 5. Such substitutions might account for the after:before proportions of responses of 81%:20% among the four-year-olds and 75%:25% among the five-year-olds.

The proportions of after:before responses among the three-year-olds were 59%:41%, but the proportions of those used correctly was lower than in the other age groups.

When Responses

The term when was used overwhelmingly in logical sequences across task (pictures, toys) and age; furthermore, when was used correctly in the majority of these responses to logical sequences. It is possible that the use of when represents a response strategy for answering when questions when the child was uncertain of which temporal term to use (before or after). In this case, the child would have used when as a substitute for before and after, as in the example, When do we feed the baby? When (meaning before) we put her to bed, or When do we feed the baby? When (meaning after) we close the bottle. In explanation of the condition difference in the use of when, it is plausible that the child heard the term when used in place of before and after in familiar event sequences in everyday discourse, as in the example, When do we eat supper? When (meaning after) Daddy comes home. This suggests an influence of real world

Table 5

Temporal Markers Used Correctly in Place of *Before* and *After*

Temporal Markers[a]	Age 3	Age 4	Age 5
First	5	31	35
Second	1	1	13
Third	1	1	5
Next	0	1	0
At the beginning	0	0	2
In the middle	0	0	1
In the morning	0	0	1

[a]Logical and arbitrary conditions are combined.

knowledge in the child's responses. However, it is not clear that this influence was facilitative, since the lower proportion of when responses in the arbitrary condition is compensated by a higher proportion of before/after responses rather than a higher proportion of errors (no responses, atemporal responses, etc.). (See Table 4).

It is possible that the child's option of using when responses in the logical condition suppressed responses that would otherwise have been made by the terms before and after. This would make the influence of real world knowledge deleterious in this task. It is also possible, though, that a subject using before and after in place of when in arbitrary sequences would show more incorrect use of before and after if she did not have true understanding of these terms. An examination of the scores of the individual subjects who made when responses to logical sequences showed no difference in the proportions of correct and incorrect before/after responses made in the logical and arbitrary conditions. (The subjects who used when as a response to logical sequences also used the terms before and after to some extent in this condition.) Furthermore, there were equal increases in both the numbers of temporal terms used and the numbers of errors made in the arbitrary condition as compared to the logical condition. These increases were significant at the .95 level by sign tests.

Logical				Arbitrary			
T+[a]	T-[b]	Wh[c]	A[d]	T+	T-	Wh	A
8	8	24	32	13	13	3	43

a=correct use of before and after
b=incorrect use of before and after
c=When responses
d=Atemporal responses

(The numbers represent the total numbers of responses per response category for the 6 subjects who used when to an appreciable degree.) Thus, it is difficult to determine whether the subjects' real world knowledge was facilitative to their competence at understanding the use of before and after or not.

The Development of Productive Competence

For each age group, every subject's when responses were totalled according to the numbers of responses made by correct and incorrect temporal terms, correct and incorrect when statements, and atemporal responses (including No Response answers), respectively. The average numbers of responses made by temporal terms and when is presented in Table 6, where the increasing frequency and accuracy of the use of temporal terms by age can be observed. A Chi-Square analysis showed a significant difference in the numbers of subjects using temporal terms, when statements, and atemporal responses by age, $X^2 = 9.23$, $df = 6$, $p < .05$. A separate analysis of the four- and five-year-olds showed no significant differences in the numbers of subjects falling

into these categories, so that the overall significance may be accounted for by the more scattered distribution of the three-year-olds. The table of cells for the Chi-Square analyses is shown in Table 7.

The Emergence of Before and After

Within the three-year-old group, there seemed to be a developmental shift from atemporal responses in answer to when questions, to the use of when responses, to the use of the temporal terms--before, after, and a few others. This sequence was highly suggested by the finding that there was very little overlap among the subjects in the use of before and after, when, and atemporal responses; that is, the responses to each of these three categories seem to have been made by different subjects. The average comprehension scores were determined for each of the three groups of subjects; these scores increased in parallel with the following order of responses to when questions--atemporal responses, when responses, before/after responses. These data appear in Table 8.

The Relationship between Comprehension and Production

In order to test the hypothesis that the comprehension of before and after and the production of these terms are related to each other, Spearman's Rank-Order Correlation coefficients were computed for the subjects' ranked pairs of comprehension and production scores for each age group.

Table 6

Average Numbers of Temporal Terms (T) and When (Wh) Statements used Correctly (+) and Incorrectly (-)

Age	T+	T-	Wh+	Wh-
3	5.4	1.9	1.7	.7
4	13.4	1.1	1.4	.6
5	16.0	3.0	.5	.1

Table 7

Chi-Square Cells

Numbers of Subjects Making Temporal Term (T), When (Wh), and Atemporal (A) Responses to *When* Questions

Age	T	Wh	A
3	6	4	6
4	10	2	4
5	14	1	1

$\underline{x}^2(\underline{df} = 6) = 9.23 \quad \underline{p} < .05 \quad \underline{t}_{.95} = 7.8$

Table 8

Comparison of Comprehension and Production

Among the Three-Year-Olds

(Average Numbers of Temporal Term (T) and When (Wh) Statements and Comprehension Scores[a] Made by Three-year-old Subjects Represented in Chi-Square Cells.)

Group	T+	T-	Wh+	Wh-	C[b]	No. of subjects
1	9.0	4.5	1.3	0.7	87%	6
2	4.3	4.5	3.0	3.0	75%	4
3	0.5	0.0	0.7	0.2	59%	6

a=logical and arbitrary conditions are averaged
b=% correct responses to toy task

At all ages, there was a significant correlation between comprehension and production The r-values and t-values are presented in Table 9.

A Chi-Square Statistic was computed to examine whether or not individual patterns of relationship between comprehension and production depended upon age. The subjects were first divided into those making consistent responses in comprehension and production, that is high comprehension-high production, medium comprehension-medium production, and low comprehension and low production. The high, medium, and low ranges were determined by dividing the total possible scores per task for the two conditions combined into three groups, e.g. comprehension: total responses across conditions = 32; (1) 0 - 10.7 correct responses or 9%-33% correct constituted the "low" group; (2) 10.7 - 21.4 cr 33% -66% constituted the "medium" group; (3) 21.4 - 32.0 or 66%-100% constituted the "high" group. There were 24 when questions across conditions, therefore 0 - 7 temporal term responses, including when, constituted the "low" group; 8 - 15 such responses constituted the "medium" group; and 16 - 24 such responses constituted the "high" group.

The remaining subjects were classified as showing greater comprehension than production (high-medium, high-low, and medium-low), greater production than comprehension, or some other pattern that depended upon inconsistent responses to the comprehension task between logical and arbitrary conditions.

The analysis showed a significant Chi-Square of 16.3, df = 6, $p < .001$. A separate analysis of the four- and five-year-olds showed no significance, so that it may be inferred that the pattern of relationships between comprehension and production changes significantly between the age of three to four years. The table of cells for the Chi-Square analyses is presented in Table 10. It may be noted that there were no cases in which production was greater than comprehension. Comprehension was greater than production for over half of the three-year-old subjects, while the number of subjects giving consistent responses across tasks was low. The 4 subjects showing inconsistencies used two different patterns of response that are not seen in the table. A breakdown of subjects in the "consistent" category appears below the Chi-Square table. It may be seen that by four and five years old, most of the subjects made consistently high responses across tasks.

Therefore, it appears that the period of acquisition of productive competence falls roughly between the child's fourth and fifth year. During the acquisition period, production trails somewhat behind comprehension, although the relationship between comprehension and production is one of interdependence.

Summary Comments on "When" Data

The when data present a developmental picture of the acquisition of productive competence with before and after,

Table 9

Spearman Rank-Order Correlation Coefficients for Comprehension and Production Scores on the Toy Task

Age	rho	t	p
3	+ .77	4.42	$p < .001$
4	+ .80	4.98	$p < .001$
5	+ .66	3.30	$p < .01$

Table 10

Chi-Square Cells

Numbers of Subjects Showing Consistent (C), Inconsistent (I), and Other Patterns of Relationship between the Comprehension (Com) and Production (Wh) Measures of the Toy Task

Age	C	Com > Wh	Wh > Com	I
3	3	9	0	4
4	11	4	0	1
5	14	2	0	0

$\underline{X}^2(\underline{df} = 6) = 16.3 \quad p < .001 \quad \underline{t}_{.999} = 16.8$

Numbers of Subjects Making Consistent Responses between Comprehension and Production Measures of the Toy Task[a]

Age	HH	MM	LL
3	2	1	0
4	10	0	1
5	12	1	1

[a]High-High (HH); Medium-Medium (MM); Low-Low (LL).

but not one that supports the original contextual hypothesis. The production of before and after seems to be acquired after the child has comprehension of these terms, and there is no evidence from these data to suggest that the terms are used in reference to logical sequences earlier than they are used or understood in reference to arbitrary sequences.

The use of before and after increased with age, but there were no differences in the use of the terms across conditions (at any age). The term when was used overwhelmingly in response to logical sequences, suggesting a response strategy influenced by the subjects' knowledge of sequences and of familiar discourse patterns. However, it is not clear that this is a facilitative strategy, thus confounding support for the contextual hypothesis.

In line with previous researchers, the use of before and after in response to when questions seemed to emerge in a developmental pattern of atemporal responses, when responses, and finally, before/after responses. While this sequence was reported to span ages three, four, and five, in earlier literature, however, the present research demonstrated this pattern within the three-year-old group alone.

The production of before and after was positively correlated with the comprehension of these terms at all ages with production levels always lower than or converging with comprehension levels. There was no evidence for the

production of before and after in logical sequences preceding the comprehension of the terms in arbitrary sequences.

Repetition: Uniformity or Diversity in Development?

The preschoolers' differential responses to task demands raised the issue of the corroboration of the contextual hypothesis with regard to a conjectured early production of before and after in logical event sequences. A task that involved the repetition of two-event sentences containing these terms was given to the subjects in order to explore this issue. Correct repetitions, reversals of meaning, and deformations were compared for arbitrary, logical, and reversed logical sentences. It was proposed that the subjects' knowledge of before and after in logical sequences would make the logical sequences easier to repeat than the the arbitrary sequences, and that the subjects would either reverse the temporal term or the order of events in the reversed logical sequences in accord with their "real world" understanding of sequences.

Scoring

The repetitions were scored according to the following system:

1000 - Sentence meaning is preserved, more or less exactly

2000 - Sentence meaning is preserved, paraphrased

3000 - Sentence meaning is reversed

4000 - Sentence meaning is deformed, sensibly and nonsensibly

1000 - Exact imitation

1100 - Near exact imitation

Simple Simon peeled the banana after he tied his shoes.
He opened the banana after he tied his shoes.

2100 - Paraphrase, temporal term reversed

After Simple Simon put on his socks he tied his shoes.
Before Simple Simon put on his shoes he put on his socks.

2200 - Clause order is reversed

Simple Simon put on his smock before he painted a picture.
Before Simple Simon painted a picture he put on his smock.

2300 - Temporal term and clause order are reversed

Before Simple Simon went inside he tied his shoes.
After he tied his shoes he opened the door.

2400 - Temporal term replaced by "X and then Y"

Simple Simon went up the slide before he went down the slide.
Simple Simon went up the slide and then he slid down.

2500 - Temporal term replaced by "X and Y"

After Simple Simon climbed up the slide he went down the slide.
He went up the slide and down the slide.

2700 - One word substitution

Simple Simon watched cartoons after he climbed up the slide.
Simple Simon watched cartoons after he went down the slide.

3100 - Temporal term reversed, reversing sentence meaning

Before Simple Simon went inside he tied his shoes.
After Simple Simon went inside he tied up his shoes.

3200 - Event order is reversed

Simple Simon painted a picture before he opened the box.
Simple Simon before he painted he opened the box.

3300 - Temporal term and event order are reversed

Simple Simon went inside before he opened the door.
Before Simple Simon opened the door he went inside.

3400 - Temporal term replaced by "X and then Y"

Simple Simon tied his shoes before he peeled the banana.
Simple Simon tied his shoes and then he peeled the banana.

3500 - Temporal term replaced by "X and Y"

Before Simple Simon put on his smock he painted a picture.
Simple Simon put on his smock and painted a picture.

3700 - One word substitution

Simple Simon opened the door after he went inside.
Simple Simon closed the door after he went inside.

4000 - Sensible

4100 - Temporal term substituted

Simple Simon tied his shoes before he went inside.
Simple Simon tied his shoes when he went inside.

4121 - Event substituted, temporally logical

Simple Simon went down the slide before he put on his smock.
Simple Simon put on his smock and tied his smock.

4123 - Event substituted, temporally illogical

After Simple Simon ate the banana he took off the peel.
After Simple Simon took off the banana he ate the peel.

4124 - Event substituted, temporally sensible

Before Simple Simon turned off the light he ate a banana.
Before Simple Simon ate the bread he ate the banana.

4125 - Event substituted, atemporal

After Simple Simon opened the box he took out a toy.
Simple Simon went to the box to get a toy.

4200 - Nonsensible

4120 - Single clause

Before Simple Simon watched cartoons he turned on the tv.
Simple Simon turned on the tv.

After Simple Simon took out a toy he opened the door.
opened the door.

4220 - No Response or "I don't know"

4231 - Nonsense, derived from stimulus sentence

After Simple Simon ate the banana he took off the peel.
After Simple Simon took off the banana after he took off the peel.

4233 - Uninterpretable

4234 - Temporal term + X and Y.

Before Simple Simon put on his socks he tied his shoes.

Before Simple Simon put on his socks then he tie his shoes.

After Simple Simon toy out a toy he opened the door.
After Simple Simon he took out the toy and open the door.

The sum of 1000s and 2000s represented the total number of repetitions which preserved the basic meaning of the sentences. The sum of the 3000s represented the total number of reversed sentence meanings. The sum of the 4000s represented the total number of deformed sentence meanings. This system enabled individual response types to be recorded while allowing the three main response types (1-2000, 3000, 4000) to be statistically compared across the three conditions (logical, arbitrary, logical reversed). The data were subjected to an ANOVA to determine age and condition differences for the three main response categories. The proportions of the total number of responses that fell into each of the three categories by age and condition appear in Table 11. Graphs of these proportions appear in Figure 3.

Main Results

The overall proportions of correct responses by age were somewhat, but not appreciably, lower on this task than on the toy task. Graphs of the proportions of correct responses on these two tasks by age and condition appear in Figure 4. In addition, trials were made on over

Table 11

Repetition: Proportion of Responses by Response Category and Sequence Type

Proportion of Correct Responses and Paraphrases

Age	Logical	Logical Reversed	Arbitrary
3	.65	.68	.66
4	.78	.70	.82
5	.80	.77	.84

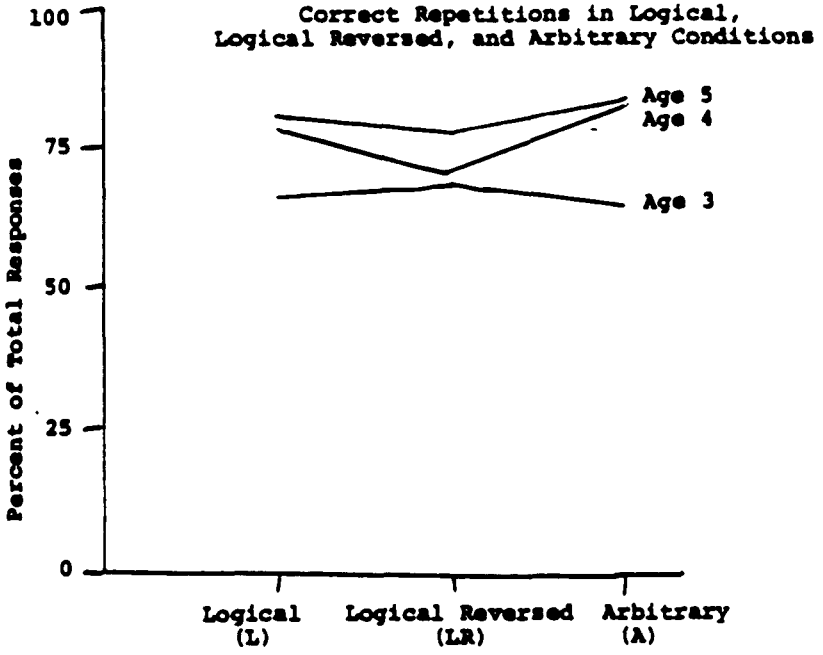
Proportion of Reversals

Age	Logical	Logical Reversed	Arbitrary
3	.22	.16	.16
4	.16	.16	.13
5	.12	.17	.10

Proportion of Deformations

Age	Logical	Logical Reversed	Arbitrary
3	.13	.16	.18
4	.06	.14	.05
5	.08	.06	.06

Figure 3.


Correct Repetitions in Logical, Logical Reversed, and Arbitrary Conditions
Percent of Total Responses
100
75
50
25
0
Age 5
Age 4
Age 3
Logical (L)
Logical Reversed (LR)
Arbitrary (A)

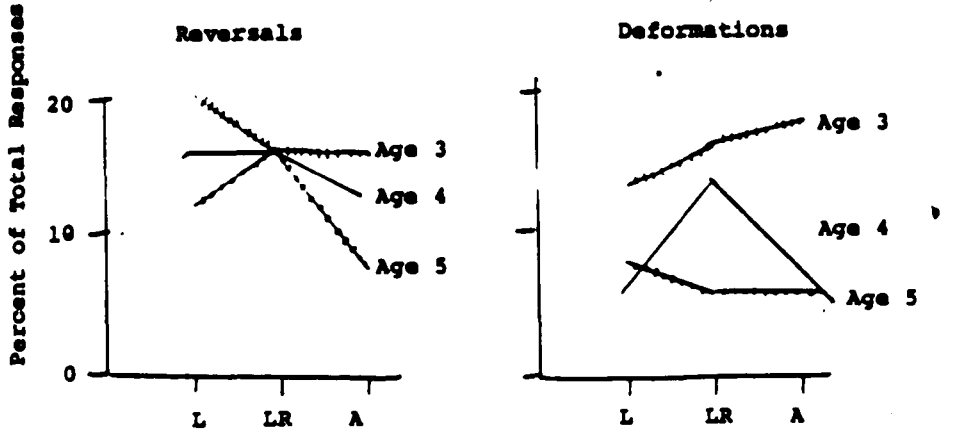
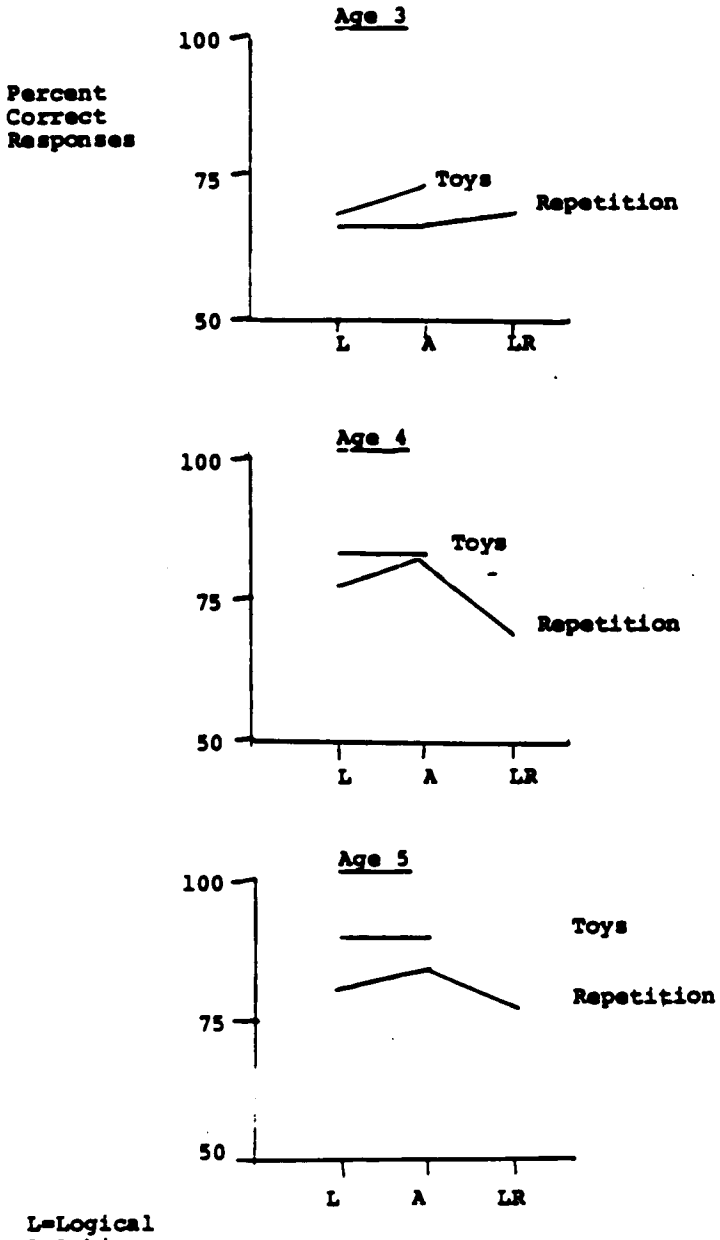

Reversals
Deformations
Percent of Total Responses
20
10
0
Age 3
Age 4
Age 5
L
LR
A

Figure 4

Comparison of Performances in the Toy Task and Repetition Task



L=Logical
A=Arbitrary
LR=Logical Reversed

30 three-year-olds in order to obtain a sample of 16 subjects who would or could perform on this task. Thus, it appears that the repetition paradigm may be a difficult task in itself for young children.

Across response categories, there were no significant differences in performance by age or condition. There were also no interaction effects of age and condition for any response category. The error patterns were examined to see if they reflected the subjects' use of event knowledge.

Reversals and Deformations

There were no significant differences in the numbers of reversals made between any pair of conditions among the three-year-olds. There were also no significant differences in the numbers of deformations between any pair of conditions. Furthermore, the three-year-olds made reversals and deformations about equally often. It is therefore difficult to tell whether or not they actually perceived the differences in the conditions. If they did not perceive the differences, there would be no reason for them to treat the stimulus sentences differently from each other, apart from the general differences of content, temporal term, and preserve/violate differences in the order of mention of the events. If they did perceive the differences, they might have been using individual strategies of resonse other than those expected by the contextual hypothesis.

An examination of the distribution of responses by particular sequences was made in order to see whether some sequences were processed differently than others. However, there were no substantial differences in responses by sequence. Second, an attempt was made on a few subjects about one month after testing to see how they were interpreting the sequences by condition; they were asked to tell whether a sequence was "silly" or "sensible," i.e. "correct" or "incorrect." This led to the subjects' giving responses of "silly" even to logical sequences, stating personal reasons as explanations. It is possible that the subjects did recognize the condition differences but interpreted them idiosyncratically. Occasionally, a subject would comment that a logical reversed sequence was "not the way it happens" (i.e. in a real-world sequence) and would repeat it as told by the experimenter anyway.

There were no significant differences in the numbers of reversals within any pair of conditions among the four-year-olds. In general, there were substantially fewer deformations than reversals, except in the logical reversed condition, where there were equal numbers of reversals and deformations. Thus, it appears that making reversals of meaning of the stimulus sentences was a general strategy of response among the four-year-olds. This marks an improvement over the three-year-olds in that making reversals implies some knowledge of the productive senses of before

and after while making deformations does not. In the logical reversed condition, however, the subjects appeared to use the three-year-old strategy of making both reversals and deformations. This does not seem to be an unreasonable response, since logical reversed sequences, taking more time to process, would be subject to different kinds of errors.

The pattern of reversals and deformations for the five-year-olds is similar to that of the four-year-olds in that there were substantially greater numbers of reversals than deformations. However, as an improvement over the four-year-olds, the five-year-olds did not show any greater numbers of deformations in the logical reversed condition as compared to the numbers made in the other conditions.

Thus, contrary to the predictions of the contextual hypothesis, there were not significantly more reversals of sentence meaning among logical reversed sequences, especially among the three-year-olds, where this result was expected. What appears to be operative are different strategies of response to the demand to repeat sentences which are age-related and, thus, most likely to represent developmental forms of the acquisition of productive competence with before and after. However, anecdotal evidence from the three-year-olds (p. 95) and the presence of three-year-old strategies of response among the

four-year-olds in the logical reversed condition suggest that the subjects may indeed be sensitive to the use of before and after in different types of sequence, but that these sensitivities are not reflected in the group means. Under such an interpretation, the lack of condition differences might not be due to a homogeneous age-related pattern of response but to a variety of context/task related strategies at each age whose presence is lost in the means.

Patterns of Difference between Conditions - Chi Squares

In order to explore the "heterogeneity" hypothesis, a Chi-Square analysis was performed on the numbers of subjects (by age) showing different patterns of relative performance between conditions on the repetition task for every pair of conditions. These data appear in Table 12.

Logical:Arbitrary

While both the ANOVA and the sign tests failed to show any significant differences in performance between these two conditions across age, the Chi-Square analysis showed a significant difference in the patterns of performance between logical and arbitrary sequences between the three-year-olds and the four- and five-year-olds. $\underline{X}^2$ (df=4) = 10.4, $\underline{p} < .05$. Most of the three-year-olds performed better in one or the other of the conditions; only one subject had equal scores between conditions. In contrast, half or more

Table 12

Chi-Square Cells

Numbers of Subjects Showing Different Patterns of Relative Response[a] between Conditions on the Repetition Task

Logical:Arbitrary				Logical:Logical Reversed			
Age	L=A	L>A	A>L	Age	L=LR	L>LR	LR>L
3	1	8	7	3	3	5	8
4	8	4	4	4	7	8	1
5	9	3	4	5	3	8	5

$\underline{X}^2$ ($\underline{df}$ = 4) = 10.4 $p < .05$

$\underline{X}^2$ ($\underline{df}$ = 4) = 15.86 $p < .001$

$\underline{X}^2_{4-5}$ ($\underline{df}$ = 2) = 1.6 NS

Logical Reversed:Arbitrary			
Age	LR=A	LR>A	A>LR
3	4	5	7
4	8	0	8
5	3	4	9

$\underline{X}^2$ ($\underline{df}$ = 4) = 4.6 NS

$\underline{X}^2_{3-4}$ ($\underline{df}$ = 2) = 3.9 NS

$\underline{X}^2_{4-5}$ ($\underline{df}$ = 2) = 4.3 NS

a=in numbers of correct responses.

of the four- and five-year-olds scored the same between the conditions. Thus, the three-year-olds used response strategies, while the four- and five-year-olds, for the most part, did not; however, where response strategies were used, there were no greater frequencies of one type of strategy than another.

Logical:Logical Reversed

The Chi-Square test showed a significant difference in the subjects' relative performances between these two conditions between three years old and four and five years old, $\underline{X}^2$ ($\underline{df} = 4$) = 15.86, $\underline{p} < .001$. Among the three-year-olds, half of the subjects performed better in logical reversed than in logical conditions. This indicates that knowledge of logical sequences may have served to facilitate performance in the logical reversed condition in this age group, contrary to the expectations of the contextual hypothesis.

Among the four- and five-year-olds, half of the subjects performed better in logical than in logical reversed sequences, which supports the contextual hypothesis for an later age than was expected.

Logical Reversed:Arbitrary

Between these two conditions, there was no significant difference in the patterns of performance across age. About half of the subjects at each age performed better with arbitrary than with logical reversed sequences, which is an expected result.

The Chi-Square data on the whole support the idea that there was much individual variation in the subjects' relative treatment of different sequence types, especially at the youngest age.

The Development of Productive Competence: Summary Comments on Repetition

While there was no main effect of age in the number of correct repetitions, there was a steady increase in correct responses that led to 80% correct performance among the five-year-olds. This speaks to a developmental trend in competence with this task that is supported by a shift in the pattern of errors toward increasing numbers of "reversals" and decreasing numbers of "deformations" with age.

The three-year-olds did not show a strong performance on this task, but the means (65-68%) were reflective of greater competence at repetition than has been reported by previous researchers (Keller-Cohen, 1975). One explanation of this is that previous investigators used stimulus sentences that had two actors performing two different actions such as, The girl watered the flowers before the boy mowed the lawn, while this study used one actor performing two actions as in the sequence, Simple Simon put on his socks before he tied his shoes. The simpler sentence types in this research might have shown that three-year-olds are better at using their productive knowledge of before and

after when sequences are easier to track.

Another possibility comes fr. the fact that the sample of three-year-olds used in this study were preselected for an ability to repeat sentences. Because of the difficulty in obtaining three-year-olds who would or could perform on this task, it was considered to be in the interest of the hypothesis to see how young children would treat the differences in sequence types when they could repeat sentences while controlling for an overall reduction in the mean proportion of correct responses due to an inability of the subjects to perform at all (complete data being more worthwhile than no data). As a result, however, the data from the repetition task may not be representative of a truly random sample of three-year-olds.

There was no significant difference in performance between sequence types in this study, but this seemed to be due to the subjects' using their event knowledge differently in response to the same task demand rather than to a failure of the subjects to discriminate between the conditions. This was particularly true of the three-year-olds who showed a significantly greater use of context-sensitive response strategies than the four- and five-year-olds. These strategies changed in kind with age while the numbers of subjects using these strategies decreased with age, indicating a developmental trend. The data suggest a pattern in which the subjects were using their knowledge of

sequence, their task sensitivies, and probably their understanding of before and after differently with development, but this combination did not serve to demonstrate the proposed role of real world knowledge in supporting productive competence with the temporal terms in this task.

The Relationship between Comprehension and Production: Repetition

In order to assess whether comprehension and production scores were interdependent between the toy task and the repetition task, Spearman Rank-Order Correlation Coefficients were determined for each age group. For this purpose, the conditions were collapsed on each task so that the subjects could be ranked for their average performances across conditions on each task. The rho-values and *t*-values for each age group appear in Table 13.

The correlation coefficient for the three-year-olds was not significant. However, the *r* values were significant for the four-year-olds, and also for the five-year-olds.

In order to account for the nonsignificant correlation in the three-year-old group and to determine the pattern of relationship between comprehension and production for the four- and five-year-olds, a Chi-Square value was computed for the frequencies of subjects showing different patterns of performance between the tasks at each age level. These patterns were (1) consistent scores across tasks (high-high, medium-medium, and low-low); (2) comprehension scores greater than repetition scores; (3) repetition scores greater than comprehension scores; (4) some other pattern of relationship that depended upon subjects' having

Table 13

Spearman Rank-Order Correlation Coefficients

between Comprehension Scores and Repetition Scores

Age	rho	t	p df=14
3	+.23	.88	NS
4	+.78	4.60	$p < .001$
5	+.60	2.80	$p < .02$

Table 14

Chi Square Cells

Numbers of Subjects Showing Consistent (C), Inconsistent (I), and Other Patterns of Relationship between the Comprehension (Com) Task and the Repetition (R) Task

Age	C	Com > R	R > Com	I
3	4	1	2	9
4	12	2	1	1
5	12	2	1	1

X^2 ($df = 6$) = 18.21 $p < .001$

Numbers of Subjects Making Consistent Responses between Comprehension (Toy) Task and Repetition Task

Age	HH[a]	MM[b]	LL[c]
3	3	1	0
4	11	0	1
5	11	0	1

[a] HH=High-High

[b] MM=Medium-Medium

[c] LL=Low-Low

inconsistent scores between logical and arbitrary conditions on either or both tasks. The table of Chi-Square cells appears in Table 14. A breakdown of the consistent responses appears below the Chi-Square table.

The four- and five-year-olds showed identical patterns of performance between tasks, with most of the subjects at these ages scoring high on both tasks. Over half of the three-year-olds fell into the "inconsistent" category. In this category, there were four patterns of response: (1) high comprehension-inconsistent repetition (2 subjects); (2) medium comprehension-inconsistent repetition (3 subjects); (3) inconsistent comprehension-medium repetition (3 subjects); (4) inconsistent comprehension-inconsistent repetition. Comprehension scores were never low and never lower overall than the repetition scores for the same subject. There were only 2 subjects for whom repetition scores were higher than comprehension scores; this result may be attributed to high auditory memory among these subjects, since the pattern of inconsistencies and the when data indicate that comprehension of before and after precedes the production of these terms in children acquiring competence with these terms.

The comprehension-repetition comparisons indicate that during the early period of the acquisition of productive competence with before and after, in the child's fourth year, children display a variety of patterns of

relationship between comprehension and production measures, but comprehension typically precedes the production of these terms.

The Relationship between Repetition and When Questions, Tasks of Productive Competence

A main question of this study was whether or not two different measures of the production of *before* and *after* would corroborate in showing a superior performance in logical than in arbitrary conditions among three-year-old subjects. In part, this question was answered by the fact that there were no differences in conditions (for any age group) in response to *when* questions. However, in order to assess whether or not a relationship existed between subjects' scores on the repetition task and the same subjects' responses to *when* questions apart from condition differences, Spearman Rank-Order Correlation coefficients were performed between the subjects' scores on these tasks, for each age group, after the scores on the two conditions were collapsed and averaged on each task. The *r*-values and *t*-values appear in Table 15.

The correlation between *when* questions and repetition scores was not significant among the three-year-olds. Among both the four- and five-year-olds, however, there was a significant positive correlation between subjects' scores on the two tasks.

In an attempt to account for the lack of significant correlation between tasks among the three-year-olds and to determine the relationship between tasks among the

Table 15

Spearman Rank-Order Correlation Coefficients between Repetition Scores and *When* Scores

Age	rho	t	p
3	+.22	.84	NS
4	+.63	2.87	$p < .02$
5	+.66	2.71	$p < .02$

Table 16

Chi Square Cells

Numbers of Subjects Showing Consistent (C), Inconsistent (I), and Other Patterns of Relationship between the Repetition (R) Task and the *When* (Wh) Responses

Age	C	R > Wh	Wh > R	I
3	5	6	0	5
4	11	3	2	0
5	11	3	2	0

χ^2 (*df* = 6) = 12.5 $p < .05$

Numbers of Subjects Making Consistent Responses between the Repetition Task and *When* Responses

Age	HH[a]	MM[b]	LL[c]
3	2	2	1
4	8	0	3
5	11	0	0

[a] HH=High-High

[b] MM=Medium-Medium

[c] LL=Low-Low

four- and five-year-olds, a Chi-Square value was computed for the frequencies of subjects showing different patterns of performance between the tasks at each age level. These patterns were (1) consistent scores across tasks (high-high, medium-medium, low-low); (2) repetition scores greater than *when* scores; (3) *when* scores greater than repetition scores; (4) some other pattern of relationship that depended upon subjects' having inconsistent responses between conditions on the repetition task. The table of Chi-Square cells appears in Table 16. A breakdown of the consistent responses appears below the Chi-Square table.

There was a significant difference in the patterns of performance between tasks between the three-year-olds and the four- and five-year-olds, $\underline{X}^2$ ($\underline{df} = 6$) $= 12.5$, $\underline{p} < .05$. The four- and five-year-olds showed identical patterns of performance between tasks, with most of the subjects at these ages scoring high on both tasks. There was no indication that any one task was more difficult than the other for the rest of the subjects.

Among the three-year-olds, the relationships between tasks were either (1) repetition greater than *when* responses; (2) inconsistent responses. The inconsistent group showed three strategies: (1) inconsistent repetition-high *when*; (2) inconsistent repetition-medium *when*; (3) inconsistent repetition-low *when*. This means that repetition was high in at least one condition, so that it

appears that, for the three-year-olds, repeating sentences may have been a somewhat easier task than producing temporal terms.

Comprehension, Repetition, and When Comparisons: Individual Strategies

In order to look at the relationship between patterns of response across tasks and age level, a Chi-Square analysis was performed on the numbers of subjects falling into "consistent" and "inconsistent" categories of scores between tasks for each age group. The Chi-Square table of cells appears in Table 17. Below it, the distributions of subjects into categories of consistent responses (high-high, medium-medium, low-low) at each age level are presented. The Chi-Square value showed a strongly significant difference in the patterns of relationships across tasks by age, $\underline{X}^2$ ($\underline{df}$ = -) = 10.94, $\underline{p} < .005$.

The three-year-old group had only 2 subjects who showed consistent scores across tasks; the other 14 showed 9 different response patterns. The four- and five-year-olds had nearly identical response patterns, with over half of the subjects performing consistently well across tasks. There were 5 individual strategies displayed among the 6 "inconsistent" four-year-olds and 5 individual strategies displayed among the 5 ("inconsistent") five-year-olds. There is, then, a clear developmental trend in which a highly variable early competence with before and

Table 17

Numbers of Subjects Showing Consistent (C) and Inconsistent (I) Patterns of Relationships between the Comprehension (Toy) Task, the Repetition Task, and *When* Responses (Toy Task)

Age	C	I
3	2	14
4	10	6
5	11	5

χ^2 (df = 2) = 10.94 $p < .005$

Numbers of Subjects Making Consistent Responses between the Comprehension Task, the Repetition Task, and *When* Responses

Age	HH[a]	MM[b]	LL[c]
3	2	0	0
4	9	0	1
5	10	1	0

[a] HH=High-High

[b] MM=Medium-Medium

[c] LL=Low-Low

after in the child's fourth year shifts to increasingly complete competence in the child's fifth and sixth years.

The tremendous individual variation in performance across tasks among the three-year-old subjects and the evidence of individual variations in performance across tasks among the four- and five-year-olds indicates that the acquisition of competence of the full range of competence with these terms is not an all-or-nothing process nor a process that follows an invariant sequence of steps. There are developmental trends, with the numbers of individual routes and the kinds of individual routes changing with age. The fact that there are such variations in pre-schoolers' response to different measures of competence with before and after, including variously displayed sensitivities to the logic of real-world sequences attests to the language learner's dependency upon a multiplicity of non-linguistic constraints in the acquisition process.

CONCLUSION: DELIMITING THE CONTEXTUAL HYPOTHESIS

The Comprehension of Before and After

The four- and five-year-old subjects performed well across conditions on the toy task, confirming the prediction of this study and supporting the hypothesis that children of these ages are indeed able to comprehend the meanings of before and after. These results strengthen the argument against previous reports that have claimed that children are only first beginning to understand these terms at four-and-a-half to five years of age.

Support for a facilitative influence of real world knowledge on the child's initial understanding of before and after would come primarily from the data produced by the three-year-old subjects. These subjects showed no significant difference in performance between conditions on the toy task. Secondly, the mean proportions of correct responses in both conditions were only slightly above chance. This appears, at first glance, to falsify the contextual hypothesis. However, the same subjects' performance on the picture task, replicated the direction of difference between conditions that Carni and French found (although the difference did not reach significance); performance was substantially above chance level with logical sequences only. Moreover, when the means for the subjects on both

the picture task and the toy task were compared according to how much they varied from the chance level for each respective task, performance was superior in the logical condition of the picture task only. This implied that the task demand in the toy experiment depressed the competence shown by the three-year-old subjects in the logical condition of the picture task.

In support of this idea, the subjects were screened for those who performed well across tasks and for those who performed comparatively poorly across tasks. The remaining 38% of the sample showed the typical Carni and French pattern of high performance in the logical condition of the picture task and poor performance in the arbitrary condition of the picture task. These subjects did not, for the most part, show evidence of competence on the toy task.

The core number of three-year-old subjects, 16 in the sample and 6-12 who showed distinct patterns of response on either task, is probably too small a figure on which to base general conclusions about development; however, the data patterns seem clear enough to warrant some reasonable speculations.

First, because the tasks did not provide any means by which the subjects could deduce the meanings of the temporal terms, superior performance (apart from that which can be accounted for by correct guessing) depended upon the subjects' prior understanding of these terms. The results

of the picture task alone showed that substantial numbers of the three-year-olds did comprehend the meanings of before and after. This seems to set the initial acquisition of the terms at some time during the child's fourth year, thus invalidating the claims that three-year-old children are incapable of understanding the meanings of before and after.

Second, response strategies seem to be responsible for young children's performance on tests assessing the understanding of before and after, regardless of whether or not a child has an initial competence with these terms. There is evidence both from previous research (Johnson, 1975) and from the facts that (a) subjects who did not perform well across tasks showed different data patterns within tasks and that (b) subjects who performed well with logical picture sequences and poorly with arbitrary picture sequences showed different data patterns on the toy task.

Third, the nonlinguistic context seems to influence the strategies of response that are produced by three-year-olds. This extralinguistic context includes both the child's mental representation of event sequences and the basic demands of experimental tasks. (There may be other nonlinguistic influences such as situational context and the status relationship of experimenter and subject, but such influences were not apparent in this research.) In this study, the child's knowledge of real world event

sequences combined with the task demands to produce differential responses to logical and arbitrary sequences in both "comprehenders," subjects who showed the Carni and French response pattern, and "pre-comprehenders," subjects who, on the toy task, used their knowledge of sequence to produce a "next-event-in-time" strategy in the logical condition and their lack of knowledge of sequence to produce a "previous-event-in-time" strategy in the arbitrary condition.

Fourth, under certain experimental conditions, knowledge of logical sequences can facilitate the display of young children's competence with before and after. However, when real world knowledge (or, the type of stimulus sequence) is controlled across different methods of assessment, the task demands are central to the child's performance. Knowledge of sequences was, in itself, insufficient to facilitate the demonstration of competence in the younger subjects across tasks.

Fifth, apart from group patterns influenced by contextual constraints, there seems to be considerable individual variation in response strategies among very young children. The subjects who showed the Carni and French pattern of response on the toy task showed among themselves different patterns of response on the toy task. This phenomenon of individual variation in response patterns is an important one because it bears on the construction

of models of the acquisition of temporal terms, or, at least, of the full use of temporal terms. It implies that individual development may not proceed according to patterns based upon group data. Weil (1977) has shown that young children tested longitudinally for comprehension of before and after made highly individualized patterns of response to a task across testing intervals; none of these subjects followed the developmental sequence predicted by Clark's group data.

Sixth, with respect to the data patterns of all of the age groups tested, it is proposed here that the main difference between the younger child's and older child's "knowledge" of before and after is that the younger child is constricted in the use of her knowledge by nonlinguistic constraints while the older child is not. What develops, then, is not a basic understanding of these terms, but a "decortextualization" of this understanding which results in an increased flexibility or an increased range of application of this knowledge.

Last, in contrast to Clark's claim that before is acquired earlier than after, there was no evidence from this study for the earlier acquisition of either term. Differences in performance with the terms, which favored the term after in this study, seem to have been due to the subjects' use of nonlinguistic strategies of response to specific tasks.

The Production of Before and After

Both tests of the production of before and after showed increasing performance with age but failed to show superior performance with logical sequences at any age. The subjects' use of event representations was suggested in their response strategies in each task but such context sensitivity did not necessarily serve to facilitate a prior productive competence with before and after.

With the when questions, a group of subjects (chiefly three-year-olds) used the term when primarily in logical sequences with the correct meaning of before and after. This was attributed to their having heard the term when used in this manner in reference to their routine events. It speaks to their understanding of the productive "senses" of before and after influenced by their knowledge of event order and of common patterns of discourse. However, the same subjects' performance with arbitrary sequences made it unclear as to whether or not this influence was actually facilitative to a display of productive competence with before and after.

In the repetition task, the error pattern showed that the strategies of response changed with age in ways that indicated increasing competence with the terms before and after (increase in reversals, decrease in deformations with age). The four-year-olds, however, used a three-year-old pattern of response with reversed logical sequences,

suggesting that the (experimentally-established) misuse of the terms with respect to sequence resulted in regressive patterns of response. Furthermore, there was much individual variation in the patterns of response between conditions that was not evident in the group means. These individual strategies changed in kind with age, showing a shift in the use of event knowledge at age four. Moreover, the numbers of subjects using such strategies decreased with age, which strengthens the developmental trend.

These data support the idea that the child adapts her event knowledge and her knowledge (or lack of knowledge) of before and after so as to produce strategies of response to particular tasks. This adaptation results in particular group patterns, but there is also much individual variation in this process. There is evidence from the data for an influence of nonlinguistic context in the subjects' response patterns, but there is no strong evidence to suggest that real world constraints in particular serve a facilitative function in the display of productive competence with before and after. The production of before and after appears to be more difficult to master than the comprehension of these terms, since context effects (differential response patterns between conditions on the repetition task) were still seen in the data patterns among the four- and five-year-old subjects.

The Relationship between Comprehension and Production

Intraindividual comparisons of the comprehension scores and the production scores of the toy task indicated that production of before and after initially trails behind the comprehension of these terms and then converges with age. This supports the reports of previous research. Similarly, the emergence of the use of the terms before and after in response to when questions from an earlier use of atemporal responses and then when responses corroborated previous studies. However, this developmental sequence was proposed to occur at four-and-a-half to five years of age, whereas this sequence was found in the three-year-old group in the present research. Thus, the generally accepted relationship between the early comprehension and production of the terms is supported, but for an earlier age than has previously been assumed.

The data did not support the prediction that the terms before and after would be used in reference to logical sequences earlier than they would be comprehended in arbitrary sequences. Subjects who used the temporal terms correctly performed well across conditions on (both) comprehension tasks, while subjects who performed well in at least one condition on either comprehension task used the temporal terms correctly and incorrectly about equally often.

Comprehension scores were also higher than scores on the repetition task, with performance between tasks

converging with age. However, considering condition differences on both tasks, there was much individual variation in performances between tasks. The greatest number of individual patterns occurred among the three-year-old subjects, but such patterns were still present among the four- and five-year-olds. The numbers of individual patterns increased further when all three tasks (comprehension, when, and repetition) were compared. These data indicate that the acquisition of productive competence both lags behind comprehension and is a highly individualized process. They argue against an all-or-nothing model of acquisition (or of the acquisition of the range of competence) and of a model of acquisition that presumes an invariant sequence of steps.

The Performance/Competence Dilemma

This study showed that strategies of response to different tasks accounted for young subjects' performance on experiments designed to assess competence with before and after. This makes it easy to reduce the research question to an issue of performance versus competence; the demonstration of early competence with before and after depends upon finding the right "method" which will produce this result, i.e. competence.[1] However, this would be too

[1]The term "competence" in this study is intended to mean any demonstrated understanding of before and after--i.e. superior performance on comprehension/production tasks that is not attributable to guessing strategies. This defini-

simplistic an interpretation of the research, since an objective of this work was to address the nature and development of the child's knowledge of before and after, apart from looking for the optimal conditions for the display of competence with these terms.

The fact that three-year-old subjects gave different results on two tasks measuring the comprehension of before and after in spite of real-world cues is not simply a question of one test "failing" (to produce competence) and the other "succeeding." It is also reasonable to assume that it is an inherent phenomenon of the three-year-old mind to be inconsistent in displaying competencies across tasks both in the lab and in life, and thus to be dependent upon all extralinguistic constraints in the display of temporal knowledge. French (1981) and Nelson (1981) have shown that the language of young children engaged in ongoing activities failed to give evidence of temporal ability,

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tion avoids a possible confusion in the interpretation of competence, a common interpretation being that competence implies appropriate performance across all conditions of use. It seems reasonable to assume that there are situations in which even adults and older children are not able to make use of some previously demonstrated knowledge, and the fact that they show understanding of some phenomenon under one condition but not another does not disqualify the proven, albeit context-bound, knowledge or competence. Similarly, since two samples of three-year-old children have shown an understanding of before and after under certain experimental conditions, it seems to be justifiable to propose that three-year-olds have some basic competence with these terms; the lack of evidence for this competence across a second experimental measure does not imply that these children are altogether "incompetent" at understanding the meanings of before and after.

while the language of preschoolers asked to talk about past events showed a highly accurate temporal organization.

Thus, with respect to early language development, the young child's dependency upon nonlinguistic contexts or constraints to performance is more than simply a response to methods; context, although a somewhat ambiguous term, implies natural contexts (e.g. situation, discourse constraints and internal contexts such as motivation and attention) as well as experimental contexts.

However, in order to arrive at this conclusion, it is necessary to test young children across a variety of methods of assessment purporting to measure the same linguistic phenomena. Any developmental claims made about preschoolers' understanding of before and after based on the results of a single experimental measure are likely to be nongeneralizable and, therefore, limited in validity. This thesis, then, stresses the position that investigators should use multiple methods in testing young children's competence with before and after prior to making any developmental claims.

The Role of Real World Knowledge

The young child's knowledge of known or knowable events constitutes a part of what has been called the "nonlinguistic context" in the present tests of the understanding of before and after. This study showed that event knowledge may either facilitate the young child's display

of competence with before and after or not, depending upon how the child coordinates this (event) knowledge with other nonlinguistic constraints. Assessing the extent to which the influence of real world knowledge is supportive to the use of before and after (and presumably, other temporal terms) during the phase in which the range of competence is context-dependent is difficult, although not impossible, because of (1) the problems in controlling other influences on performance and (2) the young child's use of nonlinguistic information in individual and therefore unpredictable ways.

Future research might attempt to (1) isolate particular influences on competence, such as the modality of information in which sequences are represented; (2) examine the influence of real world knowledge across a variety of nonlinguistic contexts (e.g. situation); (3) address acquisition (or the range of competence) in longitudinal studies of individual children by testing them at very short time intervals.

The Contextual Hypothesis

Because the young children have been shown to have a basic competence with before and after it is unclear as to whether or not real world knowledge is a necessary condition for the display of this competence. If competence with before and after cannot be demonstrated in three-year-olds using arbitrary event sequences across a variety of experimental measures (which it has not been in previous research)

then real world knowledge (logical sequences) may indeed be a critical factor in any display of early competence with these terms. This is supported by the fact that the child has to have a knowledge of reversible operations in order to understand the meanings of before and after. Since such knowledge has only been seen in the three-year-old child in reference to known or knowable event sequences (Brown, 1976), then the understanding of before and after must be bound to real world knowledge. Real world knowledge thus becomes a necessary but not sufficient condition for early competence with before and after.

Thus, while the "contextual hypothesis" initially posed in this research has undergone ad hoc modifications based upon the results of this research (e.g. knowledge of event order does not facilitate performance across tasks), the young child's knowledge of events retains a central role in how the child may first come to understand before and after or, at least, in how the child develops strategies in attempting to communicate this knowledge. Likewise, the use of logical event sequences in assessing early competence with before and after retains a central role in how researchers might assess this competence, while it is understood that, in and of itself, event knowledge will not inevitably lead to the display of competence.

Concluding Remarks

Is the (revised) contextual hypothesis a more valid account of "what develops" than the developmental models proposed by previous investigators? With regard to the Piagetian position, the present research has shown that knowledge of before and after is present even in so-called "pre-operational" children. Furthermore, this knowledge is not present-across-contexts or absent-across-contexts, an all-or-nothing phenomenon implied by Piagetian investigations. With respect to Clark's position, there is no evidence from this work that before is acquired earlier than after; this finding discredits the idea that so-called "positive" time features are learned earlier than are so-called "negative" time features. There is also no evidence for a universal sequence of steps in the acquisition process, although this study does not illuminate the issue of initial acquisition of the terms.

Furthermore, by neglecting to address the influence of nonlinguistic context, previous accounts of the acquisition of before and after have not only failed to show a very early competence with the terms but have overlooked the young child's dependency upon extralinguistic constraints to performance that serves to challenge the validity of those very accounts (those accounts being based on the results of single experimental measures that have been shown to be nongeneralizable across related tasks). The

revised "contextual model" has not only served to demonstrate an early context-sensitive understanding of before and after but has taken into account the inherent complexity (inconsistency) of the preschooler's mind that shows, paradoxically, that the developing use of these terms does not follow a logically-ordered sequence of steps.

APPENDIX

Stimulus sequences for Toy Task: Comprehension and Production

Logical I

(1) First we fill the bottle.
(2) Then we close the bottle.
(3) Then we feed the baby.
(4) Then we put the baby to bed.

Logical II

(1) First we put the leash on the dog.
(2) Then we walk the dog.
(3) Then the dog comes home and is thirsty.
So we put some water in his dish.
(4) And then we give him the water.

Logical III

In this game, we are going to play with the telephone.
(1) First we pick up the receiver.
(2) Then we dial the number.
(3) Then we say hello.
(4) Then we hang up the receiver.

Logical IV

(1) First the dog bites the doll's knee.
(2) Then we call the doctor.
(3) The doctor says to wipe her knee.
(4) and then we put on a bandaid.

Arbitrary I

We're going to dress the doll for a party.
(1) First we wash her off.
(2) Then we put the beads on.
(3) Then we put the star in her hair.
(4) Then we put the flower in her hair.

Arbitrary II

(1) First we put the money in the purse.
(2) Then we make the frog jump.
(3) Then we put the key in the box.
(4) Then we talk on the phone.

Arbitrary III

In this game, we're going to play with the keys.
(1) First we put in the green key.
(2) Then we put in the white key.
(3) Then we put in the blue key.
(4) Then we put in the pink key.

Arbitrary IV

(1) First we feed the frog.
(2) Then we brush the doll's hair.
(3) Then we draw a circle.
(4) Then we close the purse.

Stimulus sentences for the Repetition Task

Logical

A Simple Simon put on his socks before he tied his shoes.
B Simple Simon turned off the light before he wert to sleep.
C Simple Simon put on his smock before he painted a picture.
D Simple Simon opened the box before he took out a toy.
E Simple Simon took off the peel before he ate the banana.
F Simple Simon climbed up the slide before he went down the slide.
G Simple Simon turned on the tv before he watched cartoons.
H Simple Simon opened the door before he went inside.

Logical Reversed

Ar Simple Simon tied his shoes before he put on his socks.
Br Simple Simon went to sleep before he turned off the light.
Cr Simple Simon painted a picture before he put on his smock.
Dr Simple Simon took out a toy before he opened the box.
Er Simple Simon ate the banana before he took off the peel.
Fr Simple Simon went down the slide before he climbed up the slide.
Gr Simple Simon watched cartoons before he turned on the tv.
Hr Simple Simon went inside before he opened the door.

Arbitrary

A' Simple Simon went inside before he tied his shoes.
B' Simple Simon painted a picture before he opened the box.
C' Simple Simon ate a banana before he turned off the light.
D' Simple Simon took out a toy before he opened the door.
E' Simple Simon went down the slide before he put on his smock.
F' Simple Simon turned off the tv before he opened the box.
G' Simple Simon tied his shoes before he peeled a banana.
H' Simple Simon climbed up the slide before he watched cartoons.

Stimulus Sequences for the Picture Task

Scripted A List 1

SUBWAY

One day George and his daddy went downtown on the subway.

1. They walked downstairs to the subway.
2. They stood in line to buy tokens.
3. They put tokens in the turnstile and walked through.
4. They waited for the train.
5. The train came and they got on and sat down.

What did they do before they put their tokens in the turnstile and walked through?

Points? Yes No # 1 2 3 4 5

Says:

When did they wait for the train?

Arbitrary A List 1

WALK IN THE PARK

One day George went for a walk in the park.

1. He walked through the flower garden.
2. He chased a squirrel up a tree.
3. He sat down and ate a candy bar.
4. He tied his shoelaces.
5. He came to a lake and sat on the ground and watched the ducks.

What did George do before he sat down and ate a candy bar?

Points? Yes No # 1 2 3 4 5

Says:

When did George tie his shoelaces?

Scripted B List 1

MORNING

One morning when Jane woke up she was very hungry.

1. She got up and got dressed by herself.
2. She went and ate breakfast with her mommy and daddy.
3. Her daddy kissed Jane goodbye.
4. And then he left for work.
5. Then Jane watched cartoons on television and her mommy washed the dishes.

What happened before Jane's daddy kissed Jane goodbye?

Points? Yes No / 1 2 3 4 5

Says:

When did her daddy kiss Jane goodbye?

Arbitrary B List 1

PLAYGROUND

Jane met her friends Sally and Susie at the playground one day.

1. They went to the sandbox and built sandcastles.
2. They climbed up and played on the monkey bars.
3. They turned summersaults on the grass.
4. And then they swang on the swings.
5. Then they all had a race and Jane won.

What happened before they turned summersaults on the grass?

Points? Yes No / 1 2 3 4 5

Says:

When did they turn summersaults on the grass?

Scripted C List 1

BIRTHDAY PARTY

One day Jane had a birthday party.

1. Her friends came and brought her presents.
2. Jane unwrapped the presents.
3. Jane's mommy brought in the cake with the candles in it.
4. Everyone sang Happy Birthday.
5. Then Jane made a wish and blew out the candles.

What happened before Jane's mommy brought in the cake with the candles in it?

Points? Yes No #1 2 3 4 5

Says:

When did Jane make a wish?

Arbirtary C List 1

TRICYCLE

George got a new tricycle for his birthday.

1. He got on and rode it around the couch.
2. He ran it into a wall.
3. He beeped the horn at his mother.
4. He gave his sister a ride on the back.
5. Then George put his teddy bear on the seat and rode it around.

What happened before George beeped the horn at his mother?

Points? Yes No #1 2 3 4 5

Says:

When did George put his teddy bear on the seat?

Scripted D List 1

BED

George enjoyed spending the evening with his mommy and daddy.

1. They all ate supper together when daddy came home.
2. Then they watched George's favorite show on television.
3. Then George got up and got into bed.
4. Then his daddy read him a story.
5. Then George fell sound asleep.

What happened before George got into bed?

Points? Yes No # 1 2 3 4 5

Says:

When did his daddy read George a story?

Arbitrary D List 1

HIDE AND SEEK

One day Jane and her sister played hide and seek.

1. Jane crawled under the piano when her sister turned her back.
2. Then she sat under the table.
3. Then she got up and stood behind the curtains.
4. Then she hid in back of the door.
5. Then Jane sneaked behind the couch.

What happened before Jane stood behind the curtains.

Points? Yes No # 1 2 3 4 5

Says:

When did Jane hide behind the door?

Scripted E List I

GROCERY STORE

One day Jane and her mother went to the grocery store to buy some food.

1. They got a shopping cart.
2. Then Jane sat in the little seat.
3. Her mother pushed the cart around the store and they put food in it.
4. Then they paid for the food.
5. Then they carried the groceries home.

What happened after they put food in the cart?

Points? Yes No / 1 2 3 4 5

Says?

When did Jane sit in the cart?

Arbitrary E List I

VISIT FROM AN AUNT

Jane's Aunt Sarah came to visit one day.

1. They played with Jane's new doll.
2. Then they colored in coloring books.
3. Jane's aunt made pancakes and they ate them.
4. Then they sang songs.
5. Then they walked around outside.

What happened after they ate pancakes?

Points? Yes No / 1 2 3 4 5

Says?

When did they color in coloring books?

Scripted F List 1

DRESSING

One morning it was snowing when George woke up. His mother said he could go outside if he got dressed quickly.

1. He took off his pajamas.
2. He put on his underpants and socks.
3. He put on his pants and sweater.
4. He put on his snowsuit and boots.
5. He put on his hat and gloves.

What did George put on after he put on his pants and sweater?

Points? Yes No // 1 2 3 4 5

Says:

When did George put on his underpants and socks?

Arbitrary F List 1

GLOVES

One morning Jane's gloves were lost. She went around the apartment looking for them.

1. She leaned over to see under the bed.
2. She looked in the closet.
3. She looked on the kitchen table.
4. She looked on the living room couch.
5. She looked behind the bookshelf.

Where did Jane look after she looked on the kitchen table?

Points? Yes No // 1 2 3 4 5

Says:

When did Jane look in the closet?

Scripted G List 1

RESTAURANT

One night George and his mommy and daddy went to a restaurant for supper.

1. They sat down at a table.
2. They asked the waiter for a salad, a big pizza, and icecream for dessert.
3. They ate the salad.
4. Then the waiter brought the pizza.
5. Next, they had chocolate icecream for dessert.

What happened after they ate the salad?

Points? Yes No / 1 2 3 4 5

Says:

When did they eat the salad?

Arbitrary G List 1

PLAYING AT HOME

One morning it rained outside and George stayed home and played.

1. He played with his dog.
2. He read a book.
3. He drew pictures.
4. Then he watched television.
5. Next, he made a snake out of playdough.

What happened after George drew pictures?

Points? Yes No / 1 2 3 4 5

Says:

When did George draw pictures?

Scripted H List I

COOKIES

Jane and her mother decided to make cookies one day.

1. They put all the things they needed in a bowl.
2. They mixed them together to make the dough.
3. They put the dough on a pan.
4. Then they put the pan in the oven to bake the cookies.
5. They ate some cookies when they finished baking.

What did they do after they put the dough on a pan?

Points? Yes No / 1 2 3 4 5

Says:

When did they eat some cookies?

Arbitrary H List I

DOLLAR

George found a dollar on the ground one day.

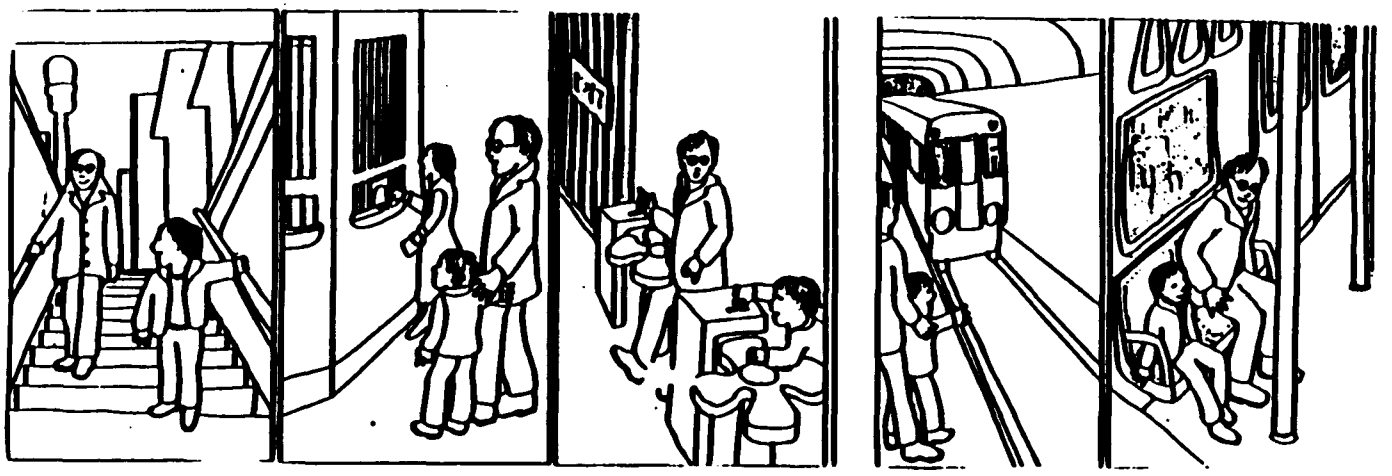
1. He bought himself some bubble gum.
2. He put some money in a blind man's cup.
3. He bought his mother a present.
4. Then he bought an icecream cone at the drugstore
5. He paid for a comic book at the news-stand when he finished his icecream.

What did George do after he bought his mother a present?

Points? Yes No /1 2 3 4 5

Says:

When did George pay for a comic book?



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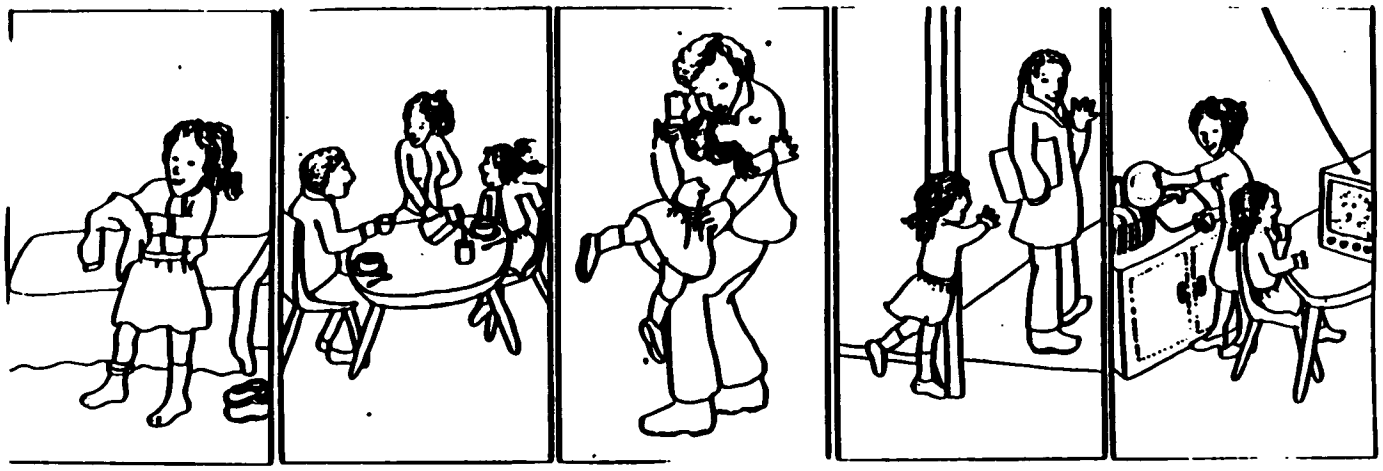

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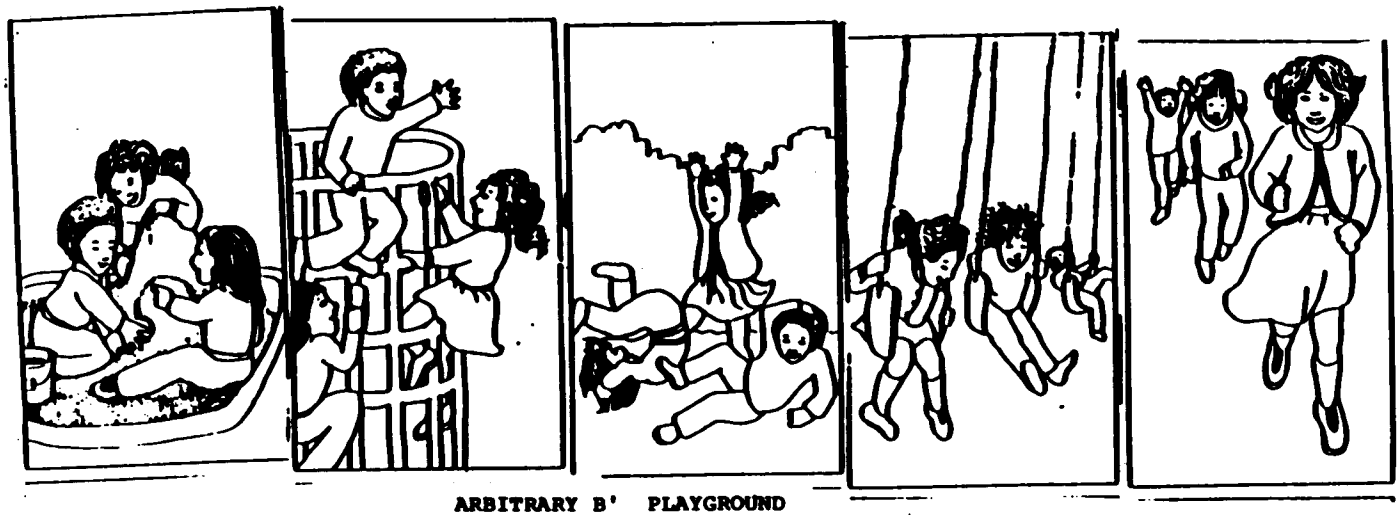

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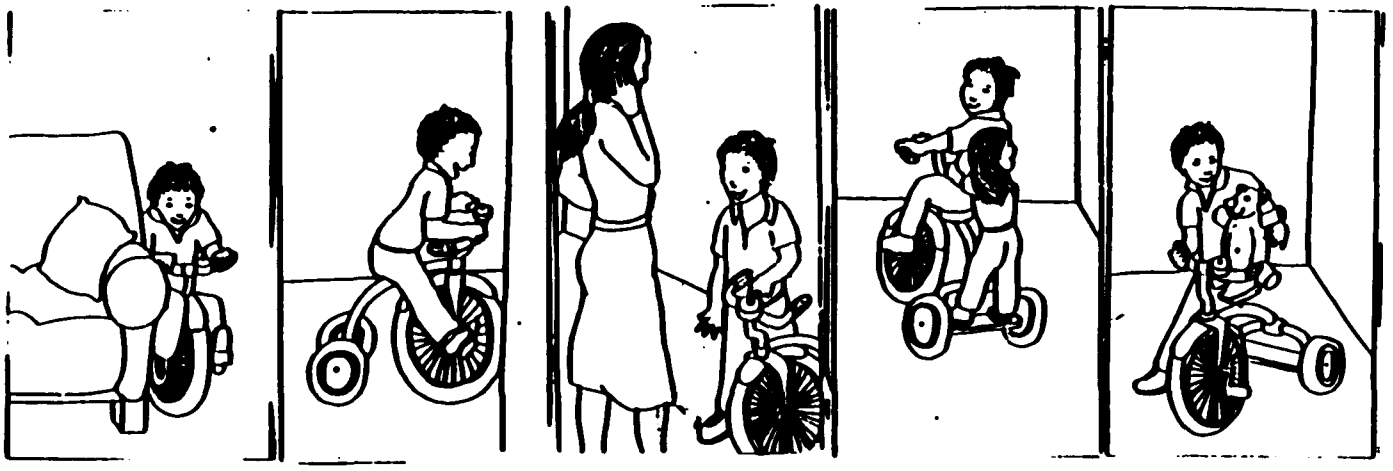

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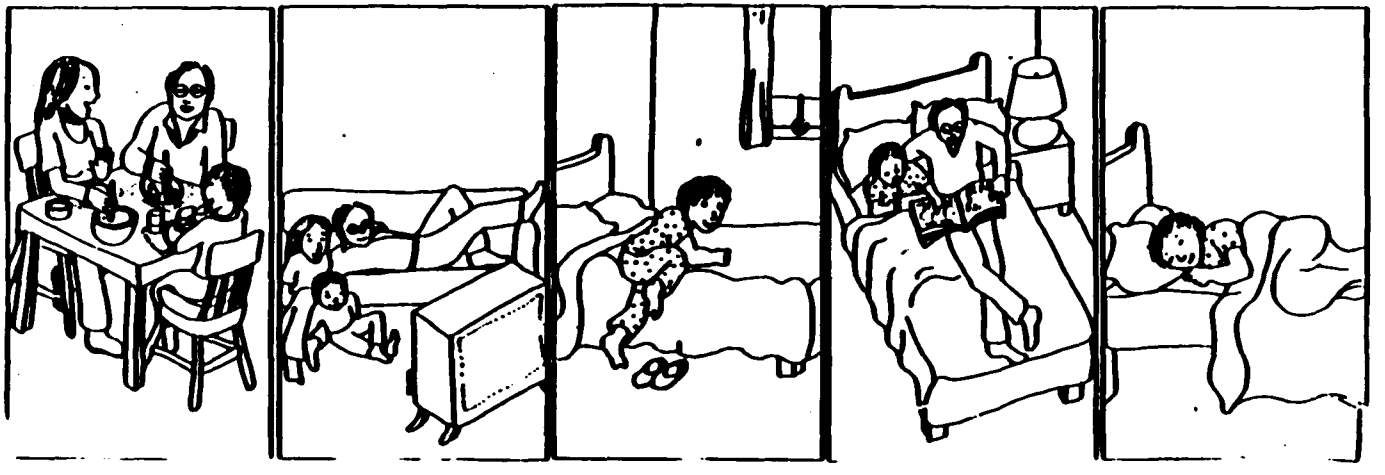

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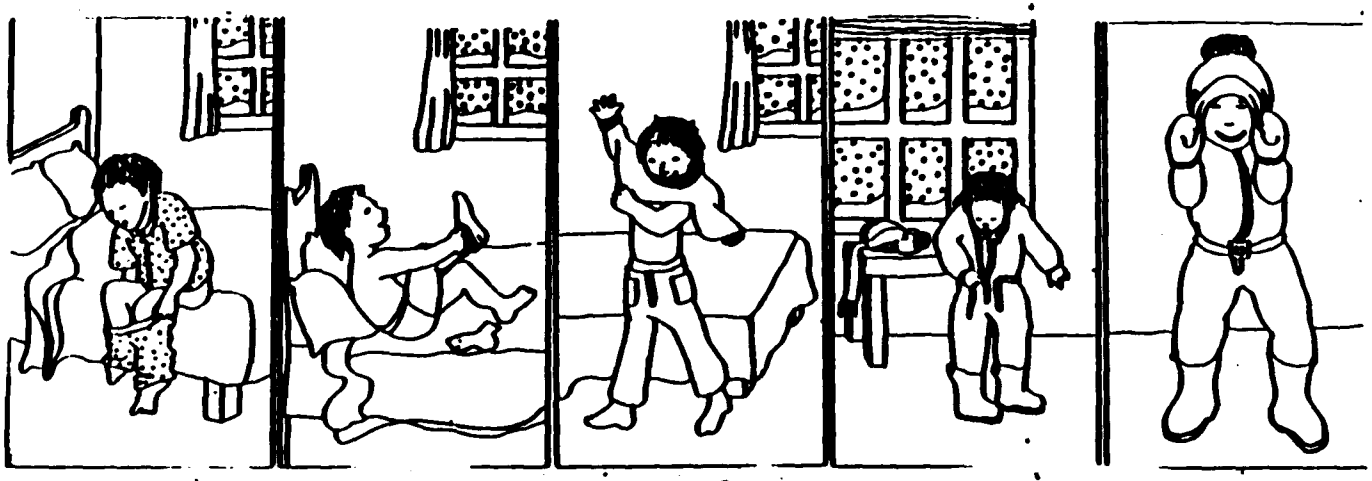
ARBITRARY D' HIDE & SEEK

SCRIPTED E GROCERIES

ARBITRARY E' VISIT FROM AUNT



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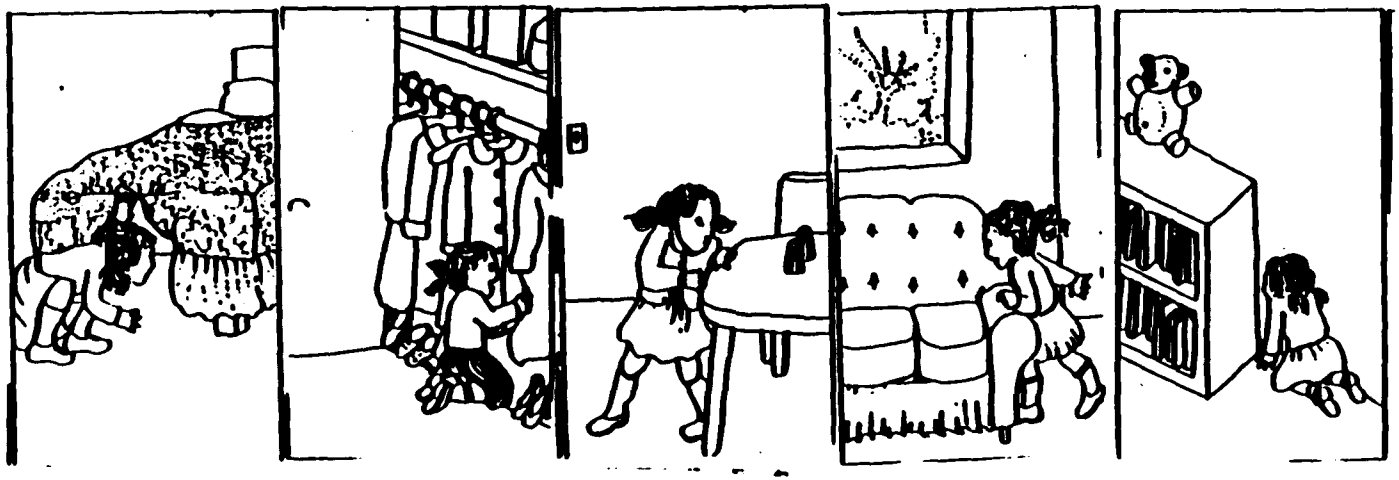
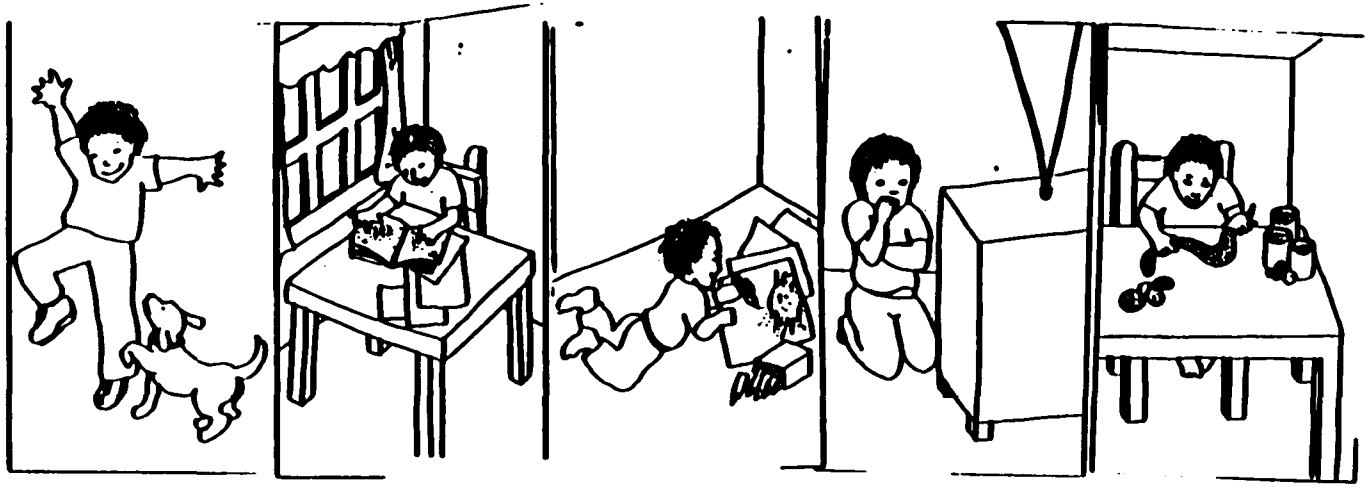
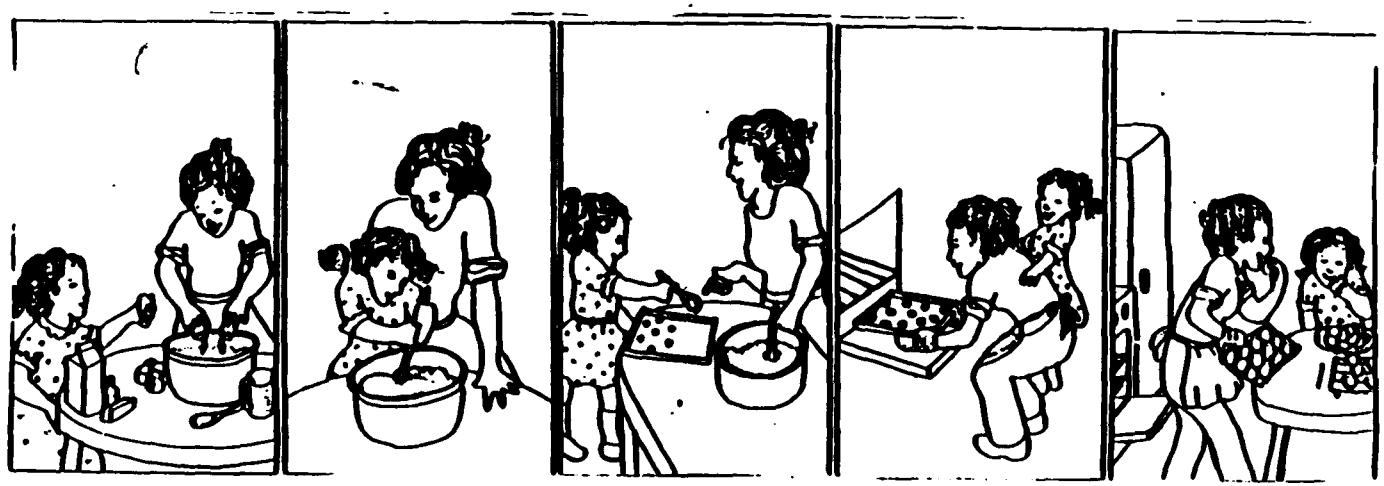


ARBITRARY F' LOOKING FOR GLOVES

SCRIPTED G RESTAURANT



ARBITRARY G' PLAYING AT HOME



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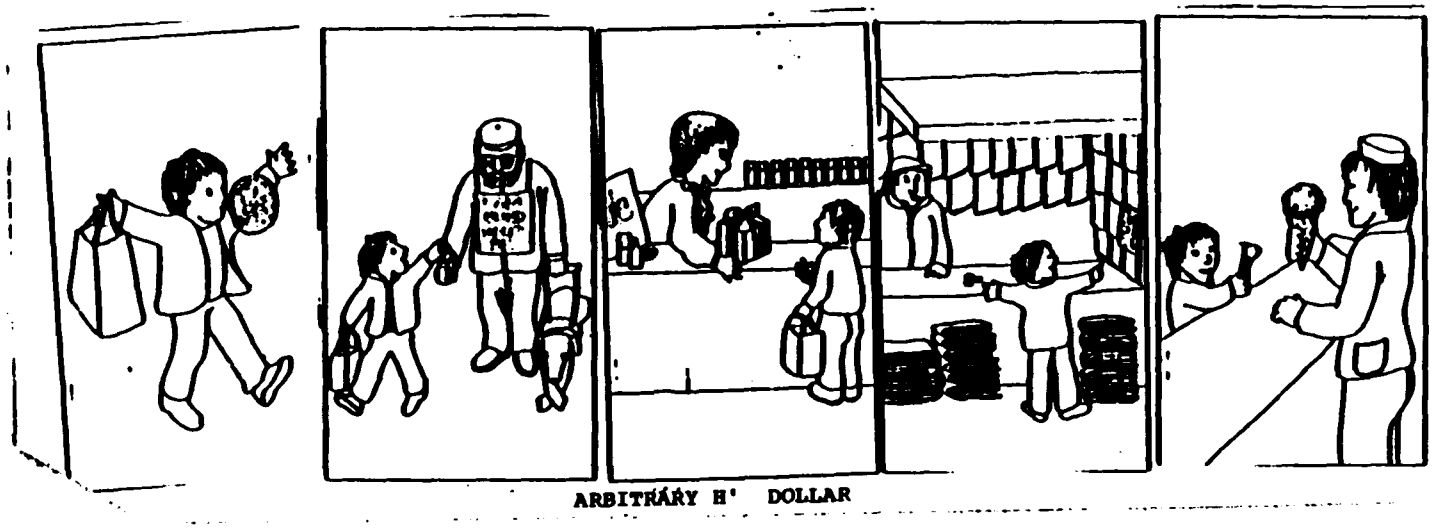

ARBITRÁRY H' DOLLAR

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