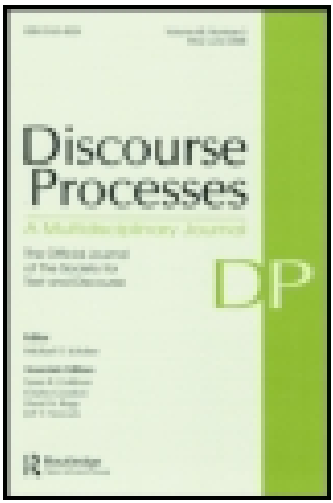

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The development of goal plans of action in the narration of a picture story

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The Development of Goal Plans of Action in the Narration of a Picture Story

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The construction of coherent narrations of events in a picture storybook by children was studied. A causal network discourse analysis (Trabasso, van den Broek, & Suh, 1989) was applied to the narrations by children, 3, 4, 5, and 9 years in age, and adults, 20 years and older. The analysis was successfully applied at the clausal level by deriving interacting causal network representations for the perspective of each character in each of the narrations. The structure and content of the network representation of the main character were analyzed in detail. The analysis indicated that 9-year-olds and adults narrate according to a hierarchical goal plan of action. It also showed striking developmental differences from age 3 to 5. The 3-year-old children described states and neutral outcomes that are unrelated to the central theme. The 4-year-olds, in contrast, encoded actions relevant to the central theme but omitted goals and purposes. The 5-year-olds added these purposes to attempts.

Coherence in the narration is achieved by applying naive theories of psychological and physical causation, reflecting knowledge about goal plans of action. The narration's content and structure are organized according to a hierarchical set of goals and a sustained plan of action. Unexpected obstacles and failures of goal attainment lead to the reinstatement of goals in order to continue following the plan. Although comprehension of this structure is attained by age 4, coherence begins to manifest itself most explicitly in the narrations of the 5-year-olds.

This article presents a study on how children construct coherent narrations about events. Coherence in narration, we argue, is achieved when children use naive

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We are indebted to Dan Slobin and Virginia Marchman for granting us permission to analyze the corpus and for providing us with the 58 protocols of the American English sample, and to Judy DeLoache for providing us with the protocols of 14 mother–child dyads in the *Frog, Where Are You?* story. We thank Jeffrey Kuperman for his assistance in analyzing the corpus and Margret Park Munger and SoYoung Suh for their assistance in data analysis.

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theories about intentional action to infer and encode information about goals and goal plans of action into speech. This use of planning knowledge leads to narrative coherence when the events are interpreted according to and structured into a goal plan. This article uses a causal network discourse analysis (Trabasso, van den Broek, & Suh, 1989) to identify explicitly the existence of planning structures in narrations to a picture story by children of different ages and by adults.

Comprehension of narratives is assumed to be based upon one's ability to detect a character's goals and to infer themes and plans. These inferences allow the interpretation of a sequence of actions according to a goal plan (Schank & Abelson, 1977). To comprehend as well as produce goal plans, one has to be able to form a mental representation of the events in which one anticipates possible problems and solutions, and monitors whether the actions follow the plan and result in successful problem resolution (Scholnick & Friedman, 1987).

The fact that children come to use knowledge of goal-directed action in both story understanding and production is well-established (Stein & Trabasso, 1982). Children are increasingly able to explain actions in terms of goals or purposes (Goldman & Varnhagen, 1985; Liu, 1988; Stein & Glenn, 1979; Wimmer, 1980). In judging the goodness of stories, they come to rely upon the presence of goals and goal-directed actions (Stein & Policastro, 1984). Finally, in producing free stories to minimal settings, they move from describing isolated states and actions to the temporal and then to the causal sequencing of events. This is followed by organizing the narrations into episodes that include goals, actions, and outcomes. The latter denote goal success or failure. Hierarchical embedding of episodes is a characteristic of stories produced by older children (Stein, 1988).

Storytelling or narrating can also be understood as communicative acts that follow certain narrative conventions, namely, that one should organize the telling of events according to the rules of intentional action and causal–temporal sequencing. Our narrative prototype is therefore an ideal representation of this narrative convention. Insofar as conventions imply normativeness, our prototypic narrative structure is normative.

An interesting, recent approach to narrative development is one that combines narrative comprehension with production, and hence, communication. Here children are asked to narrate events that occur in a picture story sequence to another person (Bamberg, 1987; Berman, 1988; Berman & Slobin, in press; Slobin, 1990). The advantage of this approach is that all the children must try to narrate the same set of events. To do so, they must understand what is depicted in each picture and they must encode these interpretations into a narrative form. One of the first published studies using this approach was that by Berman (1988), who collected narrations to a picture story by Hebrew-speaking children. The picture story (Mayer, 1969) is about a boy's continued search in the face of failure for his pet frog that had escaped. Berman found that most 3- and 4-year-old children and a few 5-year-olds described the pictures in isolation. The important developmental finding was that from age 5 to age 12, the children increasingly organized the

events sequentially in relation to an overall plot line that involved a sustained search.

Our suggestion is that Berman's "plot line and sustained search" arose from the children's use of knowledge about plans and goal-directed action. The picture story may be viewed as an enactment of a hierarchical goal plan. The top-order goal is to get the frog back, but a subordinate goal, to find the frog, dominates the story. Searching for the frog in particular locations leads to a series of unanticipated goal failures of not finding the frog and to a series of goal reinstatements to continue trying to search for the frog. Eventually, these reinstatements lead to success in finding the frog. The understanding of goals, attempts, goal failures, goal reinstatements, and ultimate success lead to the child's ability to narrate a coherent story.

Understanding and producing stories may be regarded as a bidirectional process (Bamberg, 1987; Bamberg & Marchman, in press). Knowledge of plans guides top-down processing. The events to be encoded by the plan constrain processing in a bottom-up manner. In a classic top-down view, Miller, Galanter, and Pribram (1960) viewed planning as carrying out actions that match preexisting schemes. Likewise, Hayes-Roth and Hayes-Roth (1979) regarded planning as anticipating a course of action. On the other hand, both the narrator and the comprehender are constrained by what occurs, either as actual events or as discourse. These experiential or linguistic data allow one to detect goals and to infer plans in a bottom-up manner and to use these inferred plans to anticipate, interpret, and encode later events. The narrator's and the comprehender's initial representation of the events constrain what, when, where, and how events are to be interpreted and encoded in a discourse. In short, the content and the structure of a narration is determined as a result of an interaction between a person's model of physical and psychological causation and the events to which the model is applied.

In narrating a picture sequence, the child is assumed to use interactive top-down and bottom-up processes. The child interprets the pictures as "data" according to a developing knowledge about intentional action. If the child knows about goals and goal plans and uses this knowledge to interpret the events and actions that are depicted in the pictures, the child will first detect a goal and then selectively encode into language actions as attempts that are relevant to achieving that goal. The process of inferring a goal from such data is bidirectional in that the visual information constrains possible interpretations but knowledge of goals and plans determines the detection of the goal. Once the goal is identified, a goal plan may be inferred. The plan constrains interpretations and encodings of subsequent actions and outcomes because they are evaluated against the goal. However, such interpretation is not sufficient to achieve a coherent narration because the child must also monitor these attempts and determine whether the outcomes that result from them lead to success or failure of the goals and goal plan. When failures occur, the child must understand the data in the pictures as renewed

attempts to achieve the failed goal. If these causal inferences occur, the resulting narration will become coherent. A coherent narration is thus one in which a series of clauses is organized by the character's goal and goal plan of action. The main character's actions are interpreted as renewed attempts with goal failures and reinstatements that eventually lead to goal success—Berman's (1988) overall plot line and sustained search. The picture sequence, however, also constrains what is narrated. If the picture sequence itself does not provide sufficient information to detect goals and to infer causal and temporal relations between goals, attempts, and outcomes, then a coherent narration will not result, regardless of the person's knowledge about intentional action.

REPRESENTING A HIERARCHICAL GOAL PLAN

Given a narration to a picture sequence, how do we determine whether it reflects the application of a goal plan? The process of analysis is similar to that which occurs in the narration itself: One must infer goals and interpret actions according to a plan. To decide that the narration is structured this way, one needs a discourse analytic model that is content sensitive, and provides criteria to identify explicitly the existence of goals, attempts, and outcomes, and the causal–temporal relations between these categories of content. The model should allow for the possible hierarchical structuring of these categories into episodes and of the episodes into a goal plan hierarchy.

The causal network model of Trabasso et al. (1989) is a discourse analytic model that can represent and generate hierarchical goal plans. Figure 1a depicts their model as a general causal network. Each clause's content in the narration may be classified into one of six categories: S (setting), E (event), IR (internal response), G (goal), A (attempt), and O (outcome). Outcomes are marked as successful (+), unsuccessful (−), or neutral (o) with respect to goal attainment. These categories together constitute an episode.

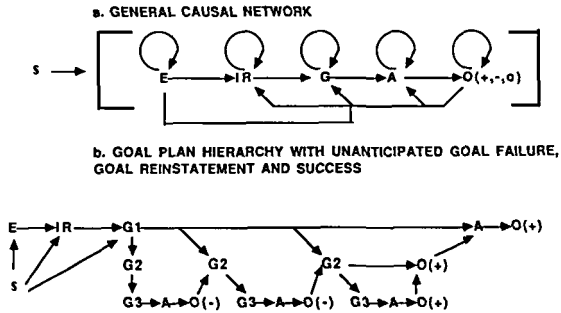


Figure 1. *(a) Causal network model of Trabasso, van den Broek, and Suh (1989). (b) Causal network showing a goal hierarchy with unanticipated failure outcomes and successes.*

The categories are assumed to be interconnected by causal relations shown as arrows in Figure 1a. In the Trabasso et al. (1989) model, the connecting relations are inferred and can be either causal, temporal, or enabling. Settings can enable all categories. Events can physically cause other events, or they can psychologically cause internal responses or goals. Internal responses (cognitions, emotions, beliefs) can psychologically cause other internal responses or goals. Goals can motivate goals or attempts to achieve them. Attempts can enable other attempts or physically cause successful or unsuccessful outcomes. Outcomes, like events, can physically cause other outcomes or psychologically cause internal responses or goals.

Figure 1b shows a representation of a goal plan hierarchy generated from Figure 1a. This particular representation has three ordered goals with attempts that lead to unanticipated goal failures, goal reinstatements, and success. The plan begins with a setting (S) that is followed by an event (E) that happens to a protagonist. These, respectively, enable and psychologically cause an internal reaction (IR). The reaction leads to a goal (G1). This goal motivates a subgoal (G2) to obtain it. The subgoal (G2) in turn motivates another subgoal (G3) to obtain it. Together these three goals constitute a plan. Here, the plan is carried out through actions motivated at the level of the third goal in the hierarchy (G3). This goal motivates an initial attempt (A) that fails, as indicated by an outcome (O−). This failure is monitored and psychologically causes the reinstatement of the second order goal (G2) that is motivated by the first-order goal (G1) that controls the overall plan. The cycle of the top-order goal (G1) motivating the second-order goal (G2) motivating the third-order goal (G3) that is followed by an attempt (A) and a failure (O−) is repeated until finally an attempt (A) leads to a successful outcome (O+) for the third-order goal (G3). This outcome enables another successful outcome (O+) at the level of the second goal (G2). This outcome enables an attempt (A) that causes a successful outcome (O+) for the first-order goal (G1), completing the plan.

Filling in the content of the categories in Figure 1b demonstrates why we suggested that Berman's (1988) notion of plot line and sustained search reflects from the application of an hierarchical goal plan. In the sequence of pictures, a boy has a pet frog (S), loses it (E), shows concern over its loss (IR), and begins a series of goals (G) and attempts (A) that enact a plan to get the frog back (G1). The plan is to find the frog (G2) by searching in particular locations (G3) for it. The boy searches by looking or calling (A) but is met with a series of failures (O−) where animals other than the frog suddenly and unexpectedly appear. The boy, however, resumes the search in particular locations for the frog (G3) in order to find it (G2), and finally does find it (O+) and takes it (A) back home (O+).

Structures such as that shown in Figure 1b emerge in narrations of events if the events permit them and if the child has the requisite knowledge of goal plans and uses this knowledge to interpret and encode the events. Because this knowledge develops with age, young preschool children may not have sufficient

knowledge about intentional action to detect a goal based upon settings and events or to encode selectively actions that follow from the goal. Rather, they may try to describe or identify what they see in terms more familiar to them. As a result, the descriptions of objects, actions, and states are not related to a conceptual plan of action, and therefore lack coherence from an older child's or adult's perspective. The extent to which one can apply the causal network model to capture the content and the structure of the narration as a goal plan of action depends directly upon whether or not the child encodes the picture sequence as such. The child who explains actions in terms of goals or purposes that are relevant to a higher-order goal is the one who tells the more coherent tale.

Our primary purpose was to apply an explicit discourse analytic model that entails a psychological theory of intentional action to narrations produced by children and adults to picture stories. We wished to find out the extent to which children reveal in their narrations a developing knowledge and theory of intentional action. Our process of analysis is inductive in that we rely upon what the narrator says as "data," but our inductions are determined conceptually by the definitions and criteria of the causal network model. Each narration is analyzed on a clause-by-clause basis according to these definitions and criteria. What may emerge is a set of categories based upon clausal content encoded and structured causally and temporally by a goal plan of action into a coherent narration.

METHOD

In order to determine explicitly whether children's and adult's narrations show planning knowledge realized in hierarchical goal plans of action, we obtained the American English speakers' corpus of narrations of the *Frog, Where Are You?* picture story by Mercer Mayer (1969; from Dan Slobin at the University of California, Berkeley). The corpus was collected by Tamar Renner and Virginia Marchman at the University of California, Berkeley, as part of a cross-linguistic study (Berman & Slobin, in press; Berman et al.,1987; Slobin, 1990). Permission to analyze the corpus with the model was obtained form Dan Slobin and Virginia Marchman.

In the Renner-Marchman corpus, four groups of 12 children each, and 10 adults were asked to tell a story based upon a booklet of pictures after paging once through the booklet. The instructions were essentially the same as those used by Berman (1988). The four groups of children were 3 to 4, 4 to 5, 5 to 6, and 9 to 10 years in age. Hereafter they are respectively referred to as the 3-, 4-, 5-, and 9-year-old groups. The adults were 20 years and older and are referred to variously as the 20-year-old or adult group. The children and adults were native speakers of American English and came from middle- to upper-middle-class backgrounds. Half of the children in each age group and half of the adults were females.

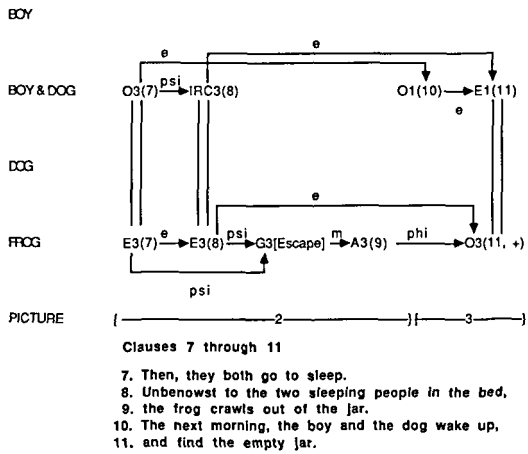


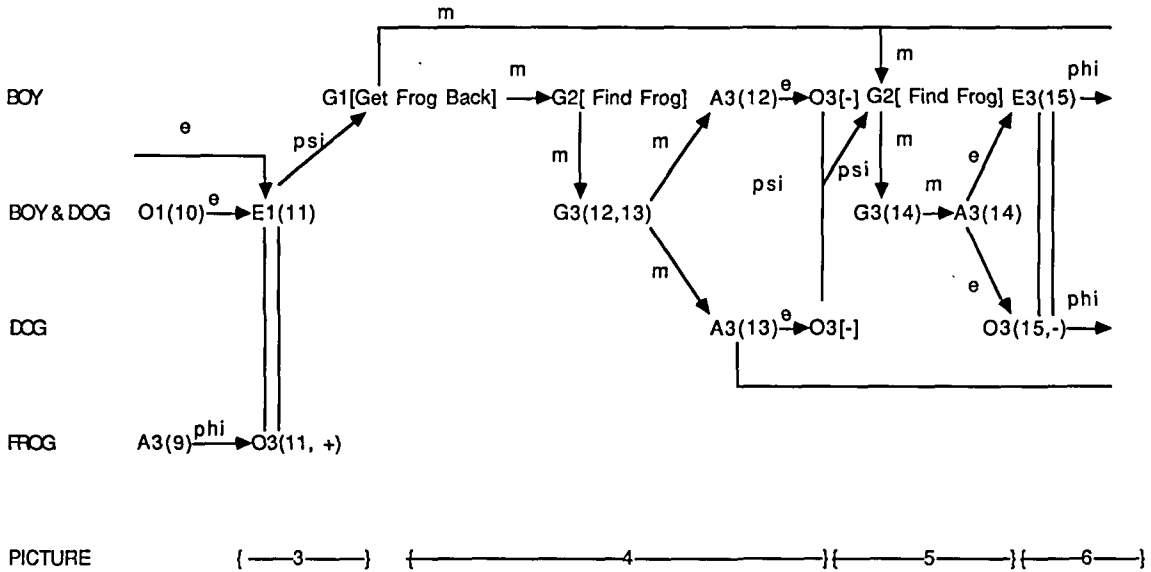
Figure 2. Causal network representations of four characters derived from Subject 20B's clauses 7 through 11 narrated to pictures 2 and 3.

Causal Network Analysis of Narrations

In analyzing the clauses in a narration, it is necessary to assume the point of view of a given character. In the picture sequence of *Frog, Where Are You?*, there are 10 possible points of view: boy, dog, boy and dog together, frog, gopher, bees, owl, deer, other frogs, and narrator. For each perspective, we derived a causal network representation for each narration in the corpus, using the Trabasso et al. (1989) model summarized in Figure 1a. This resulted not only in a representation of the perspective of each character but in a representation of a set of interacting plans for all of the characters. From this representation, we identified the main protagonist as the boy because his network was the longest and was the only one that was connected from the beginning of the story until the end.

For purposes of illustrating the method, we present part of the interacting networks derived for Subject 20B for four perspectives: the boy, boy and dog, dog, and frog. The partial networks are shown in two figures. Figure 2 shows the networks for clauses 7 through 11, and Figure 3 (p. 256) shows them for clauses 10 through 15. The numbered clauses are taken from the narration of Subject 20B in the Renner-Marchman corpus; the complete narration is presented in Table 1 (p. 257).

In the two figures, a clause is coded by a letter that denotes its category in the causal network model. Because each category belongs to an episode, the number after the letter is the level of that episode's goal in a goal–plan hierarchy. (The goal–plan hierarchy is explained below). The number in parentheses is the ordinal number of the clause in the narration. Thus, O3(7) refers to an outcome at goal level 3 for clause 7. At the bottom of the figure is a numbered picture line;



Causal Networks for Clauses 10 through 15

10. The next morning, the boy and the dog wake up 11. and find the empty jar..
12. The boy looks in his boots 13. while the dog looks in the jar for the frog.
14. They look out the window for the frog 15. The dog falls out the window.

Figure 3. Causal network representations of four characters derived from Subject 20B's clauses 10 through 15 narrated to pictures 3 through 6.

TABLE 1
Adult Subject 20B Telling *Frog, Where Are You?*

1. This is a story of a little kid/ before he goes to bed one night/ He looks in this jar/ and he's checking out his frog/ and his dog is there/ and they both check out the frog.
2. Then they both go to sleep/ Unbenownst to the two sleeping people in the bed/ the frog crawls out of the jar/
3. The next morning, the boy and the dog wake up/ and find the empty jar/ The boy looks in his boots/ while the dog looks in the jar for the frog/
4. They look out the window for the frog/
5. The dog falls out the window/
6. and breaks the jar/ The kid goes down out the window as well/ and picks up the dog/ The dog is happily rescued from/ having his head stuck in the jar/ But the kid's a little angry/ probably cause he's lost his jar and his frog/
7. The little boy and the dog go outside/ looking for the frog/ The boy is calling for the frog/ and the dog is sniffing for the frog/ But actually the dog is sniffing at a trail of bees/ coming out of a beehive/
8. The boy is looking down a hole/ to see/ if the frog is in the hole/ and the dog is intrigued by this beehive/
9. The boy gets his nose either bitten or sniffed at/ by some little animal living in the hole/ and the dog is still intrigued with the beehive/
10. Now, the beehive has been knocked down out of the tree by the dog/ and the bees are intrigued with the dog/ while the boy is sitting in a tree/ looking in the hole in the tree/ thinking/ maybe the lost frog is there/
11. At this point/ an owl pops out of the hole in the tree/ and a bunch of bees start following the dog/ probably angry/ that the dog has knocked their hive out of the tree/
12. Suddenly, the owl—oh no—now the boy is running away from the owl/
13. and the boy is climbing up on a rock/ and now the owl is gone for some reason/ and the dog is coming back/ Looks like he's either stunned/ or is just very frightened and ashamed/ that he was outdone by the bees/
14. The owl is looking at the boy/ and the boy is calling for the frog/
15. Now the boy has been picked up by some antlered beast/ that looks like a deer/
16. The deer is running to a cliff/ and the dog is barking at the deer/ This dog is pretty useless/ all he does/ is cause trouble and bark at things/
17. Now the deer has thrown the dog, no, the boy over the cliff into/ it looks like they're heading for a pond/ and the dog goes, too/ as the dog has throughout the story/
18. And they both fall in the water/
19. And they sit up in the water/
20. And it seems like they both hear something coming from behind the log/
21. And the boy tells the dog to be very quiet/ and they crawl over the log/
22. And they find on the other side of the log two happy frogs/ one of which was the frog in the jar/
23. And then they see that there was not only two happy frogs/ but there is an entire family of little frogs there/ and one would wonder how long—what the gestation period is for frogs/ and how come they're so big/ when they know/ they have to go through a tadpole stage first/ However, it seems that they've raised this happy family/ and maybe the boy was looking for these frogs for an entire six months to a year/ Who knows?/
24. Now the boy grabs one of the frogs/ and leaves with this frog/ leaving the two big frogs and all the tiny frogs/ So it looks like he has not taken away his big frog/ that was in the jar/ but he has taken away one of the sibling frogs perhaps/ one really can't tell/ The end/

Note. The numbered paragraphs contain the narration for each picture in succession. The slashes demarcate each clause.

the braces mark the clauses in the narration that were made to that picture. Causal relations between pairs of categories are indicated by labelled arrows between categories. The labels *e, psi, m,* and *phi* stand for enabling, psychological–, motivational–, or physical–causal relations, respectively. Thus, for example, an outcome, O3(7), enables (e) another outcome, O1(10). Explicit categories are shown by parentheses around the clause number; implicit categories are shown by brackets and a description following the letter and goal level. Successful outcomes are denoted by a plus sign (+) in the parentheses or brackets; failed outcomes are denoted by a minus sign (−). Because a clause can be categorized from the perspective of more than one character, it may be represented in more than one causal network and its category membership may change. Clauses that are in two networks have the same number, and their equivalence is depicted by vertical, parallel lines between them. For example, an outcome for the frog, O3(11, +), became an event, E1(11) for the boy and dog.

We shall first discuss the analysis of clauses 7 through 11 depicted in Figure 2. These clauses describe the boy and the dog going to sleep, and while they are asleep, the frog crawls out of the jar. The next morning, the boy and dog wake up and find the jar empty. Going to sleep is an outcome from the perspective of the boy and the dog because they achieve the goal of sleep. This outcome, identified as O3(7), in turn, psychologically causes a state of cognition in which they lack awareness. This cognition is regarded as an internal response and is noted as IRC3(8). Shifting the perspective from the boy and dog to that of the frog, we reclassify the boy and dog's outcome and internal cognitive response as a pair of events that are observed by the frog. These two events psychologically activate an inferred desire in the frog to try to escape from the jar, labeled G3[Escape]. This goal is inferred from the two prior events and from the frog's explicit attempt, A3(9), to crawl out of the jar. The arrow from G3[Escape] to A3(9) indicates that the implied goal motivated the attempt. In order to infer a goal, we required that it be anchored by an explicit causal antecedent or antecedents (e.g., E3(7) and E3(8)), and an explicit causal consequent (e.g., A3(9)). In inferring other categories, particularly outcomes, and, rarely, attempts, we required the presence in the narration of explicit, direct causal antecedents and consequents.

Returning to the analysis, the attempt, A3(9), results in a successful outcome of the frog escaping and leaving the jar empty, O3(11, +). At this point, the analysis shifts back to the perspective of the boy and the dog in which they wake up, an outcome, O3(10), that is enabled by the initial state of sleeping, O3(7). This change in state enables them to experience an event, E3(11), namely, that of finding the jar empty.

We now introduce the analysis of relations between categories. On the boy and dog line, the outcome, O3(7), psychologically causes an internal response that is cognitive, IRC3(8). That is, going to sleep results in a psychological state of unawareness. We believe that there is a causal relation between the outcome and the reaction because if the boy and dog had not gone to sleep, then they

would have been aware of their surroundings. This counterfactual reasoning tests the assumption that causes are necessary in the circumstances of a story (Mackie, 1980; Trabasso, Secco, & van den Broek, 1984). Counterfactual tests were applied to all identified direct causal relations throughout the analysis. To label the type of causal relation, one must know what the categories are because the categories constrain the kind of relation. For example, goals motivate actions or other goals, whereas actions enable other actions or physically enable or cause outcomes (see Trabasso et al., 1989, for rules and criteria for relating categories, and the previous discussion on the different kinds of causal relations that may be obtained between categories).

Identifying a Goal–Plan Hierarchy

Consider now clauses 10 through 15 in Figure 3. In this series, the boy and dog wake up and see the empty jar. The boy looks in his boots, while the dog looks in the jar for the frog. Then they both look out the window for the frog. The dog falls out the window. The narration contains an outcome in clause 10, an event in clause 11, two purposeful attempts in clauses 12 and 13, another purposeful attempt in clause 14, and a failed outcome or an event in clause 15.

In our analysis, we separated purposeful attempts into two categories, a goal and an attempt, which together make up a local goal plan. The goal is based upon the purpose of the action and is expressed frequently as a prepositional phrase (e.g., for the frog) or as an infinitive phrase (e.g., to see if the frog is in there). The presence of the frog in the phrase indicates that it is the desired goal object. We assume that the goal exists prior to the attempt and motivates it. Thus, the action of looking in the boots, A3(12), is motivated by the goal of looking for the frog in certain locations, G3(12). The purposeful attempt in clause 14 is another local goal plan. Here the goal is to look for the frog in another location, namely at the window, in G3(14), and is carried out as an attempt in A3(14).

Why do the boy and dog look for the frog out the window after looking for the frog either in the boots or in the jar? Apparently, they did not find the frog in the first locations. We therefore infer a failed outcome from each of their perspectives, O3[−]. (The brackets indicate that the goal or outcome is inferred.) This outcome was enabled by the initial attempts and it contributes psychologically to another, local goal plan. We now ask: What motivates these two local goal plans of searching for the frog in specific locations? These local plans are best understood as being motivated by an inferred, higher order goal, labeled G2[Find the Frog]. This higher order goal of finding the frog motivates local goal plans in which the boy and dog search in particular locations for the frog and it is reinstated each time the local goal plan fails. We now ask: Why is the goal of finding the frog reinstated? The answer is that the boy has developed yet another inferred, higher order goal, namely, to get back his pet, labelled G1[Get Frog Back]. Together, these inferred and explicit goals constitute a goal–plan hierarchy, where the top-order goal, G1[Get Frog Back] motivates a second-order

goal, G2[Find Frog] which, in turn, motivates a local goal plan, G3[Search in Particular Locations] that motivates attempts at this level. We now understand why levels 1, 2, and 3 were assigned to the categories. We finally ask: What caused the goal–plan hierarchy to arise? The answer lies, in part, in the Event, E1(11) in which the boy discovers the empty jar, indicating that the frog is lost and psychologically causes, in the circumstances of the story, the boy's goal of wanting to get the frog back, G1. Note that E1(11) is not sufficient to cause this goal. Rather, it is necessary to know that the boy values the frog as a pet, established as a setting in the first picture. It is the loss of a valued goal object that results in the desire to reinstate the relationship with the frog. The relation between goal states and changes in goal states as determinants of emotions and goals is central to Stein and Levine's (1989) theory of emotional understanding and is consistent with the present analysis.

Extracting Episodic Structures

In the analysis, episodic structures emerge when the narration permits identification of a set of categories that depict goal-directed action. A complete episode would contain one or more of each of the categories in the general recursive transition network in Figure 1a, namely, an event, a goal, an attempt, an outcome, and a reaction. Figure 3 shows a well-formed episode as part of the frog's network. The episode consists of two events, a goal, an attempt, and a successful outcome, and these categories are causally related.

In Figure 3, one can also discern basic goal–attempt–outcome episodes in the boy's or dog's networks. For example, clauses 12 and 13 contain a local goal and an attempt that are followed by a failed outcome for the boy. Similarly, for the dog, clauses 14 and 15 contain another local goal and an attempt followed by a failed outcome. The main action sequence in the narrative occurs at level 3 in which the boy is trying to find the frog in particular places.

Identifying Goal Plans

Recall that the representation of the narration consists of interacting causal networks from the perspective of each of the characters. It is usually the case that one perspective dominates a narrative. The causal network analysis enables us to determine from whose perspective the narration is told. Essentially, the main protagonist is the character with the largest network. In the present case, this was clearly the boy, although the boy and the dog actually appeared together in all but one picture.

In order to compare the narrations to the extent they indicate a goal–plan hierarchy, we extracted the boy's network from each analyzed narration in the corpus. It is not convenient to show the complete network of the boy for any one narration. However, to motivate the data analyses following, we show part of the episodic structure of the boy's network for Subject 20B in Figure 4 (p. 262). The corresponding clauses for the explicit categories in Figure 4 are presented in Table 2 (p. 263) to assist in the reading of Figure 4.

Figure 4 and Table 2 show evidence that Subject 20B's narration is structured according to a hierarchical goal plan strikingly similar to the idealized plan in Figure 1b. The network begins in the upper left with an event in which the boy finds the jar empty (E), causing his desire to get his frog back (G1) in episode 2. This goal generates a goal plan to find the frog (G2) and entails a subordinate goal to search in particular locales (G3). The first realization of the local goal is in episode 9 in which the boy wants to search for the frog outside [G3] and so he calls for the frog (A) but fails to find it [O−]. The boy's goal plan is reinstated in episode 10 in which a hole in the ground (S) is discovered and the boy wants to see if the frog is in it (G3). He looks (A), but a small animal that lives there (S) bites him on the nose, a failed outcome (O−).

The goal plan (G2) is reinstated once again in episode 11 in which the boy is sitting in a tree (S) and there is a hole in the tree (S). The goal plan to find the frog [G2] psychologically causes the boy to think about these two conditions as a *possible* location in which the frog might be searched for and found (IRC). This cognition psychologically causes the activation of the goal to look in the hole (G3). This goal motivates an attempt to look (A) which is disrupted when an owl pops out and the outcome is consequently a failure to find the frog (O−). Later, in episode 14, the boy finds himself sitting in water, an outcome from episode 13 in which a deer has thrown him over a cliff into the pond. An event occurs in which he hears (IRC) some sound coming from the other side of the log (E). This cognition, in conjunction with the reinstatement of the goal plan (G2), causes the local goal of wanting to see if the frog is on the other side of the log (G3). This motivates him to crawl over the log (A) where he finds some frogs (O+), one of which was the frog that had been in the jar (O+). This outcome completes episode 3 in that it finally satisfies the goal of finding the frog. The finding of his frog completes our criteria for inferring a second-order goal (G2), and enables the boy to attempt (A) to achieve his top-order goal of getting the frog back home (G1). The attempt of taking the frog back home (A) constitutes part of the second episode. This explicit attempt supports our inference that there is a top-order goal (G1) of wanting to have the frog back. Once again, we require an antecedent, the initiating event of the frog leaving the jar empty (E), and a consequence, the attempt to bring the frog back (A), for the inferred goal. The inferred goal–plan hierarchy is anchored by explicitly narrated clauses, either an event that causes a goal and an attempt to achieve it, or by failed outcomes and instances of goal plans to search in particular locales.

Analyses of the Content and Structure in the Representations of the Boy's Perspective in the Narrations

If a narrator interprets the pictures as a sequence of actions that follow a goal–plan hierarchy, then we expect the causal network representation to approximate in form and content the ideal structure shown in Figure 1b. If this is the case, the network representation would contain first- and second-order goals (G1 and G2) and be organized into episodes that each consist minimally of a level three goal

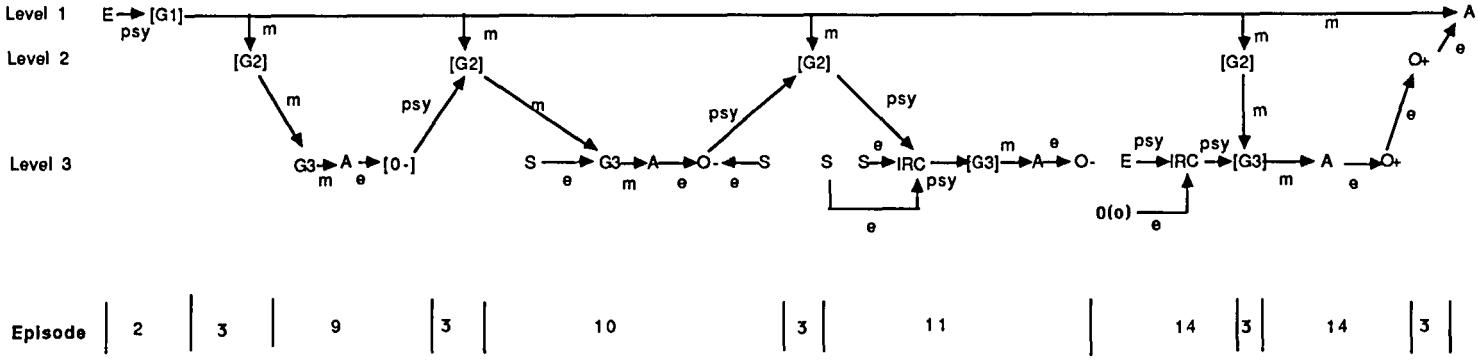


Figure 4. Selected episodes showing a goal hierarchy with unanticipated failure outcomes and success taken from the boy's perspective in the causal network representation of Subject 20B's narration.

TABLE 2
Selected Episodes (Boy's Perspective) of Subject 20B's Narration

Episode	
2	The boy finds the frog's jar empty. (E)
	He wants his pet frog back home. [G1]
3	The boy wants to find his frog. [G2]
8	He wants to search for his frog outside. [G3]
	So he called for the frog. (A)
	But the frog did not come. [O−]
3	The boy wants to find his frog. [G2]
10	There is a hole in the ground. (S)
	The boy wants to see if the frog is in there. (G3)
	The boy is looking in the hole. (A)
	Some little animal is living in the hole. (S)
	The boy gets his nose bitten by the animal. (O−)
3	The boy wants to find his frog. [G2]
11	The boy is sitting in a tree. (S)
	There is a hole in the tree. (S)
	The boy thinks that maybe the lost frog is in there. (IRC)
	He wants to see if the frog is in the hole. [G3]
	So he looks into the hole. (A)
	But at this point an owl pops out of the hole in the tree (O−)
14	The boy sits up in the water. (O)
	Some sound is coming from behind the log. (E)
	The boy can hear the sound. (IRC)
3	The boy wants to find his frog. [G2]
14	He wants to check if there are frogs behind the log. [G3]
	So he crawls over the log. (A)
	And he finds on the outer side of the log two happy frogs. (O+)
	One of which was the frog in the jar. (O+)
2	Now the boy leaves with his frog. (A)

Note. The letters correspond to the content categories of the general causal network. The numbers on the goals refer to their level in the hierarchy. The positive and negative signs for outcomes indicate goal success or failure. The bracketed goals and outcomes are inferred.

(G3), an attempt (A), and an outcome (O), hereafter called GAO episodes. For these properties, we report analyses with age as a factor in order to assess the development of the use of knowledge of goal plans of action to organize a narration.

RESULTS

Evidence for a Goal–Plan Hierarchy

The existence of first- and second-order goals in the representation provides evidence that narrators structure their narrations in terms of a goal–plan hierarchy. We analyzed each person's network representation as to whether it con-

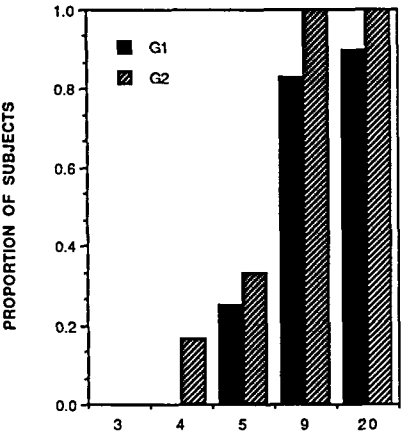


Figure 5. Proportion of subjects with a level 1 goal (G1) and at least one level 2 goal (G2) for each age group.

tained a first-order goal (G1) or one or more second-order goals (G2). The respective proportions of subjects having these goals in the representations of their narrations are shown in Figure 5.

Figure 5 shows that second-order goals first appeared at age 4 and first-order goals at age 5. The 9-year-old narrators showed nearly the same number of these goals as did the adult narrators. The ordering of the age groups $3 = 4 < 5 < 9 = 20$ was statistically significant, $\chi^2(2) = 37.45$, $p < .01$.

Episodic Structures

In order to assess the degree to which the narrations were structured episodically, we identified two kinds of units. The first unit is termed a goal–attempt–outcome (GAO) episode, and has been previously defined and illustrated. The second, termed a non-GAO unit, consists of a clause or a set of clauses that maintain a topic but does not allow the inference of a goal. The clauses within each unit may or may not be connected. For each representation, we counted the number of GAO episodes and non-GAO units. Comparisons between the age groups on these two measures were done by analyzing them in a 5×2 analysis of variance with age as a between-subject factor and the type of unit as a within-subject factor.

In the analysis, there were no statistically significant age differences as to the mean number of combined episodes and units, $F(4, 53) = 1.28$, $p = .29$. There was, however, a significant interaction between age and type of structural unit, $F(4, 53) = 298.96$, $p < .01$. The means for age, and for the two kinds of units in the interaction with age, are shown in Figure 6.

In Figure 6, the GAO episodes followed the same pattern as the higher order goal data. The GAO episodes were rare for both the 3- and the 4-year-olds. They

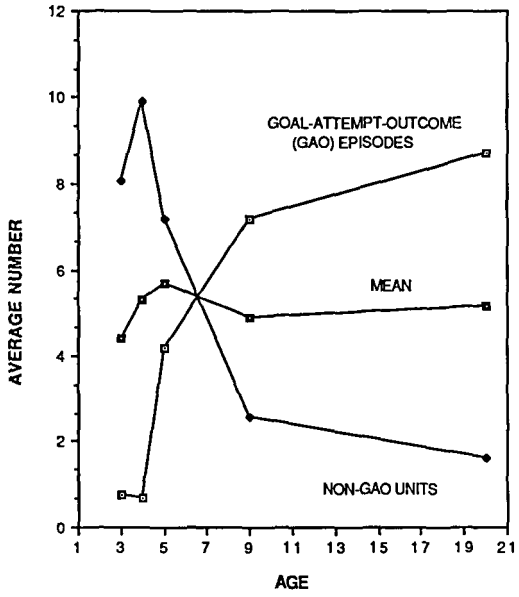


Figure 6. Average number goal–attempt–(+, −)outcome episodes, mean number of units, and non-GAO units for each age group.

increased substantially in frequency for 5-year-olds and approached the level of adult frequency by 9 years of age. For the non-GAO units, the pattern was completely reversed, and quite symmetrical compared to the GAO episode data. That is, the majority of the units for the two younger groups were non-GAO units. These units declined, were still a slight majority at age 5, and became very rare for the 9-year-olds and the adults. Individual comparisons between the types of units at each age indicated that all differences were statistically significant ($p < .05$).

Categories in GAO Episodes

What kinds of categories were included in the GAO episodes and how many, relatively speaking, were there of each kind? The number of categories in a narration is approximately equal to the number of clauses, because every clause could, in fact, be categorized using the definition and criteria of Trabasso et al. (1989). Recall from the examples given in the previous analysis, that, on occasion, a clause can have more than one classification, for example, a purposeful attempt. The proportion of each kind of category to the total number of categories was found for each narrative representation. Separate analyses of variance with age as a factor were carried out. The first analysis was on goals, attempts, or outcomes; the second was on settings, events, neutral outcomes, or internal responses.

Figure 7 (p. 266) shows the data on goals, attempts, and outcomes that

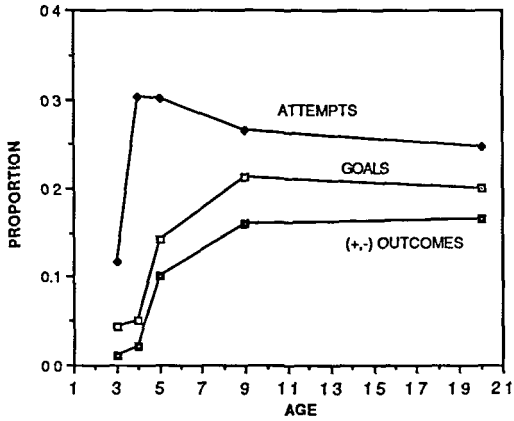


Figure 7. Average proportion of clauses classified as a goal, attempt, and success or failure outcome for each age group.

encoded success or failure. Consider the data on attempts first. Note that the proportion of clauses that were attempts was relatively constant from age 4 to adulthood. Only the 3-year-olds produced a significantly lower proportion of attempts relative to all the other groups, $F(4, 53) = 3.14$, $p < .05$, for age as a variable, and by individual comparisons ($p < .05$). Note also that the attempts were relatively more frequent than either goals or outcomes at all age levels. Consistent with previous findings on higher order goals, level three goals and outcomes increased with age, $F(4, 53) = 23.88$ and 27.80, $p < .01$; the ordering from lowest to highest across the ages was $3 = 4 < 5 < 9 = 20$, by individual comparisons ($p < .05$).

In order to identify the categorical content that is more representative of the younger children's narrations, similar analyses were carried out for settings, events, neutral outcomes (those not involving success or failure with respect to the goal of finding the frog), and internal responses (emotions or cognitions). Figure 8 shows these proportions of the total number of clauses produced in the narration.

In Figure 8, the most striking finding was that the 3-year-old children exhibited a very high proportion of neutral outcomes (e.g., "he fall down"). These declined up to age 5 $F(4, 53) = 6.05$, $p < .01$, and were ordered $3 > 4 > 5 = 9 = 20$, by individual comparisons ($p < .05$). Settings were the next most frequent for the youngest children and this category declined, somewhat, for 5- and 9-year olds, but increased for adults, $F(4, 53) = 6.28$, $p < .01$. Events increased and then decreased slightly with age, $F(4, 53) = 3.47$, $p < .02$. Internal responses increased slightly with age, but their effect was not significant ($F < 1$) and was overall relatively infrequent.

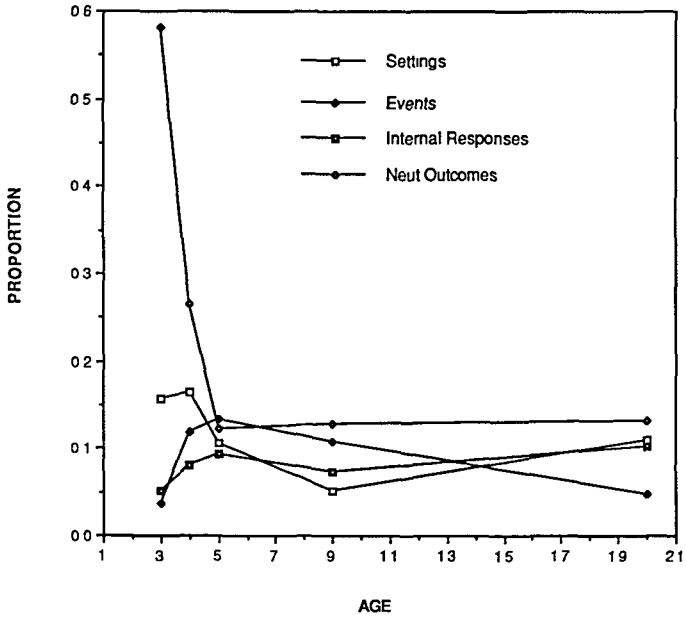


Figure 8. Average proportion of clauses classified as a setting, event, neutral outcome, or internal response for each age group.

Local Cohesion Within Episodes

The previous analyses suggest that the narrations became increasingly coherent at a global level with development: They include more higher level goals and greater structuring of the narration into GAO episodes. Local cohesion at the third goal level in the hierarchy can also be obtained and allows the narrators to increase the length of the narration by adding categories at this level of organization. These added categories are causally related to the other categories of the GAO episode.

For each narration, the total number of additional categories and the total number of different categories added to the minimal GAO episodes were found and entered into separate analyses of variance with age as a factor. The analysis showed a significant effect for both the total number of categories, $F(4, 53) = 29.04, p < .01$, and different categories, $F(4, 53) = 14.22, p < .01$. Figure 9 (p. 268) shows the respective means as a function of age.

The proportion of different categories declined with age: .94, .99, .85, .87 and .77. This means that as the narrators grew older they added more of the same kinds of categories at a faster rate than they added different kinds of categories to their episodes.

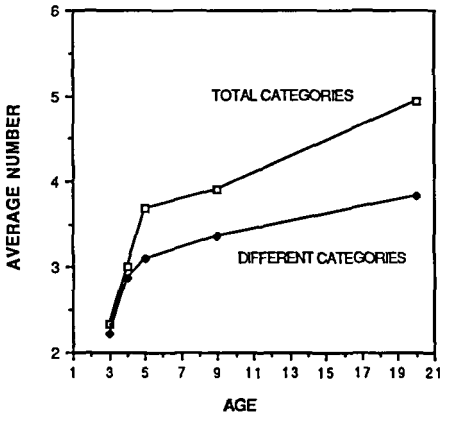


Figure 9. Average total or different number of categories per episode per subject for each age group.

Global Coherence: Causal Connections Within and Between Episodes

To build a coherent narration, the narrator needs to provide the listener with the information necessary to infer causal and temporal relations among the clauses. Given that the narrations are increasingly organized into GAO episodes and that the number and diversity of the episodic categories increase with age, the next question addressed was to what extent the clauses within and between the GAO episodes are connected by these kinds of relations. To understand this analysis, refer to Figure 3. For the GAO episode representing the narration of clauses 12 and 13 from the perspective of the boy, one can see that there is one connection between the goal and the attempt and one between the attempt and the outcome. That is, the goal, G(12, 13), to look for the frog in a particular location motivates the attempt to look in the boots. However, this attempt fails, O[−]. Thus, there are two connections within this GAO episode. Between-episode connections arise when outcomes of previous episodes either cause or enable states or actions in subsequent episodes. In Figure 3, the failed outcome, O[−], for the GAO episode involving clauses 12 and 13 psychologically causes the reinstatement of G2[Find Frog] which, in turn, motivates the local goal, G3(14), to look for the frog at the window. These two connections are considered to be between-episode relations because they connect two different GAO episodes. For each narrator, the number of within- or between-episode connections per episode was found and analyzed in different analyses of variance with age as the between-subject factor. Figure 10 shows the average number of each kind of connection for the age groups.

The analysis of variance indicated that there were significant effects due to age for within, $F(4, 53) = 48.99; p < .01$, and between, $F(4, 53) = 31.71, p < .01$ connections. Individual comparisons on the means ($p < .01$) ordered the age

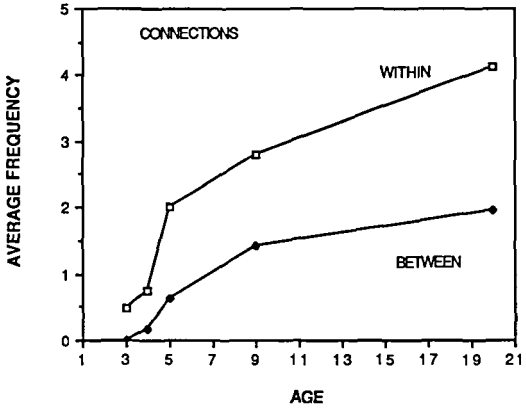


Figure 10. Average number of connections within or between episodes per subject for each age group.

groups in the same sequence for each kind of connection: $3 = 4 < 5 < 9 < 20$. The ratio of between to within connections increased with age up to 9 years: .00, .23, .30, .51, and .47.

The analytical model identifies four kinds of connections: enabling, psychological, motivational, and physical. The respective proportions of each type of relations for the within or between connections were found for each person's narrative representation. The proportions for the within-episode connections are given in Figure 11.

In Figure 11, with the exception of the 4-year-olds, the relations were ordered from the most frequent to the least frequent as follows: enabling, motivation, psychological, and physical. Aside from the 4-year-olds, there are no changes in

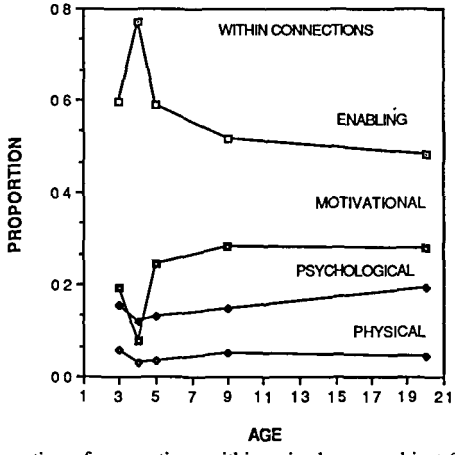


Figure 11. Proportion of connections within episodes per subject for each age group.

these relative frequencies across age. The 4-year-old narrations show slightly more enabling and slightly fewer motivational relations compared to the other groups. For the between-episode relations, from age 5 to adulthood, the proportion of enabling, psychological, and motivational relations were equal (.33) and physical relations were nonexistent; for 4-year-olds, enabling relations were more frequent and motivational ones were less frequent, as before.

DISCUSSION

Development of Plans of Action

The causal network representations reveal striking developmental differences in the content and structure of the narratives. The changes were both qualitative and quantitative in nature. From 3 to 5 years in age, the children's narrations changed first from predominantly describing states and identifying objects to encoding isolated actions. The encoding of the actions was, however, related to a goal plan to find the frog. The next developmental change was the explicit encoding of the goals and purposes behind these actions. Older children and adults more explicitly organized actions according to a goal plan by encoding them along with goals and outcomes into episodes of increasing diversity and causal interrelatedness. This developmental sequence was first reported on children ranging in age from 5 to 11 years by Stein (1988) and Stein and Policastro (1984) for both free story generation to setting statements and for judgments of what constitutes a story.

The 3-year-olds in the present study were clearly descriptive in their narrations, a result consistent with Berman's (1988) claims about this age group. Their descriptions consisted mainly of state changes classified as neutral outcomes unrelated to the goal of finding the frog. Settings constituted the second most frequent category. These descriptive statements were primarily deictic in nature. The 4-year-old children showed a similar but lesser trend. These descriptive categories accounted for a large percentage of the nonepisodic units in these two younger age groups.

The 4-year-olds did show evidence of an awareness of the goal plan in that they encoded a relatively large proportion of their clauses in terms of actions that may be interpreted as attempts relevant to the goal of finding the frog. They did so without the inclusion of phrases with goal objects or purposes so that we were not provided with a basis by which we could infer these motivational categories. The result is that the 4-year-olds appear to be describing rather than explaining the boy's actions. This description appears to be temporal rather than causal, corresponding to the a second stage of development reported by Stein (1988) in story production by children.

One explanation for the 4-year-olds' omission of goals is that the goal object (the frog) is absent from the pictures in which the goal-directed search occurs.

Four-year-olds may encode only what is shown with respect to goal-directed activity. This interpretation is supported in a recent undergraduate honors thesis by Munger (1989) directed by the senior author. When the 4-year-olds were asked to narrate the *Frog, Where Are You?* story in which the frog is absent, children encoded goals as purposes in only 17% of the pictures that contains an attempt to find the missing frog. In contrast, when they were asked to narrate another picture story by Mayer (1967), entitled *A Boy, A Dog and A Frog*, in which the frog is present, they encoded goals in 51% of the pictures that contained an attempt to catch the frog.

Evidence for the narration being organized according to a hierarchical goal plan of action appears most clearly in the data of the 5-year-olds. The 3-year-olds did not provide sufficient explicit information in their narrations to permit inferences for either first- or second-order goals. Second-order goals, however, were inferred for two (17%) of the 4-year-olds and for four (33%) of the 5-year-olds. By age 9, the vast majority of the narrators included both kinds of goals. These American English data are consistent with those of the Hebrew speakers in Berman's (1988) report. We believe that the development and use of planning knowledge accounts for the present data and for Berman's (1988) particular findings of an increase in overall plot line constituents and in sustained search.

The Development of Narrative Skills

The data suggest that the children are not only learning to apply their knowledge about intentionality to their narrations of events but also that they are learning about the requirements of narration as a conventional, communicative form. Listeners need information in order to establish a foundation for constructing a coherent interpretation of what is narrated. Developmental differences in orienting the listener occurred in how the children narrated the beginning of the story and in how the children narrated actions that occurred in different scenes

In their setting statements, the 3-year-olds merely point to and identify either the boy or the dog or the frog and seldom mentioned all three together or the fact that the animals were the boy's pets. The 4-year-olds, however, introduce all three characters in relation to one another, frequently including new information that one or both of the animals are the boy's pets. This information is very important to the listener or reader because it establishes who are the main characters in the story, and points to the relationship between the boy and the frog. Later, when the frog escapes, one can infer that the boy is upset and wants to find the frog so as to have him back as a pet. Without knowing that the frog is of value, inferences about the goals of wanting it back and finding it are unwarranted. The 5-year-olds also orient the listener when scenes shift in the pictures. These shifts happen to co-occur with renewed attempts. By providing reasons in the form of goals or purposes for these attempts in a new context, the 5-year-old narrator is both orienting the listener and providing explanatory coherence.

Narrative Skill and Story Complexity

The *Frog, Where Are You?* story (Mayer, 1969) presents the child with a very complex task. There are several characters whose goal plans interact. The protagonist's plan is interrupted by several unexpected obstacles. These characteristics contrast with more typical stories for young children in which one character seeks to attain a single goal with one or two blockages. Stein (1988), for example, reports that the typical story generated by a 5-year-old is a goal-based story with two episodes with one or no obstacles. The complexity of Mayer's (1969) story may have prevented the younger children from demonstrating what they know about simple goal plans. Our data indicate that the children were able to deal with this complexity. By age 5, several children encoded sustained goal plans of action. By age 4, however, they encoded only the relevant actions to a goal plan. The 4-year-olds may understand goal plans of action even if they do not explicitly encode goals and purposes. They do encode goal plans when the goal object is explicit and present in the situation being encoded. In the study by Munger (1989) cited previously, two picture stories were contrasted on explicitness of goal objects but were similar in complexity. Both stories portrayed a sustained plan of action with multiple obstacles. When the 4-year-olds saw an action directed towards a explicit goal object, they encoded purposes with attempts. If the goal object was not present, they rarely encoded purposes explaining the action. However, in both cases, when Munger asked them *why*-questions on the actions, they stated the relevant purposes. Four-year-olds thus appear to know about goals but do not encode them if the goal object is not present. Thus, the underestimation of the 4-year-olds' knowledge does not appear to depend upon the complexity of the story but does depend upon the physical availability of the goal object and other knowledge about narrative conventions. Our conjecture is that the 4-year-olds have not as yet acquired narrative conventions of explaining behavior in terms of goal plans.

The Episode as a Unit in Working Memory During Production

The fact that the number of structural units was relatively constant across the age groups is striking. Of equal interest is the fact that the number of clauses per unit increased with age, leading to an increase in the length of the narration. The constant number of units suggests some upper limit in what can be narrated. The picture story, as conceived by Mayer (1969) probably constrains the number of episodes one could generate in order to encode it. In addition, the demands of the task to try to narrate every picture also constrained how many units were produced. The episode, however, may also be thought of as a kind of working memory unit, a "chunk," according to Chi (1978), that organizes a number of categories into a single psychological structure for purposes of production and storage in memory. The sizes of these chunks in memory are known to increase with one's knowledge in a domain (Chi, 1978). The more knowledge children have about goal plans, the more information they can include and organize into

the same number of narrative units. Further, we know that both in memory and in on-line processing of stories, the episode is an efficient psychological unit (Black & Bower, 1979; Haberlandt, 1980). Episodic structuring allows the narrator to work with an efficient unit of memory in production because it allows the narrator to expand and diversify the information within the unit without increasing the demands on working memory. Our data on the constancy in the number of units encoded into the representation of a narration, along with the developmental increase in the total number of categories and different categories added to episodes, and the increase in the number of relations within and between episodes are consistent with this interpretation. These developmental changes first become evidence by age 5.

CONCLUSION: THE USE OF A CAUSAL NETWORK DISCOURSE ANALYSIS

The causal network model of Trabasso et al. (1989) was successfully applied to narrations of a picture story by children ranging in age from 3 to 9 years and by adults. This analysis, applied from the perspective of every character in the picture story, allowed us to depict the narration as a set of interacting goal plans from which we extracted the goal plan of the main protagonist. The boy's goal plan corresponded to a hierarchical set of three goals and a sustained plan of action at the level of the third goal in the hierarchy to search for the frog in particular locations. Unexpected obstacles and failures of attaining the third goal led to the reinstatement of the second-order goal of continuing the search. Success in locating the frog enabled the attainment of the goals of finding it and taking it (or a substitute pet) back home.

The explicit representation of narratives as a causal network showed how children from 3 years onward progressively move from identification and description of states to actions and then to explanation of actions carried out according to a goal plan of action. This developmental sequence corresponds to Berman's (1988) taxonomic findings on plot line and sustained search development, and to Stein's (1988) and Stein and Policastro's (1984) classification of stories produced by children as descriptive sequences, temporal action sequences, or episodic structures organized by goals and causal relations. The use of knowledge of goal plans of action to interpret and encode actions as attempts demonstrates the importance of the use of knowledge of psychological causation in narration and narrative knowing (Polkinhorne, 1988). The choice of which lexical terms should be used to encode the actions appears to be dependent upon this knowledge of intentionality. Further, the development of a well-formed overall plot line and a theme that is sustained over the course of the narration depends directly on the development and use of this and other knowledge of narrative communicative conventions.

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