Assessment of Comprehension Abilities in Young Children

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"*To grasp the meaning of a thing, and event or a situation is to see it in its relations to other things: to note how it operates or functions, what consequences follow from it; what causes it, what uses it can be put to*" (Dewey, 1933/1963, p. 135)

The ability to read is essential for successful functioning in society and therefore is one of the most important 'survival' skills to teach our children. In virtually all instances, the goal of reading is to identify the meaning or message of the text at hand. Doing so involves the execution and integration of many processes. These processes roughly fall into two main categories, those involved in translating the written code into meaningful language units and those involved in combining these units into a meaningful and coherent mental representation. In the context of teaching young children reading skills, the bulk of attention of researchers and educators has been on the first set of processes, those involved in *decoding* (e.g., Catts, Fey, Zhang, & Tomblin, 1999; Ehri, Nunes, Stahl, & Willows, 2001; Perfetti, 2003; Rayner, Foorman, Perfetti, Pesetsky, & Seidenberg, 2001; Whitehurst & Lonigan, 1998).

The second set of processes, those involved in *comprehension*, has received less attention. In this chapter, we focus on the development and assessment of comprehension skills in young children, from preschool into the early grades of elementary school. In the first section of the chapter, we discuss what it means to comprehend a text, drawing on research in psycholinguistics and cognitive sciences. In the second section, we summarize what is known about the development of comprehension skills in preschool and early grades. In the third section, we propose a methodology for assessing comprehension skills at these ages. In the fourth and final

section, we provide validation for this methodology by summarizing findings on the relations between comprehension measures as well as between comprehension measures and decoding skills and on the relation between preschool comprehension skills and later reading comprehension.

Our aim in writing this chapter is to elucidate the development of comprehension skills in young children and to discuss possible ways of assessing such skills. Two recent developments make discussion of comprehension skills in young –i.e., preschool- children especially important. First, in educational and political circles there is a growing emphasis on early diagnosis and intervention, particularly at the preschool level (see, for example, No Child Left Behind – Public Law 107-110). Second, the results of recent cognitive-developmental research has shown that comprehension skills relevant to reading comprehension start developing well before children reach elementary school age. In this context, it is crucial that we consider how comprehension skills develop in preschool children and how we can assess and instruct those skills.

What does it mean to comprehend?

Before discussing the development and assessment of comprehension in young children, we need to consider what it means to 'comprehend'. Different researchers and educators use the term in different ways, emphasizing different skills and activities. For example, some define 'comprehension' as the ability to remember what the text was about, others as the ability to apply the knowledge conveyed in the text to a concrete situation, to recognize the theme or moral of the text, to give a critical appraisal of the text, and so on (see Pearson & Hamm, present volume, for an excellent historical overview of the varying views held in different approaches to comprehension instruction

and assessment). To some extent, these different types of comprehension involve unique processes. This is important to recognize because it reflects the fact that 'comprehension' is not a unitary phenomenon but rather a 'family' of skills and activities[1]. As a result, comprehension in its different forms cannot be quantified and assessed easily along a single dimension -unlike phenomena such as height, weight, strength, and perhaps even basic reading skills such as vocabulary and phonological awareness.

At the same time, the different types of comprehension share a large common core of processes. Invariably, comprehension is assumed –explicitly or implicitly- to involve interpretation of the information in the text, the use of prior knowledge to do so and, ultimately, the construction of a coherent representation or picture of what the text is about in the reader's mind (e.g., Applebee, 1978; Gernsbacher, 1990; Graesser & Clark, 1985; Kintsch & van Dijk, 1978; Mandler & Johnson, 1979; Stein & Glenn, 1979; Trabasso, Secco, & van den Broek, 1984; This commonality is easy to discern in a review of different instructional approaches, for example as in Pearson & Hamm, this volume). This mental representation is the foundation on which the reader can build for specific reading purposes and types of comprehension, to do things such as retelling the story, applying the knowledge gathered from the text, identifying the theme, critically appraising the text, and so on. In this fashion, 'comprehension' can mean different things but it always involves a meaningful representation of the textual information in the reader's mind. Somewhat irreverently one can call this the 'onion peel' nature of comprehension: A core of processes common to different types of comprehension with

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[1] An analogy illustrates this point: Consider how one would define someone being a good basketball player. Some players are considered good for different reasons: because they have strong shooting percentages, others because they are good passers, rebounders, defenders, etc. At the same time, these different skills

layers of additional, increasingly unique processes for each specific type. In this chapter, we focus on the core of comprehension, the construction of a representation of the text one is reading. Understanding how readers construct such a representation –and how they may fail to do so- may allow one to increase the effectiveness of instruction and assessment, regardless of one's particular view of comprehension. These core processes have been studied extensively in various areas of cognitive psychology and linguistics. Let us first consider how skilled, adult readers go about comprehending texts they read.

Identifying meaningful relations. Recent research in psycholinguistics and cognitive sciences has greatly increased our understanding of how a skilled reader constructs a coherent representation. Through a dynamic interplay of cognitive processes, the reader identifies meaningful relations between parts of the text. There are many different types of meaningful relations but two types have been found to be especially important: causal and referential relations. For example, imagine reading a text that contains the following sentence pair:

(1) John dropped the banana peel on the floor.

   Mary fell on her back.

Most adult readers immediately connect the two sentences and assume that Mary fell *because* John dropped the banana peel. They make this causal connection by inferring that Mary slipped on the banana peel, even though the text does not say so. This inference is supported by our world knowledge about the slippery nature of banana peels and about the fact that people usually do not fall without a cause. It is also supported by our

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and activities tend to co-vary to some degree within individuals and, moreover, tend to be built on a set of core skills such as eye-hand coordination, physical strength and agility, sense of direction, etc.

knowledge about text conventions that considerate texts usually only juxtapose sentences if they are somehow connected. Consider a second example:

(2) The lady gave the waiter $100.

He returned to give her the change.

Again, most skilled, native readers connect the two sentences without problem and with minimal cognitive effort. As in example (1), the connection involves causal relations (e.g., the lady gave the waiter money because she was in a restaurant and had something to eat or drink, he returned because the $100 was more than the expense of the food or drink, etc.). It also involves a more basic type of connection, namely referential or anaphoric relations: We infer that the 'he' in the second sentence refers to the waiter and that 'her' refers to the lady. Again, these connections are not explicit in the text, yet skilled readers identify them without effort and often without even being aware of doing so

Sometimes the identification of a meaningful connection requires more cognitive effort. Consider a third example:

(3) The moon exerts gravitational pull on earth,

thereby contributing to the development of life on earth.

Most of us have considerable difficulty identifying the causal relation between these two clauses. This is striking because, unlike in examples (1) and (2), the text in this example even helps us by explicitly stating that there *is* a causal relation to be identified. Of course, the difficulty arises because we do not have the background knowledge required for the relation readily available. As a result, readers (if motivated to comprehend) stop in their tracks and search their semantic memory for information that

would allow the causal inference. For most readers, the associations to 'moon', 'pull on earth', and 'life on earth' lead to some inference that tidal variations somehow provide the missing causal link (this inference is, in fact, incorrect; the correct answer is that the gravitational pull causes an electromagnetic field around the earth that protects it from lethal cosmic radiation).

Results of numerous studies show that readers indeed process texts as suggested in these examples (for reviews of relevant research, see Singer, 1994, van den Broek, 1994). For example, after reading the sentences about John dropping the banana peel and Mary falling (example 1) readers have been found to have the concept 'slip' more active than after reading two neutral sentences or even two sentences with the same words as in (1) arranged in a different way. Likewise, notions such as 'waiter', 'restaurant', 'eat' are more active after reading the second sentence in example (2) than after reading control sentences. These examples illustrate several important principles concerning how successful, adult readers construct a coherent mental representation of a text. *First*, a crucial component of comprehension –common to all types of comprehension- is the identification of meaningful relations between different parts of the text. Of particular importance are causal and referential relations because they tend to lend coherence to many different types of text and across reading purposes, but other types of relations also may be inferred (for example, children's stories often contain associative and spatial relations in addition to causal and referential ones. Likewise, comprehension of expository texts often requires the additional identification of logical relations). Dewey (1933/1963) was correct: A crucial step in successful understanding is the identification of meaningful relations. *Second*, there are two basic types of processes by which readers

can identify such relations, a quick, effortless, and automatic process that usually

proceeds without the reader being aware of it, and a slow, effortful, and strategic process

that requires conscious attention by the reader (e.g., Kintsch, 1988). Both of these types

of processes take place during reading and, with practice, some strategic processes can

become automatized. These two distinct types of processes are not only observed in

reading, but exist in many arenas of cognition (e.g., Stanovich &West, 2000; for a

particularly eloquent description of this distinction see Kahneman, 2003, in his Nobel

Prize acceptance speech).

A *third* principle is that for a complete text the inferential processes are

considerably more complex than for the sentence pairs described above. In a full text,

individual events or facts have multiple connections to many other events and facts.

Moreover, the connections themselves vary in their difficulty. As we will see later in this

chapter, for example, causal inferences vary in their abstractness, they may require

extensive background knowledge, they may extend over long distances in the surface

structure of the text, they may require coordination of multiple pieces of information,

they may differ in the amount of cognitive resources required, and so on.

A useful way to think of the outcome of these inferential processes, if all goes

well, is as a *network* representation that includes the different parts of the text, relevant

background knowledge, and the relations amongst these pieces of information (Graesser

& Clark, 1985; Kintsch & van Dijk, 1978; Mandler & Johnson, 1977). An illustration of

such a network representation for a simple story is provided in Table 1 and Figure 1. For

purposes of this illustration, we have represented each event in the text (captured by the

individual sentences) as a node, with the meaningful relations depicted as arcs between

nodes. To keep things simple, we have only included the most basic, causal relations between the text elements themselves. The total number of relations that a reader identifies in a text depends on the complexity of the text and on the motivation and background knowledge of the reader. A reasonable estimate is that, on average, a skilled, adult reader infers between 200 and 300 semantic connections, causal ones as well as others, per page in a text of moderate difficulty. As illustrated above, good readers make the vast majority of these connections without being aware of doing so. As we will see later, beginning readers and readers with reading difficulty infer fewer relations and, moreover, the inferential process often requires much more (conscious) effort.

   Evidence for network representations in adult readers. There is overwhelming evidence that proficient adult readers construct semantic networks of the texts they read. A full review of this evidence is beyond the scope of this chapter, but three examples are worth mentioning. One important property of these networks is that events and facts in a text vary in their number of semantic connections to other parts of the text. This property has been found to be a strong determiner of the psychological salience of the different parts of the text. Readers perceive events or facts that have many connections to be more important than those with fewer connections. Likewise, the more connections an event or fact has, the better it is remembered and the more often it is included in a summary of the text (Fletcher & Bloom, 1988; Goldman & Varnhagen, 1986; Trabasso & van den Broek, 1985; van den Broek, 1988, 1989a, 1989b). A second property is that relations may span a considerable distance, connecting events or facts that are far apart in the text itself. There is considerable evidence that reminding a reader of one part of the text activates related other parts of the text more than unrelated parts even if the unrelated parts are

closer in the text itself (O'Brien & Myers, 1987). For example, readers are both faster and more accurate in remembering related, distant items than unrelated, but closer items. As a third example, the ability to identify semantic relations between parts of a text has been found to be related to reading skills. In particular, this ability distinguishes good from poor readers (Wolman, 1991; Wolman, van den Broek, & Lorch, 1997). Moreover, providing readers with training in identifying relations results in improved comprehension (Medo & Ryder, 1993).

In summary, at the core of successful reading comprehension is the ability to identify meaningful relations between the various parts of a text and between these parts and the readers' background knowledge. To do so, readers engage in inferential processes which, if all goes well, result in a coherent mental network representation of the text.

Comprehension in young children

Research on reading development in young -preschool and early elementary-school children has focused largely on the role of basic literacy skills such as phonological awareness, letter knowledge, vocabulary, and so on. In comparison, little reading research has been done on the development of reading comprehension skills at these ages. Fortunately, narrative comprehension in young children has been investigated in other, non-reading contexts. The results of this research provide important insights in the nature and development of comprehension skills at this early age (for reviews of research on developmental changes in comprehension skills, see for example, Applebee, 1978; Bourg, Bauer, & van den Broek, 1997; van den Broek, 1997).

In considering the development of comprehension skills and processes, it is important to distinguish between age differences in the *type* of processes in which

children engage during comprehension, in the *efficiency* of those processes, and in the *content* of those processes. To illustrate the importance of these distinctions, consider the role of a central aspect of cognitive development, the accumulation of experiences and background knowledge (e.g., Chi, Hutchinson, & Robin, 1989; Chi & Koeske, 1983). This accumulation results in increased knowledge of facts about the world, about how people interact, and so on, and, hence, affects the content of whatever processes the child executes. Importantly, however, the accumulation also results in increased knowledge of strategies that work (in comprehension, as well as in every other aspect of a child's life). As a consequence, processes can be executed more efficiently. In the context of comprehension, for instance, experience plays an important role in more efficient use of one's limited attentional or working memory capacities (with another important role possible for maturation. See Case, 1992, 1995; Siegler, 1994 for discussions of the development of attention/working memory). Thus, observed developmental differences may appear to reflect the development of processes but in actuality be due to increases in background knowledge and corresponding processing efficiency. A classic example of this is found in the observation that very young children can create remarkably complex and abstract knowledge structures for domains in which they happen to have extensive knowledge (for example, dinosaurs or chess; e.g., Chi et al., 1989; Chi et al., 1983; Gobbo & Chi, 1986)

A similar situation has been found to apply to the development of reading comprehension skills. The research findings suggest that young children's comprehension is both remarkably similar and systematically different relative to that of adults. On the one hand, it is clear that children at an early age engage in very much the same inferential

processes as adults do, identifying meaningful relations and establishing coherence. For example, when 4- and 6-year old children watch television programs, they tend to recall events with many causal connections better than events with fewer causal connections (van den Broek, Lorch, & Thurlow, 1996). Likewise, when asked questions about events in the television program they tend to answer them by following the connections in the network. Similar findings have been observed when 6-year olds listened to aurally presented stories (Trabasso & Nickels, 1992). Thus, even at the age of four years children make causal inferences and establish meaningful connections between elements of the events they experience, much as proficient readers do. With appropriate testing techniques and materials, these findings can be extended to even younger children (e.g., see Bauer, 1996, 1997; Wenner & Bauer, 2001, who demonstrate that 2-year old children identify causal relations between events in 3-event sequences they are shown). Thus, even very young children engage in causal-inferential processes to comprehend the events they experience.

On the other hand, there are systematic age differences in the ability to infer semantic relations. Some of these developmental differences are summarized in Table 2. For instance, whereas very young children are primarily able to identify relations between concrete events, older children increasingly become able to identify relations among abstract events as well (e.g., Goldman, 1985; van den Broek, 1989). Likewise, young children readily recognize connections between external events whereas older children and adults routinely identify connections between internal events, such as the goals and feelings of characters, as well. Finally, young children limit their inference making mostly to identifying relations between individual events; with age, children

increasingly connect groups of events (e.g., episodes). These developmental trends reflect the different experiences that children at different ages have had as well as increasing efficiency of working memory and attention allocation.

It is important to note that even very young children *can* generate all of these types of inferences but they generally need the inferences involved to be less complex and more supported by text or background knowledge than do older children. Conversely, even experienced readers may fail to make types of inferences they ordinarily would make without a problem when the text materials are very challenging. Thus, many of us would have difficulty generating abstract inferences when reading technical papers about theoretical astrophysics. The trends described in Table 2 reflect dimensions of ease/difficulty of inference generation. Whether a child will be able to generate a particular type of inference in a particular comprehension situation is a function of the interaction between the child's inferential abilities and the difficulty of the inference involved. As their experience grows, comprehenders are able to negotiate more demanding inference generating situations.

Thus, children engage in the same types of inferential processes as do older readers but they develop in knowledge and efficiency. As a result, with age they do so more routinely, with greater ease, and across texts of a wider range of difficulty. Conversely, even young children can engage in these processes, but they tend to need easier materials to do so. These findings are consistent with findings in other areas in cognitive development. For example, when asked to categorize concrete objects even preschool children are able to draw relatively abstract inferences (e.g., Massey & Gelman, 1988). Likewise, preschool children have been shown to be able to make

inferences about internal events, provided that the scenarios in which they encounter these events are concrete and familiar (e.g., Bartsch & Wellman, 1995; Stein & Liwag, 1997; Wellman, Harris, Banerjee, & Sinclair, 1995).

Together, these age trends result in a developmental sequence of relations that children can identify routinely. In the context of narrative comprehension, important steps in this development can be seen in Table 3 (e.g., Applebee, 1978; Bourg et al., 1997; van den Broek, 1997; Williams, 1993). As mentioned before, whether a particular type of inference is made in a particular situation depends on the interaction between the child's knowledge and experience and the complexity of the inference. For this reason, no definite ages for attaining each step are given. This is consistent with theoretical accounts of other cognitive-developmental sequences where age ranges are illustrative rather than definitive (e.g., Piaget, 1954).

The first type of relations that children usually are able to identify involves concrete, physical relations between events that occur close together in the text or narrative. The example of John dropping the banana peel and Mary slipping exemplifies such relations. The second type of relations that children are able to identify concerns relations between distant events. Third, they are able to identify causal relations involving characters' goals, emotions, and desires. For example, they understand how receiving a nice toy causes joy and how this joy may, in turn, lead to laughing. Fourth, as children gain experience and deepen their cognitive abilities, they increasingly become able to recognize the hierarchical and thematic relations that exist between groups of events. They recognize, for example, that the narrative consists of several episodes, each revolving around a goal and connected by a theme. Finally, they will recognize that the

theme of the episodes translates into an overall plot or point of the story. Examples of this plot or point are the moral or lesson of the narrative.

In summary, preschool children engage in very much the same comprehension processes as do their older counterparts. They make inferences and create network representations of the events they experience; they use these networks to remember or answer questions. However, their networks are less developed than those of older children or adults. They contain fewer relations and, in particular, fewer relations that are abstract, distant, or that involve groups of events. As their knowledge, comprehension skills, and processing efficiency expand, their networks become richer and richer, increasingly incorporating relations according to the developmental sequence described in Table 3.

These findings have important implications for understanding the development of reading skills and for educational practice. One implication is that comprehension skills begin developing at an early age, at the same time as do other features of children's competencies including basic literacy skills, such as phonological awareness and letter/word identification. Thus, the commonly–held view that reading comprehension skills develop *after* basic literacy skills, depicted in Figure 2, is incorrect. A more appropriate view highlights the parallel development of basic and comprehension skills, as depicted in Figure 3. From an educational perspective, this means that instructional efforts at the preschool and early elementary school level should address comprehension as well as basic literacy skills, rather than focus on the latter only. As can be seen from the above description of comprehension, reading for meaning is a complex activity, consisting of the confluence of many skills and processes. These skills and processes

develop over time and experience, starting at an early age –preschool and earlier. If we wait in teaching children these comprehension skills until they have mastered the basic literacy skills, we will have lost precious time –especially for children at risk.

The 'old' model has guided educational practices. Phonological processing and other skills that are essential to word decoding are often the focus of early reading instruction. However, evidence of young children's rapidly developing comprehension skills suggests that preschool and early elementary school reading curricula should address comprehension as well. As part of this effort, we need comprehensive, authentic, and valid tool for assessing developing comprehension skills.

The assessment of comprehension skills in preschool children

Understanding what it means to comprehend and how comprehension skills develop in the pre- and early-school years provides a basis for the development of assessment tools of comprehension skills in these young children. The above review of theoretical models and empirical evidence suggests a set of principles that is useful in guiding assessment practices and tools.

Three principles for assessment.

1. **A significant development of comprehension skills takes place during the preschool years**. Children as young as four years of age engage in comprehension processes that are very similar to those that older children and adults use when reading – albeit perhaps with less efficiency and with less knowledge upon which to draw. Comprehension skills and basic literacy skills such as phonological awareness and vocabulary develop in tandem rather than in sequence. As a consequence, comprehension

instruction and assessment should start at the preschool level rather than be deferred to elementary school.

2. **Preschool comprehension assessment uses non-textual contexts**.

Comprehension assessment in preschool and beginning elementary students poses some practical challenges. One of these challenges is that children at this age are still developing basic written language skills such as letter and word identification. Fortunately, as the review of the research literature shows, children and adults use similar comprehension processes when comprehending events in different media. In all instances, they identify connections –causal, referential, and others- by making inferences. Further, in all cases they have to negotiate limited attentional/working memory resources, use their background knowledge, search back in their memory for the prior events, etc, to do so. This allows a solution to the practical problem of assessing comprehension without being able to do so in a textual context: to obtain a valid measure of comprehension skills, without contamination by basic skills, comprehension should be assessed in a non-textual context. Examples of such contexts are videos (see below) or picture books (e.g., Paris & Paris, 2003).

It is important to note that this does not mean, of course, that there are no differences in what children comprehend in different media. For example, video and text presentations of the same narrative will differ in the extent to which they draw attention to different aspects of the story, in the extent to which basic language skills are required, in the extent to which they draw on established strategies in the child, etc. Thus, the content of the resulting mental representation of the narrative will differ. The important point here is that the *processes* themselves are remarkably similar.

3. **Assessment focuses on the developmental sequence of comprehension skills rather than on a single dimension or score**. Comprehension skills develop in qualitative as well as in quantitative respects. As we have seen, the identification of connections is essential to comprehension and with age children come to recognize increasingly complex types of connections. Proper assessment of comprehension skills gauges not only the *number* of the connections in individuals' representations as a function of the informational structure but also of the *types* of connections included. Whereas one sign of improved comprehension is that a student identifies more relations of the same type in a text, another –and perhaps more telling- sign is that a student has advanced to include new, more complex types of relations.

A methodology for assessing comprehension. In this section, we illustrate how what we know about the development of comprehension skills can be used to develop assessment tools by describing an assessment methodology that implements the three principles outline above. In this methodology, children view television narratives and listen to aurally presented narratives. Consistent with principle 2, we use non-textual contexts to gauge children's comprehension skills. Two contexts –television and audio- are used to make sure that we measure comprehension as it generalizes across media rather than comprehension that is particular to one medium. The assessment method uses children's narratives because they contain relations at all levels of complexity and because the content tends to be familiar to children of a wide range of ages, thus reducing the likelihood of confounding of comprehension skills and background knowledge. In addition, the structure of narratives is relatively well understood (e.g., Mandler & Johnson. 1978; Trabasso et al., 1984) making the identification of inferences at different

levels of complexity fairly straightforward. It is important to point out that the same method could, in principle, be applied to other text types as well.

Children's comprehension is measured by assessing the quantity and quality of their representation of the narratives, in terms of the extent to which their recall focuses on the events and facts that have many connections to other events and facts and in terms of their ability to answer comprehension questions at different levels of complexity. In principle, any authentic program could be used, as long as it contains both simple and complex relations. Here, the television narratives consist of 20-minute episodes of *Blinky Bill*, an Australian children's program, and of episodes of *Rugrats*, a popular American children's television program. Both programs have a complex plot structure that includes the different types of relations. In addition, they are appealing to children of a wide age range. The audiotaped stories are fairytales unfamiliar to the children. They too are structurally complex. They are aurally presented with an average length of about 8 minutes.

The relational structure of the narratives was determined using the methods developed by Trabasso and van den Broek (e.g., Trabasso, van den Broek, & Suh, 1989; Trabasso et al., 1984). On the basis of these structures, several important properties of the narratives were determined. First, we distinguished those elements in the narratives with many causal connections from those elements with few connections. Second, we identified types of connections of different levels of complexity, conform the distinctions made above (see Table 3). These connections formed the basis for comprehension questions. For the purposes of this study, we distinguished two levels of complexity. Basic coherence-building connections were those that establish causal relations between

events that happened close together in the narrative. An example in the sample text in Table 1 and Figure 1 is the causal relation between the boy carrying the cake under his arm (sentences 6 and 7) and it crumbling to pieces (sentence 9). Complex coherence-building connections were those that establish distant causal relations (e.g., the causal relation between the boy living in a hot country (sentence 2) and the sun shining hard (sentence 17), internal relations to protagonists' goals (e.g., the relation between the boy wanting to be very careful (sentence 14) and his putting the butter on his head (sentence 15) or between the grandmother calling him silly (sentence 10) and his wanting to be careful (sentence 14), and thematic relations (e.g., the fact that this boy tried hard to do the right thing but simply did not think through his actions well enough).

Both number of connections and the complexity of those connections can be used to assess the quality of individuals' comprehension and representation of the narratives. With regards to number of connections, more proficient comprehenders will tend to recall more elements from the narratives and, more importantly, their memory for the narratives will focus on those elements with many connections. With regards to the comprehension questions, good comprehenders are those who are particularly skilled at answering questions about the more complex relations.

To investigate the validity and usefulness of this assessment tool we asked preschool children to watch the television programs, listen to the audiotaped stories, and perform both memory and questioning tasks. Our first goal was to find out whether their performance was stable across the two media and whether their behavior was consistent with patterns reported in prior research. Our second goal was to follow these children in a

longitudinal study and see if their comprehension scores as preschoolers predicted their reading comprehension several years later.

Validating the comprehension assessment: Preschool children's Comprehension across Media. As a first step in determining whether the assessment tool is valid, we investigated the extent to which children's comprehension was determined by causal connections –as reported in prior research-, and whether individual children's comprehension scores for the television narratives were related to their comprehension scores for the aurally presented narratives. With regards to the latter purpose, we also determined if any relation between the comprehension scores in the two domains simply was the result of basic literacy skills rather than of a common comprehension component. If this method of assessing comprehension in preschool children is valid then their performance should be consistent across domains and, moreover, in general should reflect factors that have been found to influence comprehension in prior studies. To do this, preschool (4-year old) children received the above assessment as well as tests of basic language skills: The Peabody Picture Vocabulary Test - III (PPVT-III, Dunn & Dunn, 1997), the letter and word identification subtests of the Woodcock Reading Mastery Test (WRMT, Woodcock, 1987), and the Initial Sounds Frequency (phonological awareness) subset of the Dynamic Indicators of Basic Early Literacy Skills (DIBELS, Kaminski & Good, 1996).

First, with regards to memory for the narratives, the preschool children showed the pattern familiar from prior research with older children and adults: the more causal connections an element from the narrative had, the more often it was recalled. This was the case for both televised and audiotaped narratives, with the average r = .74. Thus,

consistent with prior findings the causal structure of these narratives was a strong determiner of the representations that the children constructed. Moreover, this pattern was observed for both media, supporting the notion that similar processes are involved in the comprehension in the two domains.

Second, individual differences between children proved stable across the two domains: the amount of information that the children remembered –and in particular the amount of causally central information- from the television narrative was strongly correlated with how much they remembered from the aural narrative, with an r = .63. Thus, children who are good comprehenders in one medium also tend to be good comprehenders in other media. These results indicate that a child's comprehension skills are not specific to a particular medium but generalize across comprehension contexts.

Third, children's comprehension of televised and aurally presented narratives were strongly related even after basic literacy skills were taken into account, residual R = .59. Thus, the similarity in comprehension in the different domains held independent of basic skills and, conversely, basic skills did not cause this similarity.

In summary, the proposed comprehension assessment tool appears to be a valid indicator of comprehension skills. In general, the patterns of findings with regard to recall for the narratives in the assessment tool are consistent with those reported in the research literature: Preschool children recalled events with many connections more often than events with fewer connections. Moreover, individual differences in comprehension performance were stable across the media: children who comprehended narratives in one medium well also comprehended narratives well in the other medium. These findings are not explained by differences in basic written language skills but instead appear to reflect

comprehension skills. Analyses of the comprehension-question data showed similar patterns, thereby corroborating these conclusions.

Validating the comprehension assessment: Predicting reading comprehension. The second step in determining the validity and usefulness of the assessment is to test whether preschool children's performance on the comprehension tests predicts their later reading performance. If the assessment is valid and captures stable aspects of a child's comprehension ability, then we would expect that performance on the comprehension measures at preschool would predict reading comprehension in elementary school. To investigate the predictive validity of the assessment tool, we followed the preschoolers into 2nd grade. At that time, they received the same tests as they had received as preschoolers, with two modifications: they saw new television and aurally presented narratives and they also read written narrative passages. They then performed recall and question-answering tests that were designed using the same principles as in Preschool.

The results showed that the preschool comprehension assessment using television narratives predicted reading comprehension in 2nd grade. The correlations were considerable, particularly considering what is usually found when predicting early reading: $r = .58$ for memory for causally central information and $r = .53$ for scores on the complex questions. Thus, a preschool child's comprehension skills –as measured in the context of television viewing- strongly predicts the child's reading comprehension as a 2nd grade student.

In interpreting these results it is important to consider if they could be due to the common influence of basic literacy skills at both preschool and 2nd grade test points. After all, as described in the introduction to this chapter, there is ample evidence that

basic skills predict reading scores on standardized tests. We considered this possibility by testing whether preschool comprehension scores predicted 2nd grade comprehension after differences in basic literacy skills were taken into account. The results of statistical regression techniques showed that the predictive power of early comprehension on later reading comprehension remained very strong even after the possible role of basic skills were factored in: residual Rs = .53 and .46 for memory and question-answering, respectively.[2] Thus, the fact that early comprehension performance predicts later reading comprehension performance is not caused or mediated by basic literacy skills such as vocabulary, letter and word identification, and phonemic awareness. This provides further evidence for the validity and usefulness of an assessment tool like the one we outlined here. More generally, an important implication is that reading comprehension assessments based on a thorough understanding of the cognitive processes involved in comprehension have a powerful and unique role to play in determining whether our children learn the reading skills that they need to thrive in school and beyond.

<div align="center">Concluding Remarks</div>

The comprehension processes that preschool children use when they try to comprehend the events and facts they encounter (e.g., on television or by listening to someone else read) are remarkably similar to those that older children and adults use when they read. At the heart of these processes is the identification of meaningful relations between the events and facts, in particular of referential and causal relations. Even preschool children engage in these processes and can be successful, particularly

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[2] The basic skills themselves predict later reading comprehension but only modestly so. This result is consistent with prior findings that the strength of the relation between early basic skills and late reading comprehension declines during the elementary school years (e.g., Ehri, Nunes, Stahl, & Willows, 2001).

when the materials are about concrete, familiar events, and when they provide ample support for the necessary inferences.

Moreover, the ability of a child to engage in these processes at a young age is predictive of that child's ability to comprehend what he or she reads years later. Our findings show that an individual's ability to infer relations at the preschool level strongly predicts his or her later reading comprehension and that it does so over and above basic literacy skills such as vocabulary, letter and word identification, and phonemic awareness. Thus, comprehension skills develop at an early age, and to a large extent are independent from basics skills.

These results have important implications for comprehension assessment. First, they indicate the importance of developing tools for assessing comprehension in young children. Such comprehension assessment should go beyond the sheer assessment of basic skills. Our findings show that assessment of comprehension skills in very young children is possible by using non-textual materials. For example, television narratives provide a rich and intrinsically motivating context, often with a wide range of possible inferences. Others non-textual materials include picture tasks in which children are asked to relate a story about a series of pictures, thus allowing one to observe the child's inferential skills (see, for an excellent example of the use of picture tasks, Paris & Paris, 2003). These and other non-textual contexts provide an important window into the processes that children will later use to comprehend texts.

Second, comprehension assessment should focus on the structure of the mental representation of the text or narrative. As children grow older, they accumulate more knowledge, comprehension strategies, and increase the efficiency of their cognitive

processes. As a result, they improve their ability to generate more challenging inferences, such as ones about relations that are abstract, span large distances in the text, etc. Accordingly, the emphasis in assessment should be on the *quality* of recall, question - answering, and so on, rather than on the sheer *amount*. Consider, for example, using memory as a measure of comprehension. As skills develop, the amount recalled may increase but, more importantly, the pattern of recall will change, focusing more and more on those events or facts that have complex connections. A simple count of the number of events or facts recalled gives an inadequate picture of an individual's skills. Similar considerations apply to using comprehension questions. As in the assessment tool outlined above, comprehension questions should span the range of different types of inferences. Development and individual differences are more likely to be captured by including questions about the more challenging relations, such as those in the latter half of the developmental sequence in Table 3, than by adding more questions about simpler relations. These implications are in contrast to established practice. The scores on many standardized tests are based on a single dimension -amount of recall, number of questions correct, etc. Moreover, they usually focus on the lower levels of comprehension, as captured in the lower half of Table 3, only. Given the recent advances in our understanding of the complex nature of the reading process, it is time that tests start focusing on the rich and multifaceted aspects of comprehension. Thus, measures of individual differences in sensitivity to the causal connections in a text and in the extent to which one can detect adjacent versus distant relations, physical/concrete versus goal and theme relations, have strong psychological validity and good predictive power. Such

measures can be based on sound cognitive theory and, as our results indicate, have tremendous predictive potential.

This does not mean that the measurement of basic literacy skills is superfluous. It is likely that the development of comprehension and of basic skills dynamically interact. As a child advances in comprehension skills, basic literacy skills are likely to develop as well. Conversely, with increases in basic literacy skills, a child gains new occasions to practice comprehension skills. Thus, comprehension and basic skills engage in a dynamic interaction resulting in distinct yet connected developments (Morris, Bloodgood, Lomax, Perney, 2003). Moreover, both contribute to reading performance, especially in the beginning grades, when basic literacy skills are still developing and thus may limit a child's opportunity to exercise his or her comprehension skills (Ehri et al., 2001).

The work presented here is only a first step towards constructing usable comprehension assessment tools. A broader range of materials needs to be developed and additional tests of reliability and validity need to be done. We are currently pursuing two lines of research to achieve this goal. The first involves following the children described in this chapter into higher elementary school grades with the goal of observing whether the predictive power of early comprehension tests remains strong. The second involves developing and validating curriculum-based assessment versions of our test that teachers can use to gauge the progress –or lack thereof- in their students (McConnell, Horst, Passe, Rodriguez & van den Broek, 2003).

As mentioned at the outset of this chapter, 'comprehension' means different things to different people. Each type of comprehension involved unique processes, but they also have a large common set of processes. At the core of comprehension –any type

of comprehension- are the set of processes involved identifying and inferring relations to build a coherent representation. Surrounding this core, as peels to an onion, are the processes unique to different types of comprehension. For example, to be able to apply the information in a text to a real-life situation one needs to build on the coherent representation to connect the particulars of the situation to their relevant corollaries in the text. Or, to understand the theme or moral of a narrative one can reflect on the coherent representation to identify more abstract relations (e.g., van den Broek, Lynch, Naslund, Ievers-Landis, & Verduin, in press; Williams, 1993). Ultimately, assessment should include all concentric layers but a start should be –and, as the current chapter demonstrates, can be- made by assessing children's ability to detect meaningful relations between the events and facts they experience.

Acknowledgments

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Table 1

Epaminondas Story

1. Once there was a little boy,

2. who lived in a hot country.

3. One day his mother told him to take some cake to his grandmother.

4. She wanted him to hold it carefully

5. so it wouldn't break into crumbs.

6. The little boy put the cake in a leaf under his arm

7. and carried it to his grandmother's.

8. When he got there

9. the cake had crumbled into tiny pieces.

10. His grandmother told him he was a silly boy

11. and that he should have carried the cake on top of his head

12. so it wouldn't break.

13. Then she gave him a pat of butter to take back to his mother's house.

14. The little boy wanted to be very careful with the butter.

15. so he put it on top of his head

16. and carried it home.

17. The sun was shining hard

18. and when he got home

19. the butter had melted.

20. His mother told him he was a silly boy

21. and that he should have put the butter in a leaf

22. so that it would have gotten home safe and sound.

Table 2

Examples of Developmental Trends in Inference Making in Narrative Comprehension

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Relations between Concrete Events   à Relations between Abstract Events

Relations between External Events   à Relations involving Internal Events

Relations between Individual Events à Relations between Clusters of Events

---

Table 3

Developmental Sequence of Inference Types in Narrative Comprehension

| Developmental Order	Inference Making
1	Concrete physical relations that occur close together
2	Concrete physical relations between distant events
3	Causal relations involving character's goals, emotions, and desires
4	Hierarchical and thematic relations between clusters of events
5	Translation of the story theme into moral or lesson

Figure 1

Epaminondas Story Network
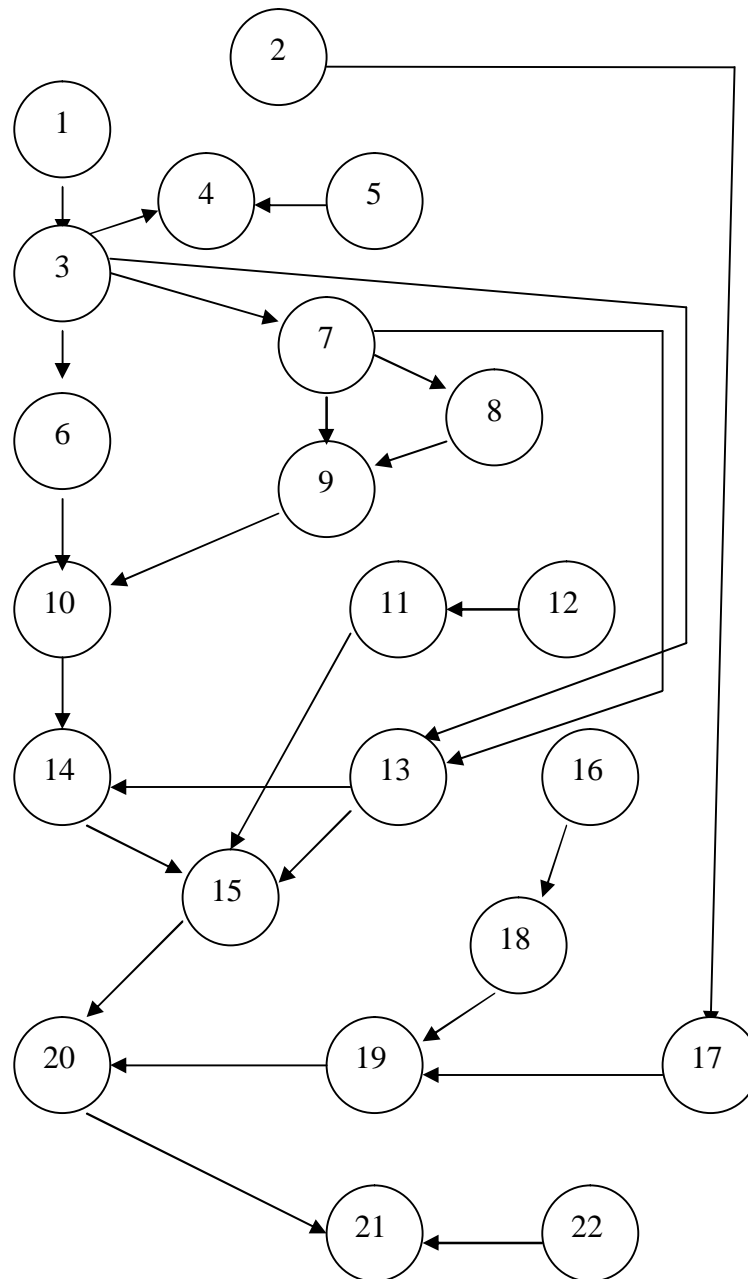
Figure 2

Commonly-held View of Comprehension Developing after Basic Literacy Skills

Age/Time

```
┌──────────────────────────┐
│  Basic Language Skills   │
└──────────────────────────┘
             │
             ▼
┌──────────────────────────┐
│        Decoding          │
└──────────────────────────┘
             │
             ▼
┌──────────────────────────┐
│   Comprehension Skills   │
└──────────────────────────┘
             │
             ▼
┌──────────────────────────┐
│  Reading Comprehension   │
└──────────────────────────┘
```
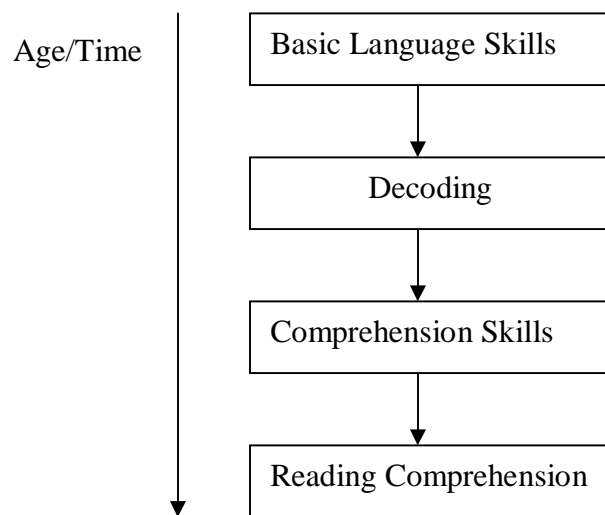
Figure 3

Parallel Development of Comprehension and Basic Literacy Skills

Age/Time

Basic Language Skills

Comprehension Skills

Decoding

Reading Comprehension