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ABSTRACT

The psychological process of segmenting sentences into meaningful units or "chunks" is believed to be an important aspect of text comprehension processes. The most characteristic type of parsing task elicits perceptions of text structure indirectly by asking individuals to make judgments about pause placement in sentences. In four studies of sentence parsing, individuals were asked to locate boundaries between groups of words on the basis of one of the following cues: words that form meaningful groups, locations where one would pause when reading out loud, and locations where it would be acceptable to pause. A major conclusion from these studies was that any one of these instructions was likely to be confusing to children. Children understood the parsing task best when the instructions directed their attention to both the sound and the meaning of instrasentence units. Most studies of pausing phenomena as measures of structural units are based on the idea that pausing is at least acceptable at constituent boundaries. Although the units defined by children's pausal judgments seem to agree fairly well with adult intuitions of parsing structure, it is not clear that such units give a description of the optional "chunks" for processing by poor readers. Critical factors in the selection of an optimal unit appear to be whether information is new or old and the number of propositions expressed (which is correlated with the number of words). (HOD)

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PARSING TASKS IN READING COMPREHENSION RESEARCH

David Snow

ABSTRACT

This paper reviews some techniques that have been used for eliciting children's judgments about functional parsing units in sentences. The review suggests that children understand the parsing task best when the instructions direct their attention to both the sound and meaning of intrasentence units. In pause acceptability judgments, for example, the children mark boundaries in the text where it is permissible to pause and the text still makes sense. Activities using pause acceptability judgments can be used to assess (and facilitate) children's acquisition of sentence perception skills in reading.

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PARSING TASKS IN READING COMPREHENSION RESEARCH

David Snow

The psychological process of segmenting sentences into meaningful units or "chunks" is believed to be an important aspect of text comprehension processes (Clark & Clark, 1977; Rode, 1974-1975). Parsing skills have been studied by reading researchers in an effort to determine the ways in which individual segment written sentences into processing units having psychological significance. This paper summarizes the procedures and findings of several studies focusing on text parsing skills, and discusses the implications of this research for instructional issues such as the use of parsed text in interventional training for poor readers.

The procedures discussed in this review all use elicited judgments from participants, rather than an analytic scheme, to determine meaningful word groupings in prose. In general, participants are asked to divide sentences into groups of words by placing slashes in the text. The approaches differ from one another in three areas: 1) the specific instructions given to participants as to how to identify groups of words having syntactic or prosodic integrity, 2) the format in which the text is presented, for example, whether or not it contains line breaks or punctuation, and 3) the amount of practice and/or modeling that is used to explain the task.

SURVEY OF PROCEDURES

The most characteristic type of parsing task elicits perceptions of text structure indirectly by asking individuals to make judgments about pause placement in sentences. This technique was first used by Johnson (1970), who sought an objective method of specifying the linguistic subunits of prose. Johnson defined such units as places where speakers could pause. Boundaries where it was acceptable to pause were hypothesized to be an important locus of encoding and decoding processes. In order to locate these boundaries, adult judges were asked to divide a narrative passage into units bounded at junctures where one could pause in order to catch a breath, to give emphasis to the story, or to enhance meaning. These units were called "pause acceptability units" or "linguistic units." The validity of each unit was established when at least half of the judges marked it as acceptable for pausing.

Using a technique similar to Johnson's, Mason and Kendall (1973) studied children's ability to identify meaningful units in passages. Both adults and children (ages 9 to 11) were asked to identify pause locations in passages by marking their boundaries with slash marks. These "intrasentence pausal junctures" were described to participants as locations "where they would pause if they read the passage aloud." No other instructions, examples, or explanations of the task were apparently given. The passage format is unknown, except that it apparently contained standard punctuation.

Comparisons between the children's and adults' parsing of the texts showed little agreement. Nine year-olds tended to make idiosyncratic judgments, suggesting that the task had not been well understood. Older children were very cautious in marking pause junctures; many of them restricted their judgments to locations already marked by commas in the text. In general, the results were interpreted as showing that even upper elementary school children are not able to identify intrasentence units in passages.

In a second study, Mason and Kendall investigated the effect of text manipulations on children's reading comprehension. Fourth graders read paragraphs in Standard, Parsed, and Short Sentence formats. The Parsed version presented each meaningful unit on a separate indented line, with parsing apparently determined by the experimenters. The Short Sentence version did not control for line breaks, but presented the text in simple sentences. An example of the three formats is shown below.

Standard

Dick will be in Grade Five and though he enjoys math he likes art class best.

Parsed

Dick will be in Grade Five
and though he enjoys math
he likes art class best.

Short Sentence

Dick will be in Grade Five. He enjoys math. He enjoys art. He likes art class best.

The examples shown above give the only indication of what the actual text formats looked like. No punctuation other than periods was apparently used.

Multiple-choice comprehension testing showed that both experimental formats led to better comprehension and slower reading times than the Standard text format, but only for low-ability readers. It is interesting to note that these effects were strongest for the Short Sentence version. Thus, it appears that Parsed text may provide a good bridge for some readers between simple-sentence passages (which are easiest to understand) and the more structurally complex language that predominates in the reading materials of upper elementary school children. An additional conclusion of the study is worthy of note. The authors point out that middle- or high-ability students did not benefit from text organizations that segmented the text into meaningful word groups. This implies that such readers are already proficient at the task of identifying intrasentence junctures as required for comprehension, even though children of the same age did not perform well in the earlier parsing task. Therefore, the children's inability to identify pausal boundaries in the context of this parsing task does not indicate an inability to tacitly identify and use intrasentence junctures as a part of the comprehension process itself. The results show that the task may simply fail to reveal the children's understanding of constituent structure in sentences.

Kleiman, Winograd, and Humphrey (1979) elicited judgments about intrasentence units by appealing more directly to children's intuitions of sentence structure. They used a parsing task in the context of testing the hypothesis that children's text parsing skills would be facilitated by the availability of prosodic information that is missing from written material.

The stimuli consisted of short, descriptive passages about fictional creatures. Each sentence was presented on a separate page. Line breaks were apparently determined by imposing a maximum line length. Except for periods, no punctuation seems to have been used. Participants were fourth grade children, evenly divided between above- and below-average readers. Judgments by adults on the same task provided a normative parsing of the text which was used to assess the children's accuracy on the task.

The children were asked to divide the sentences into "meaningful groups of words" by making slashes at word group boundaries. They were shown several examples of how sentences might be divided. The children were asked to read each sentence twice. On the first reading, they were to think about words that formed meaningful groups; on the second, they marked slashes at the boundaries of word groups.

The scoring focused on four types of structure which were candidates for designation as meaningful word groups:

1. Clause subordination marked by conjunctions like <u>because</u>, <u>when</u>, <u>if</u>.
2. Clause conjunction, that is, clauses conjoined by <u>and</u> or <u>but</u>, including coordinate predicate constructions.
3. Sentence-initial noun-phrases containing adjectives, conjunctions, or prepositional phrases.
4. Within-phrase conjunction, such as conjoined noun phrases and adjectives.

The last two categories refer to structures at the phrase or within-phrase level. Length of these units (number of words) was found to be

an important factor that determined whether they were marked as separate word groups. Thus, clause structures were more consistently marked by both children and adults than phrasal or within-phrase structures.

Candidate structures that were marked by half or more of the adult judges were considered to be word groups requiring breaks. The children's performance was compared to this consensual parsing of selected structures in the passages. Some example sentences are given below, showing the adults' judgments of meaningful word groups. A superscript above each boundary indexes the type of structure (1 to 4) as listed above. Line breaks are shown as they occurred in the text.

Glods are very large^{2}/and they are easy to see.

Because they have such long wings^{1}/they can fly very fast^{4}/and ~~for~~ a long time.

Glods sleep during the day^{2}/and eat at night.

The people on Orese^{3}/get scared^{1}/when they know glods are coming.

Glods are afraid of water^{2}/and they stay away from rivers^{4}/and large lakes.

Children performed the task in two conditions. In the "No Prosody" condition, there was only a written presentation of the text; in the Prosody condition, the children received a simultaneous written and spoken presentation of the sentences. The analysis focused on the frequency with which participants marked breaks at points required by the adult-normed version. As predicted, results showed that the parsing skills of below-average readers were significantly better in the Prosody condition. The authors concluded that the lack of prosodic information contributes to the difficulty some children have with parsing written text and hence with reading comprehension.

Cioffi (1980) used a parsing task as a means of addressing two major questions. 1) Do good and poor comprehenders differ in their ability to perceive and articulate sentence structure? 2) Is the comprehension of poor readers facilitated by articulating the structure of sentences as identified by their peers?

Children in the study were third and fourth graders representing Good Comprehenders and "Skilled Decoders" (Gibson & Levin, 1975), the latter group corresponding roughly to readers identified by Cromer (1970) as Difference readers. Children participated with the experimenter in the study, in small heterogeneous groups of from 6 to 15.

Each participant received either a narrative passage (about a science fiction incident) or an expository text (about volcanoes). The passage was typed in standard format, with double-spacing. Participants also received the same passage in a format in which each sentence was typed lengthwise on a separate line, with triple spacing between lines. Except for sentence-final periods, no punctuation was used in any of the experimental materials. Participants were first asked to read the story in the standard format (typed on one page) to find out what it was about. Next, participants were told they would be dividing sentences but would first practice the task. Practice materials were four sentences from "Jack and the Beanstalk."

A crucial aspect of Cioffi's procedures is the careful practice that was provided for the children to help them understand the task. Cioffi had found that simply asking students to mark places where it makes sense to pause sometimes confuses them. His explanation of the task and practice session are described below.

> The experimenter told the subjects that he was going to read the first sentence from "Jack and the Beanstalk," and he wanted them to tell him what he was doing wrong. The sentence was then read in a grossly exaggerated word-by-word fashion.
>
> Typically, students responded by suggesting that the sentence was being read too slowly or spaces were being left between all of the words.
>
> The experimenter probed, "Are there places where it is okay to pause, say to take a breath?"
>
> The students agreed there were.
>
> "Where are they?"
>
> Students invariably suggested periods or commas signalled places where one might pause.
>
> "And if there are no periods or commas, are some places better than others?"
>
> Students admitted that there were places without punctuation where it was permissible to pause.
>
> At this point their attention was directed to the first sentence, and they were asked to mark one place where they could pause and still have the sentence make sense. While they were deciding, the experimenter circulated among the students, encouraging them, apologizing that the task was sometimes hard, and praising any response. (Cioffi, 1980, pp. 107-108)

The experimenter continued in this manner until the children were able to practice the task of finding two and finally three pause locations within a sentence. After this practice session, subjects were then asked to find three pause locations within each sentence of the experimental passage they had read.

Pause acceptability locations that were chosen by at least 10 of 18 subjects in each group were selected as group judgments for sentence constituents. The analysis focused on differences between groups in pause acceptability judgments, and on the relationship between individual performance on the parsing task and other measures of reading skills such as auditory vocabulary and comprehension.

A sentence parsing index was computed for each child by tallying the number of pause acceptability judgments that agreed with the group norms. Correlations between this parsing index and other reading skills

such as comprehension ability were weak and nonsignificant, except for Skilled Decoders on the expository text. This finding indicates that the relationship between parsing abilities and other subskills of reading needs to be further explored.

Comparisons between the judgments of Good Comprehenders and Skilled Decoders showed quantitative but not qualitative differences in sensitivity to syntactic structure. Although the Good Comprehenders identified more constituent boundaries to criterion than did the Skilled Decoders, the two groups did not differ in the types of structure that were marked as acceptable for pausing. In general, both groups placed pausal boundaries at acceptable grammatical locations. The most frequent locations marked for pauses were within-clause junctures between noun phrases and verb phrases, as well as the boundaries of prepositional phrases. Some examples are shown below reflecting the group judgments of good comprehenders.

Simple sentences with prepositional phrases

(1) The Earth - looked blue and green - and fragile - through the window.

(2) In some volcanoes - big pieces of rock - are thrown from the crater - in giant explosions.

Coordinate constructions

(3) The cabin - lights flickered - and dimmed.

(4) Volcanoes are very different - and no two - have the same history.

Complex sentences

(5) The ship - was beginning - to tumble.

(6) There must - be a leak - she thought.

(7) She was one of the first - of the star children - as they were called.

(8) The Hawaiian Islands - were formed by lava - slowly flowing, from the craters - of volcanoes on the ocean floor.

(9) At the top of the cone - where the lava leaves - the volcano - a crater forms.

(10) Active volcanoes - are the ones like Mount Saint Helens - that are erupting now.

The examples show that the children's marking of pause acceptability locations corresponds generally to constituent boundaries. However, as Cioffi points out, the parsing is sometimes agrammatical or reflects lower-level boundaries rather than larger constituent structures of the sentence. Examples include the split between cabin and lights (sentence 3) or the split between lava leaves and the volcano (9). Some of these instances of local constituent breaks may reflect the fact that the forced-choice task can encourage children to analyze sentences in more detail than is required for facilitating comprehension. This and related issues are further discussed in the following section.

This review has mentioned four studies that use a sentence parsing task. Some major characteristics of the methodology in each case are listed in Table 1.

DISCUSSION

In the parsing tasks described in Table 1, individuals are asked to locate boundaries between groups of words on the basis of one of the following cues: 1) words that form meaningful groups, 2) locations where one would pause when reading out loud, 3) locations where it would be acceptable to pause. A major conclusion concerning these tasks generally is that any of these instructions are likely to be confusing to children. In order to be successful, the task procedures must include sufficient practice and training.

TABLE 1. SUMMARY OF STUDIES USING PARSING TASKS

Task Descriptors	Johnson (1970)	Mason & Kendall (1978)	Kleiman et al. (1979)	Cioffi (1980)
Participants	adults	children (9-11 years)	children (Grade 4)	children (Grades 3 & 4)
Cue for defining units	pause acceptable	pause locations	meaningful groups	pause okay, still makes sense
Name of units	pausal units	intrasentence units	word groups	sentence constituents
Norms by	adults	adults	adults	participants
Findings for parsing skills	N/A	not successful	prosodic cues aided parsing skills	no substantial differences between reading groups

As Cioffi points out, these tasks can be approached with one of two strategies. In one strategy, individuals will look for syntactic and semantic cues to guide their marking of intrasentence units. That is, they will use intuitions of structural units and mark boundaries that maintain the integrity of these units. An approach of this kind was encouraged by instructions asking children to look for "meaningful groups of words" (Kleiman et al., 1979). On the other hand, tasks in which children are asked to make pause acceptability judgments invite a strategy of using prosodic information or an auditory sense of "what sounds right."

Since the purpose of these tasks is to reveal children's sensitivity to constituent structure (which presumably corresponds to the encoding unit of comprehension), a task focusing on intuitions of syntactic structure would seem to be the most direct method of probing such abilities. However, this task is more difficult to explain to children than one based on prosodic cues. Cioffi's approach seems to be a good compromise. He asked children to look for locations where it was okay to pause and the sentence would still make sense. Since this procedure makes an appeal to both prosodic characteristics of sentences ("okay to pause") and syntactic-semantic structure (it still "makes sense"), the children may use either strategy or both. Anecdotal reports in Cioffi's study indicated that this was indeed what the children did. It may, in fact, be possible to combine possible instructions to children in even more explicit ways.

Validity of Parsing Tasks Based on Pausal Judgments

Because pausing phenomena are more accessible than syntactic intuitions and more easily defined in behavioral terms, pausal judgments

have been used as the basis for most parsing tasks. It would be worthwhile to consider the validity of pausal judgments as indicators of children's knowledge of structure in sentences. Clearly there are instances in which pause acceptability judgments fail to reveal the parsing skills that children must indeed possess. For example, in the Mason and Kendall (1978) study, neither good or poor readers performed well on the task. However, good readers must have a good (if tacit) knowledge of syntactic structure because parsing strategies are presumably a necessary adjunct to the text comprehension skills that these children demonstrate. This means that the parsing task failed to reveal their knowledge of sentence structure.

Some of the reasons for the poor results that are sometimes obtained in parsing tasks are procedural in nature. For example, the Mason and Kendall task did not seem to be supported with sufficient practice and explanation, which is an important issue, as mentioned above. Children cannot be expected to perform a task that they do not really understand.

A second problem relating to procedures is that participants were directed to mark places in the text where they would pause if they read the text out loud (not just where it would be acceptable). This is probably too stringent a requirement if pausal judgments are to be used as an indirect reflection of the perception of constituent boundaries in sentences. Although speakers do frequently pause at constituent boundaries within sentences (Goldman-Eisler, 1968), the relation between pausing and structure is not absolute but only a correlation that is not always reliable (Larkey, 1979; Cioffi, 1980). Perhaps one reason for this is that pausing may be used for other purposes than that of marking or

enhancing the packaging of sentences, functions such as emphasis and focus. In addition, information blocking (which may be marked by pauses and intonation changes) is dependent on the speaker's estimation of the density of new information being conveyed (Grimes, 1975). Thus, there are probably few instances in which the relation between pausing and structure is absolutely predictive.

Most studies of pausing phenomena as measures of structural units are based on the idea that pausing is at least acceptable at constituent boundaries. That is, when pauses occur in speech perceived to be fluent, they generally do not disrupt the temporal and prosodic integrity of constituent units (Clark & Clark, 1977). Tasks that attempt to elicit such judgments seem to be more reliable than those that focus on unstructured performance.

If pauses are acceptable at constituent units, what type of units are important? Are they clauses, phrases, or constituents within phrases? The following discussion addresses these questions and their relation to the purpose of parsing tasks. These questions are pursued by looking first at some brief examples of analytic or intuitive models of text parsing and then comparing these models with children's group judgments of pausal units in Coffi's study.

The Structure of Pausal Units

Sentences can be analytically divided into increasingly refined constituent units. Eventually each word is a constituent of some higher-level unit. The question addressed here is: At what point do constituents become sufficiently complex and integrated to become important as units in processing? In other words, what level of text parsing is important

and how does it relate to pausing judgments? As a starting point, it can be hypothesized that a "chunk" corresponds to a major syntactic unit. Such units might be defined as ones that are not contained within the boundaries of any other constituent except for the sentence as a whole. For example, a sentence used in the well-known click experiments of Fodor and Bever (1965) is shown below, with diagramming in labeled brackets to indicate the constituent structure.

(11) [[That [[he] [was happy]]] ↓ [was [evident [from
S1NP1 S2 NP2 VP2 VP2 S2 NP1 VP1 ADJ PP

[[the way] [he smiled]]]]]]
NP3 S3 S3 NP3 PP ADJ VP1 S1

Fodor and Bever found that perceptions of sentence interruptions (locus of clicks) migrated to the major syntactic boundary, which is shown above by the arrow. This boundary occurs between the complex subject noun phrase and the verb phrase, units that are not embedded within any other intrasentence constituent. Other structures fitting this definition of major constituents would be sentence adverbials and subordinate clauses. Such examples seem to be the clearest cases of constituent boundaries that are also the most likely to be marked by pauses or by other prosodic phenomena.

However, other examples show that the parsing of sentences may result in units that do not correspond to major constituent boundaries in this sense. For example, a sentence used in the study conducted by Graf and Torrey (1966) is shown below. Graf and Torrey arranged sentences in meaningful phrases, an example of which is used here as a standard for comparison with responses given by children in the pausal judgment task.

(12) [[During World War II]
S1 ADV ADV

(13) [even fantastic schemes]
NP1 NP1

(14) [received consideration]
VP1 VP1

(15) [if they [gave promise
S2 VP2

(16) [of shortening the conflict]]]]
S3 S3 VP2 S2 S1

The first three phrases correspond to the type of constituents discussed above; that is, they are major syntactic constituents. Lines (15) and (16), however, split the subordinate clause (a major constituent) into two smaller units. This parsing is determined primarily by length (the whole clause is too long). As a result, line (15) is not a whole constituent. It contains the subject, verb, and object head-noun. The embedded clause (16) is parsed as a separate constituent. Note also that the subject noun they is not separated from the verb phrase, again because of length considerations. In general, the parsing seems to be sensitive to three factors: 1) number of propositions expressed, 2) major constituent structure, and 3) subordination structure.

The judgments of pausing acceptability observed by Cioffi show a number of striking similarities to the parsing shown above. In the examples that follow, the sentence constituents identified by the Good Comprehenders in his study are written on separate lines.

(17) [[This morning]
'S ADV ADV

(18) [Kim] [[was sitting in the forward cabin]
NP NP VP VP1 VP1

(19) [and watching the Earth
VP2

(20) [through the cabin window]]]]
PP PP VP2 VP S

The second verb phrase ("and watching the Earth through the cabin window") has been divided into two units, probably because it is too long (three propositions). These two units are not major constituents, but they maintain the integrity of the verb and object noun phrase (line 19) and the prepositional phrase (20). On the other hand, the subject noun phrase of the main clause ("Kim") is not separated from the verb phrase. Again, this seems to be because of length: The single noun is too short and does not express a proposition. In all cases, an interaction between word length (probably propositional density) and structure seems to guide the assignment of pausal boundaries.

Another example shows some of the same features.

(21) [[The Hawaiian Islands]
S1 NP1 NP1

(22) [were formed by lava
VP1

(23) [slowly flowing from the craters
S2

(24) [of volcanoes [on the ocean floor]]]]]
PP PP PP PP S2 VP1 S1

This example contains a long, complex verb phrase whose pausal junctures divide it into units reflecting the subordinate structure of the sentence. This is shown particularly by units (22) and (23), each of which contains a verb and a head noun dominating the immediate lower level of structure.

The examples discussed above show that pausal judgments agree fairly well with some adult models of sentence parsing. The units do

not necessarily coincide with major constituent boundaries. Instead, parsing structure is sensitive to an interaction between (1) number of propositions expressed (1 to 3 propositions per chunk), (2) constituent structure, and (3) subordination.

On the sentence level, parsings tend to divide the sentence into clausal and adverbial units, giving main clauses, sentence adverbs, subordinate clauses, and coordinate sentences (e.g., "This morning/Kim was sitting in the forward cabin/and watching . . ."). As the number of propositions increases within clauses, subject noun phrases and prepositional phrases may become separable units ("Big pieces of rock/are thrown from the volcano/. . ."), but parsings usually retain the integrity of the relation between the verb and object noun phrase. Within phrases, complexity is built by post-nominal qualifiers such as prepositional phrases and relative clauses. The parsing structure usually separates the head noun from the subordinate qualifiers (" . . . were formed by lava/slowly flowing from the craters/or volcanoes. . .").

Although the units defined by children's pausal judgments seem to agree fairly well with adult intuitions of parsing structure, it is not clear that such units give a description of the optional "chunks" for processing by poor readers. Critical factors in the selection of an optimal unit appear to be (1) whether information is new or old, and (2) the number of propositions expressed (which is correlated with the number of words). Further research should be directed to the problem of specifying these characteristics more accurately.

SUMMARY

This paper examined methods of eliciting child judgments about the segmentation of sentences into meaningful units. The most effective methods relied on judgments of acceptable pause placement, but encouraged readers to attend to both prosodic and semantic cues. All parsing judgment tasks require considerable practice, probably in a setting with small groups of children. Judgments of pause placement do not show any substantial differences between 1) children and adults, and 2) good comprehenders and skilled decoders. The units identified by children's pausal judgments (or by adult models of text parsing) are not always major syntactic constituents such as noun phrases and verb phrases. Purely syntactic criteria are necessary but not adequate to account for the placement of pausal or phrasal junctures. A number of semantic factors interact with syntax as determinants of intrasentence units, including 1) number of propositions expressed, and 2) whether information is new or old. Specification of an optimal processing unit awaits further clarification of these and other factors affecting sentence perception.

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