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Individual Differences in Semantic Cohesion

by

Kathy Lynn Look Howery

A THESIS

SUBMITTED TO THE FACULTY OF GRADUATE STUDIES AND RESEARCH

IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE

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Thos J. Baker
Supervisor

Ian Taylor

Leo Hardwick Stanford

Date 25 Sept 1984

To my parents, Edward and Gail,

Who always had faith in me

ABSTRACT

The variable of semantic cohesion as perceived by subjects making judgements of intra-sentential semantic relations is presented in this thesis. The importance of describing this measure as a component of a subject's perception of a sentence rather than a component of the sentence per se is stressed.

Ninety-four high school students were asked to judge the interrelatedness of the main subject, main verb, main object, relative clause verb, and relative clause subject or object of 128 syntactically controlled relative clause sentences. Their judgements were found to fall into three differentiable categories, corresponding to high, medium, and low semantic cohesion. Data analyses were done based on these three categories.

It was found that while a few sentences were perceived by the majority of the subjects as having high, medium, or low semantic cohesion, there was a profound subject-by-sentence interaction present for each sentence. In order to investigate this interaction, rather than treating it in the conventional manner and relegating it to the error term, subject group analsis was undertaken based on the method presented in Baker and Derwing (1982).

Subject groups were discovered based on the pattern of responding of the subjects. These groups were found to demonstrate differential strategies in their judgements of semantic relations within the sentences. This precluded any

analysis which failed to treat the groups seperately. Within each subject group, clusters of sentences were found where the judgements of the subjects corresponded to high, medium, and low semantic cohesion. Two of the subject groups also presented a cluster of sentences which, while being treated similarly by the subjects, showed response patterns that indicated the subjects did not agree on the categorization of these sentences. Between group comparisons of the clusters demonstrated a great deal of consistency in treatment of the sentences over and above the strategy differences.

The results, therefore, demonstrate both that subject differences were present and interpretable, and that the differences seen in the sentences were present across the groups. This then demonstrates that perceived semantic cohesion is a variable of potential importance in studies which employ sentences as stimuli, but that in order to study this, individual subjects' perceptions must be seen as the defining measure. The implication of the findings for psycholinguistic research are discussed with special emphasis on studies employing sentences as stimuli for grammaticality judgements, and studies employing sentences as stimuli for investigation into memory.

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To acknowlegde all the people who have contributed in ways great and small to this thesis would constitute a task not unlike that of writing another thesis. There are, however, a few special folks to whom my gratitide must be expressed. I can only hope that anyone I fail to mention here will understand that I am grateful for their contributions as well.

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...when new groups of phenomena compel changes in the pattern of thought ... even the most eminent of physicists find immense difficulties. For the demand for change in the thought pattern may engender the feeling that the ground is to be pulled from under one's feet ... I believe that the difficulties at this point can hardly be overestimated. Once one has experienced the desparation with which clever and conciliatory men of science react to the demand for a change in the thought pattern, one can only be amazed that such revolutions in science have actually been possible at all.

-Werner Heisenberg

I. INTRODUCTION

This thesis began as an attempt to characterize sentences in terms of their semantic cohesion. This characterization was then to be employed as a covariate in studies which involve the use of sentences. Due to the nature of the stimulus, however, it became, beyond this, an attempt to demonstrate the problems involved in characterizing sentences. This characterization must necessarily involve individual subjects' characterizations. Characterization of the semantic cohesion of a sentence per se is not possible; it is not even a relevant concern for psycholinguistics. This is not to say that human beings do not see different within-sentence word relations. On the contrary, this thesis will demonstrate exactly that, while pointing out the difference in these two statements. The importance of these differences for psycholinguistic studies will be emphasized in the attempt to point out and deal with the "problem" of subjects being subjective.

The problem can best be construed as an investigation into the meaning relation differences elicited from subjects when judging a group of syntactically similar sentences. Both subject differences and ascribed meaning relation differences must be seen as important variables. These are critical considerations firstly because any attempt to investigate how subjects see sentences as differing in

meaning must necessarily involve the subjects' responses to them. Secondly, it holds that because psycholinguists and psychologists are constantly using syntactically similar sentences in their studies with the assumption that they are replicate stimuli, irrespective of any subject differences or any differences in how meaningfully cohesive the sentences are seen to be by the subjects. Many studies have been done within the realm of semantics that purport to ascribe meaning to a linguistic unit. No such meaning exists without a human ascribing it to the unit, and it is not necessarily the case that all subjects would consistently ascribe the same meaning to any given sentence. Any investigation into language must deal with the subjects and their responses as the crucial variables.

While investigators dealing in verbal learning and those dealing with studies using sentences have recognized that verbal materials are different, they all have focused on finding the properties of the stimuli that determine these differences. When the property is meaningfulness or the association value of a linguistic unit, this search is futile if not ridiculous. Linguistic elements, in and of themselves, cannot <u>have</u> meaning, the meaning must be ascribed to them by the human processor. In other words, the problem of meaning cannot be reified.

All studies to date have missed this extremely important point. Psychologists and psycholinguists continue to search for properties of linguistic units. The vastness

of the problem will be demonstrated in the studies discussed in this chapter. Examples of the fallacious conclusions these approaches lead to will be presented in order to better illustrate the problem.

Verbal Learning Studies Investigation into Meaningfulness

Psychologists have been plagued by the "problem" of meaning since they began to study verbal stimuli and verbal behavior. Ebbinghaus, in constructing the first verbal learning experiments, recognized the fact that words are seen as meaningful entities by humans. But rather than attempting to deal with this problem directly, he attempted to eliminate differential meaning by using nonsense syllables in verbal learning experiments. He was searching for equivalent verbal stimuli. In doing so he was wise enough to recognize that words in the subjects' language would certainly have different meanings associated with them by the subjects. The CVC nonsense syllables he created were then supposed to solve the dilemma of subjects ascribing differential meaning to verbal materials, because they were to initially have no associations and, therefore, be similar in their meaningfulness.

Of course, he did not succeed in finding meaningless or equivalent stimuli. He himself came to discover that these syllables were learned with differential ease. But he failed to discover the explanation for this difference. It was some years later when Glaze (1928) undertook to find the

difference seen in these syllables. He found that this difference was based on subjects' perceptions of meaning in these nonsense syllabes.

Glaze's 1928 study (cf. Cofer, 1971) represents the first attempt to measure the association value of nonsense syllables. Glaze presented subjects with nonsense syllables, instructing them to indicate if the syllables suggested anything or not. All that was required from the subjects was an answer of "yes", the syllable did suggest something, or "no" it did not. From these responses, he calculated the "association value of the syllables" (Cofer, 1971). The error discussed at the beginning of this chapter is evident in this measure. Glaze was suggesting that the syllables evoked associations or had meaning. In reality syllables cannot possibly have meaning without the subjects in the experiment producing a meaning to ascribe to them.

The error becomes more dramatic when one considers how these association value scores were derived from the subjects' responses. The association value scores Glaze reported were based on the proportion of the subjects who saw the CVC syllable as being meaningful. If all the subjects saw the syllable as having some degree of meaning, it received a 100% association value. If none of the subjects saw the syllable as being meaningful, it received a 0% association value. CVC syllables that some subjects saw meaning in, but that other subjects saw no meaning in,

received an intermediate association value score. For example, if half of the subjects saw a CVC syllable as being meaningful, and half the subjects saw it as being meaningless, Glaze's scoring system would say that the syllable had a 50% association value. The problem is obvious. For whom does this syllable have 50% association value? Beyond this, there is the important question of what could 50% association value possibly mean for an individual subject.

Given the two choices of meaningful or not meaningful, the syllable must be either 100% meaningful or 0% meaningful for any given subject. Basing association value scores on aggregate percentages results in only these two extreme values having any degree of constant interpretation for the subjects. And truly only the 0% association valued CVCs could be seen as equivalent, as the meaningfulness ascribed to the 100% association value CVCs could be based on subjects' individualistic interpretations of the meaning in these syllables. The main point of the present argument, however, is that these syllables can in no way "have" intermediate association values. For each subject this was an all-or-none question, and it is only the subjects who in any sense "have" the meaning. Glaze's experiments represent a prototype case of the problem. The same problem can be seen in countless psychological studies which purport to be searching for defining characteristics of verbal materials.

Once psychologists realized nonsense syllables were seen as meaningfully different, they went on to find that this meaning was what affected the learning ease differences in them. This then countered the argument for their use, as they were no longer seen as meaningfully equivalent stimuli. The focus reverted to quantifying association values seen in words.

Postman and Keppel published a complete volume of studies which presented "Norms of Word Associations" in 1970 (cf. Keppel and Strand, 1970). Although the book contains pages of norms based on frequency of associations by a group of subjects, it does not address the issue of the differences in the subjects' treatments of the words. The norms presented are rather presentations of frequencies which represent alleged attributes of the words themselves. Looking for these attributes in the stimuli again presents the problem of for whom are the frequency values valid. The problem of treating subject differences as stimuli differences is seen in an example from the Keppel and Strand norms, which are presented in their book.

The Keppel and Strand norms are based on the frequency with which a group of subjects gave a specific response to a specific lexical stimulus. The subjects were given a list of words and were asked to write the first word they thought was associated with each of these words (Keppel and Strand, 1970). The norms then represent a tabulation of the frequency with which subjects gave that word as a

response. For the word bad, for example, 91 out of the sample of 182 subjects gave the response good. This represents an association value of 50% for the words "good" and "bad" according to the rationale on which these norms are based. Just as in the studies of association values of syllables, this value is being presented as a charateristic of these words. Fifty percent association value, however, is a statement about half of the subjects, not about the words being associated by them. A far better test of assocation value must involve looking at how the subjects treat the words. The stimuli presented in norms of word association are treated quite differently by different subjects. This difference is the difference of interest. The subjects' responses must be used as a basis to divide the subjects, so that confident statements can be made as to how much associaton they see between words.

The fundamental error in looking for characteristics of the stimuli irrespective of the subject will hopefully be apparent from these two examples from the field of verbal learning. The present study goes beyond the level of syllables and words to the more complex linguistic unit of the sentence. The rationale for investigating differences in subjects' perceptions of within sentence semantic relations, or what will be refered to in this paper as semantic cohesion, is based on the premise that the sentence represents a more realistic unit of natural language. Further, sentences have been, for the most part, the unit of

major focus in the field of psycholinguitics.

Numerous psychological investigations into memory and language have used sentences as stimuli. At least an equal number of linguistic and psycholinguistic studies have employed sentences as stimuli in studies of grammaticality and language processing. Just as Ebbinghaus attempted to treat nonsense syllables as equivalent stimuli, so have the vast majority of these investigators treated all syntactically similar sentences as being equivalent stimuli for their subjects. It is even less likely that sentences would be seen as meaningfully equivalent when syllables and words have been seen not to be.

There have been some attempts at characterizing what makes sentences different for subjects. It will be shown in the following section that these studies also approached the problem from the wrong point of view. While the phenomena they were attempting to investigate were interesting, they were again searching for them as components of the sentences instead of characterizations by the subjects.

Attempts at Defining Characteristics of Sentences

Paivio and his associates have attempted to characterize various linguistic units on the basis of concreteness or abstractness. Paivio, Yuille, and Madigan (1968) attempted to characterize the concreteness, imagery, and meaningfulness of 925 nouns. Begg and Paivio (1969) took these charcterizations one step further to the level of

the sentence. The dimensions they invoked for sentences however, were only concreteness and imagery. At the risk of beating an already dead horse, it can be again noted that the problem of not considering the subjects can be brought to bear on these studies.

The study involving sentences is most relevant to the present discussion. Begg and Paivio reported that they constructed 100 concrete and 100 abstract sentences with the same syntactic properties. They then had three raters separate the sentences that "made sense" into three categories: "concrete", "abstract", or "neither abstract nor concrete" (Begg & Paivio, 1969, p. 822). Out of the 100 original sentences in each category, the three raters could only agree upon half of them. Therefore, only 50 "concrete" and 50 "abstract" sentences remained. These sentences were then used as the basic sentences in the study. Lexical and semantic changes were made to them as part of the design. They were presented as samples of concrete and abstract sentences to 120 student volunteers in a recognition task.

The issue of where the concreteness lies has clearly been overlooked in this study. The fact that one half of the originally composed concrete and abstract sentences were not agreed to as being concrete or abstract by the three raters shows how differently different subjects can view the same stimuli.

Going from an "n" of one (presumably) to an "n" of three caused a change in categorization of half the

sentences. Yet in their next step, Begg and Paivio presume to believe these sentences will be seen as concrete or abstract sentences by the 120 students who were involved in their experiment. Because three raters agreed upon the concreteness of these sentences does not warrant the quantum leap necessary in saying the subjects in the experiment will agree these are examples of concrete and abstract sentences. Before such a supposition could be made, the students themselves would have had to rate the sentences.

Another group of studies to be reviewed were done by Rosenberg and his associates (Rosenberg, 1969; Rosenberg & Jarvella, 1970a; Rosenberg & Jarvella, 1970b). These studies attempted to investigate how differences in semantic integration of sentences affect subjects' treatment of them in various experimental paradigms. The investigation then is based on relations within sentences as in the present study. On the basis of this similarity, Rosenberg and Jarvella's studies are perhaps the closest attempts at doing what has been done here. The logic of these studies, however, requires that relations within sentences be seen as a property of sentences. Further they used sentences which were created by the experimenters based on word association norms. These norms were derived from the frequency of occurence of adjectives, verbs, and adverbs in association with a specific noun embedded in a sentence frame. For example, subjects would be given the sentence frame:

The __ king __ __ .

and were asked to fill in the blanks. The norms were based on frequency of occurrence of lexical items in each blank. From these norms sentences were derived that had strong normative associations, e.g.,

The old king ruled wisely.

and sentences that had low normative associations, e.g.,

The poor king dined gravely.

(Rosenberg, 1969).

Similar norms were used to create sentences for several studies. They came to be called the Rosenberg & Koen norms of Sequential Associative Dependencies (Rosenberg, 1969). The sentences created from the extreme frequencies were deemed Semantically Well-Integrated (SWI) sentences and Semantically Poorly-Integrated (SPI) sentences (Rosenberg, 1969; Rosenberg & Jarvella, 1970).

The problems involved in these studies are two-fold. First, there is the recurrent problem of reification of meaning or, specifically in this case, "semantic integration." The sentences themselves are not semantically well or semantically poorly integrated, only the subjects can perceive them as such. The second problem is that, in this case, subjects' judgements were not obtained. Subjects were not asked to judge the meaning relations among the words in the sentences; they were asked to produce sentences given a frame. Production and comprehension are not merely opposite processes. Indeed, it seems quite likely that these two processes are quite different (see Baker, 1976 for

a discussion of this). It is not clear that the sentences which were formed in a production task would be judged as either sematically well or sematically poorly integrated in a task which involved comprehension of these sentences. The magnitude of the problem increases when the subjects whose productions are the basis for the association norms are not the subjects who are involved in the subsequent studies where the sentences are supposed to be exemplars of SWI or SPI sentences.

Rosenberg and Jarvella used SWI and SPI sentences in studies which investigated the effect such stimuli would have on subjects' abilities to perceive and memorize sentences. Their results showed a significant effect in both types of study. Research by investigators of verbal learning has also lead to a vast number of studies which correlated norms of word associations with memory factors. While the logic involved in the characterization of the stimuli has been shown to be dubious, these studies nevertheless point to the realization that the differences subjects perceive in verbal units can affect the results in experiments where such units are employed as stimuli.

The present study recognizes this reality. The relations subjects see in verbal materials may affect any experimental results where such stimuli are used. Beyond this, the fact that all subjects may not see similar relations in verbal stimuli is presented as an important consideration in this thesis. Rather than aggregating the

responses to come out with a measure that in fact represents few if any of the subjects actual perceptions, the attempt here is to show that these differences are present and interpretable. In the past these differences have been treated as the "error term" in the experimental design. What that then says is that psychology treats subject differences as a problem to be hidden or ignored rather than the problem which the discipline seeks to investigate. Surely if psycholinguistics is to be the science which studies the human species' use and understanding of language, psycholinguistic studies must not do away with the individual subject. Especially in the realm of language, differences in subjects' perceptions must be considered. Verbal stimuli do not evoke the same response in all people; therefore, these subject response differences must be investigated first. Then the commonalities can be sought, keeping the differences clearly in mind.

Sentences are complex verbal material. The interrelations of lexical items that subjects perceive within them can arise from both the denotational or commonly agreed upon meaning as well as the connotational or experiental meaning which is more specific to an individual's interpretation. In the sentence:

The man saw a chipmunk in a tree.

one person may see no obvious relations among the underlined words, while another, who is an outdoorsman, may see the whole sentence as being highly related by virtue of his

experience. This sentence then is not perceived as equivalent by these two hypothetical persons. It would seem likely that the effect of this inequivalence could affect the results in studies where these two persons were subjects and the sentence was a stimulus item.

Different sentences can also be perceived differently. Given the following two sentences:

The farmer plowed the field with a harrow.

and:

The woman saw a man on the street corner.

the differences in the perceived interrelations of their lexical items might be seen as obvious. The first sentence could be seen as involving a theme of a "farm", whereas the second sentence could be seen as fairly unrelated or neutral. SEMANTIC COHESION can be defined with these examples in mind as the degree to which the sentence is perceived by a subject as having a strong theme. Operationally, semantic cohesion would be seen as the number of lexical items the subject saw as being related in the sentence. This can lead to a more conceptual definition based on the thematic integration of the sentence. The more lexical items the subject saw as being related, the greater the thematic integration or semantic cohesion he would have perceived in that sentence. A theme is strengthened by the number of lexical items seen as related. This strengthened thematic perception is what is meant here by greater semantic cohesion. Subjects might then judge the first

sentence to be high in semantic relatedness or cohesion and the second to be low. The point is that they also may not or that some subjects may and some subjects may not. Looking for differences in how the subjects treat the sentences first, and then seeing if there is consensus amongst some of the subjects as to how sematically cohesive the sentences are, is the method of searching for differences which can subsequently be brought to bear on studies incorporating sentences. This study presents a methodology for investigating differences in sematic cohesion which subjects perceive in a set of sentences. The findings are not meant to characterize the sentences, but rather the opinions of the subjects with regards to the sentences.

II. METHODOLOGY

Subjects

Ninety-five grade eleven and twelve students from Swift Current Comprehensive High School in Swift Current, Saskatchewan were participants in this experiment. Of these 95, only one subject failed to complete the task. This person omitted one page of the sentences to be categorized. He was subsequently dropped from the analysis, leaving the number of subjects at 94.

There were 57 females and 37 males in the group of students tested. The majority of students were 16 or 17 years of age, with the age range spreading from 15 to 18 years. All students seemed to be co-operative and interested in the task.

Stimuli

One hundred and twenty eight Subject-Verb-Object (SVO) sentences were employed in this experiment. Each sentence had embedded within it a relative clause. The position of the relative clause was systematically varied so as to modify the Subject or the Object of the sentence, and the relative pronoun was varied as subject or object of the clause. The sentences also varied as to whether the verb in

the relative clause was reversable or not and in whether the main Subject and Object determiners were definite (e.g., the boy) or indefinite (e.g., a boy). These sentences were composed to be used in an ongoing study of relative clause processing (cf. Prideaux & Baker, 1984) which accounts for the strict syntactic variation. They were not composed specifically to be used as stimuli in this study of semantic cohesion.

There were thus 32 syntactically different types of sentences with four replications of each type (yielding 128 lexically distinct tokens) written for the relative clause study and used in the present experiment. The types can be described using the following code: ABcde, where:

A refers to the grammatical function of the main clause NP on which the relative clause is formed (Subject or Object, A = S or O)

B refers to the grammatical function (Subject or Object, B = S or O) of the relative pronoun (RP)

c refers to the definiteness or indefiniteness (c = d or i) of the main clause NP

d refers to the definiteness of indefiniteness (d = d or i) of the main clause object

e refers to the non-reversability or reversability (e = n or r) of the relative clause verb.

There was no explicit attempt made to create sentences that varied in semantic cohesion. The only control was syntactic. A complete listing of the stimuli can be found in Appendix A.

Procedure

The focus of this study was not the structural differences among the sentences, but the semantic relationships subjects see among the words in them. The control over structural differences was advantageous as it has been previously demonstrated that both syntax and semantics affect sentence processing.

Each subject was presented with all 128 sentences on a four page typed handout. There were 32 sentences on each page, along side of which there was a space for the subject to write his/her response. The main subject (MS), main verb (MV), main object (MO), relative clause verb (RCV), and relative clause subject or object (RCS or RCO), were underlined. These were the lexical items which the subjects were to consider for their category judgements as described below.

The subjects also received a set of written instructions (see Appendix B for a complete set of instructions). These instructions indicated that the subjects were to judge the underlined words as to how meaningfully related they believed the words were to each other.

Categories were defined for the subjects, and were presented as part of the written instruction set, along with some examples. The categories were designed to reflect the range of relationships that could be seen among the five lexical items. The choices ranged from all 5 words being related, to none of the 5 words being related. There was no provision made for a judgement that saw one word belonging to more than one group of words.

The categories given to the subjects were as follows:

A. All five of the underlined words are related in meaning (5-0).

B. Four of the five underlined words are related in meaning, but the fifth does not belong (4-1).

C. There are two groups of words that are related in meaning with one group made up of three related words and the other made up of two related words (3-2).

D. Three of the five words are related in meaning, but the other two are not related (3-1-1).

E. There are two pairs of words that are related in meaning, but the pairs are not related to each other, nor to the fifth word (2-2-1).

F. Two of the five words are related to each other, but the other three are not related (2-1-1-1).

G. None of the words are related to each other in meaning (1-1-1-1-1).

Because of the large number or categories, numerical

descriptions were included as memory aides. To further insure the results were not unduly affected by memory problems, the instruction sheet was presented as a separate handout that the subjects could refer to at will.

The subjects were to assign a category judgement to each sentence by writing the letter corresponding to that category in the space provided. Subjects were assured that the judgements were purely subjective and that they could be in no way "wrong" or "right."

Four sample sentences were included in the instructions. These sentences were not from the test set:

> The farmer who plowed the field harvested with a combine. (5-0)
>
> The minister who preached the sermon built the church. (4-1)
>
> The salesman who sold the camera met the photographer. (2-2-1)
>
> The daschund that broke the umbrella saw the elevator. (1-1-1-1-1)

The subjects were told that these judgements of categories A,B,E,and G for the sentences were strictly those of the experimenter and need not necessarily correspond with their own. The rationale for the experimenter's judgements was explained, suggesting that the relationships in these sentences may well be more obvious than relationships they would see in the test sentences. The subjects were told to categorize each sentence according to where it best fit, and

that not every category may be needed.

The task was completed by all students during a one-hour class period. Although no time constraint was imposed, all students finished within the one hour time period. The experimenter monitored the subjects so that comparisons of answers could not take place.

III. ANALYSIS AND RESULTS

It became clear from some preliminary analyses that subjects were perceiving only three distinct categories of sentences. These were sentences which have four or more related words, sentences which have at least three related words, and finally, sentences which have at the most one pair of related words. An original subject frequency analysis based on the seven categories showed subjects were only using three of the seven categories. A frequency analysis of the categorization of the sentences by the subjects further indicated a three category distinction was all the subjects were seeing. These results showed clusterings of subjects around categories A and B, or around categories C and D, or finally around categories E, F, and G. This pattern followed from the subject frequency data in that the individual subjects only saw three real distinctions. The clustering in the sentence frequency data suggested the method of reducing the number of categories to best capture the distinctions the subjects' were making.

The seven category system allowed for more distinctions than the subjects seemed to be using. When the data were reanalyzed using the three category system, the results were much clearer. It was quite evident that the three-way distinction captured the differences the subjects saw.

The subjects' categorizations of the sentences were recorded in the following manner:

1) Sentences categorized as E, F, or G, where there were no more than pairs of related words, became members of Category 1 (2-2-1;2-1-1-1;1-1-1-1-1).

2) Sentences categorized as C or D, where there were three related words, became members of Category 2 (3-2;3-1-1).

and 3) Sentences categorized as A or B, where there were at least four related words became members of Category 3 (4-1;5-0).

This scoring system reflected the degree of cohesion in the sentences, as well as the patterning of the relations. The cohesion in Category 3 must extend across the sentence, linking both main and subordinate clauses, as at least four words were seen as related. There was a meaningful theme across these sentences. The cohesion in Category 2 would encompass at least a phrase, or single clause, as at least three words were related in these sentences. In Category 1, the cohesion was a result of only pairwise relations, therefore the cohesion seen by the subjects could only involve pairs of words in these sentences. The 128 rescored values for each of the 94 subjects were used as the basic data scores in the subsequent analyses.

Frequency of Category Use by Subjects

A frequency analysis of category use by subjects was obtained for each sentence. These data showed that all the subjects had judged at least one sentence to fall into each of the three categories. There was a preponderance of Category 1 scores for the majority of the subjects. The frequency of Category 3 scores was lowest for all but one subject. The proportion of responses overall for each category was .46, .36, and .18 for Categories 1, 2, and 3, repectively. Since the stimuli were constructed as sentences in isolation, simply to reflect the syntactic properties required for the relative clause study, the categories of interest here would not be equally represented. It is interesting to note, and probably typical of sentences constructed in this artificial manner, that the bulk of the sentences showed very little semantic cohesion. However, it appeared the subjects were able to make distinctions among the sentences following the instructions set out for them. This analysis showed no aberrant subjects. They all appeared to be complying with the task as it was presented.

Frequency of Category Responses to Sentences

To obtain the number of subjects who categorized the sentences as falling into each of the three response categories, the SPSS subprogram CROSSTABS (see Nie, Hull, Jenkins, Steinbrenner, & Bent, SPSS, for details) was

employed. This analysis presented the actual number of subjects who rated each sentence as falling into each category. As well, the analysis presented absolute and relative frequency data corresponding to the actual counts.

The frequency analysis showed the subjects did not all agree on the categorization for the majority of the sentences. Instead, the results indicated that the subjects varied a great deal in their categorizations. These results provide evidence for a profound subject-by-sentence interaction for almost every sentence in the 128 sentence set.

A high degree of intersubject agreement was seen for a minority of sentences, however. If 70% category agreement can be seen as suffiecent to suggest the sentence should fall into one category, some sentences can be seen as exemplars or prototypes of each category.

Table I presents the prototypical sentences. There are 45 such sentences out of the set of 128. The presentation is organized in order of same category membership. The sentences which 70% or more of the subjects put in Category 1 are presented first; those which 70% of the subjects put in Category 2 are next, and finally, the few sentences which 70% or more of the subjects put into Category 3 are presented.

There are 31 Category 1 type sentences which show this 70% or greater agreement across all subjects. Presented as a block in Table 1, their inherent blandness and

TABLE 1

Sentences with > 70% Agreement

Category I Sentences (n = 31)

%	S#	Sentences
93.6	95	A photographer saw a woman who knew the doctor.
92.6	11	The minister who wanted the reduction told a lie.
88.3	12	The boy who visited the factory gave a presentation.
88.3	33	The bird that the man bought liked the cage.
88.3	33	A priest recognized the woman who knew the premier.
	Group	I II III Total
87.2	61	A woman who the manager knew bought the lamp.
87.2	87	A friend borrowed the book that inspired the movie.
85.1	31	A tourist who visited the doctor had an infection.
85.1	69	The boy kicked the girl who saw the dog.
83.0	7	The man who knew the diplomat bought the document.
81.9	16	The fellow who saw the astronaut owned a telescope.
81.9	25	A mother who watched the serial saw a disaster.
81.9	49	A silence that the teacher imposed lasted the hour.
81.9	128	A grocer served a man whom the housewife saw.
80.9	65	The woman scolded the boy who ate the pie.
80.9	78	The airport impresses a tourist who saw the statesman.
80.9	125	A flower entranced the baby whom the aunt loved.
80.9	42	The team that the country sent needed a coach.
80.9	32	A teetotaler who married the harlot needed a drink.
78.7	109	The teacher helped the boy whom the squirrel bit.
78.7	40	The twins whom the couple befriended fought the decision.
77.7	41	The car that the couple bought required a tuneup.
76.6	56	A damsel whom the vampire threatened fled the scene.
76.6	126	A bee stung a cow that the farmer heard.
75.5	72	The lion ate the people who visited the hermit.
74.5	86	An accident hospitalized the boy who hated the coach.
74.5	13	The girl who hit her brother recieved a spanking.
73.4		The boy who hit his friend remained a bully.
72.3	29	A renter whom the owner cheated sued the company.
71.3	77	The assignment baffled the technician who hated the boss.
70.2	45	The dress that the shoes matched cost a fortune.

TABLE 1 (cont.)

Sentences with > 70% Agreement

Category 2 Sentences (n = 12)

%	S#	Sentences
86.2	91	A writer wrote the novel that boosted his prestige.
86.2	35	The building that the architect designed won the award.
84.0	19	An artist who painted the portrait won the honors.
83.0	106	The cowboy found the horse that the Indian lost.
79.8	8	The hunter who killed the wolf impressed the princess.
77.7	21	A rancher who found the bull recognized the brand.
76.6	23	A singer who despised the drummer left the band.
76.6	26	A director who wrote the script loved a joke.
76.6	96	A lunatic threatened a pilot who radioed the controller.
72.3	116	A woman took the drink that the bartender spiked.
72.3	5	A driver who saw the woman parked the limousine.
70.2	37	The guest whom the hostess disliked left the party.

Category 3 Sentences (n=2)

%	S#	Sentences
78.7	120	A specialist examined the patient whom the doctor sent.
72.3	4	The student who failed the test questioned the the professor.

artificiality stand out, and yet these are probably quite typical of the sentences similarly constructed for the vast majority of studies conducted in psycholinguistics over the past 20 years. The 12 tokens in Category 2 begin to sound more natural and real, and the two sentences in Category 3 for which there was general agreement easily demonstrate what is meant by full thematic integration for a sentence in isolation.

These sentences can be presented as examples of low, medium, and high semantically cohesive sentences, if the 70% agreement level can be said to be strong enough to counterbalance the subject-by-sentence interaction so evident in the remaining 83 sentences. Of course, the 70% value being used here is an arbitrary choice for illustrative purposes only.

The other 83 sentences can in no way be presented, unequivocally, in terms of any single sentence type. The existence of a strong subject-by-sentence interaction indicates that the sentences cannot be decribed without consideration of the subjects making the judgements. Examples of these types of sentences can be seen in the CROSSTABS table in Appendix C. The frequency of category membership as seen by the subjects is represented in the totals. There were many sentences where there was almost a 1/3, 1/3, 1/3 split across the three categories, e.g., Sentence 9, "The woman who read the article wrote a letter." showed 37, 22, and 40% for categories 1, 2, and 3

respectively. This type of sentence defies categorization. The mean cohesion value would be 2.03. This value, of course, is inapprpriate for 78% of the subjects as only 22% of them actually saw this sentence as falling into Category 2. It is not at all evident that it makes any real sense to treat these ess ially qualitative judgements as if they are quantifiable even though there seems to be an ordered metric present. With such sentences, any attempt to give them a score becomes, at best, a dubious task, again because of the strong subject-by-sentence interaction and the nature of the judgements being made.

Due to this interaction, a subject group analysis was done. This analysis was done to discover subsets of subjects who were approaching the problem of categorization with similar basic strategies. Since there was so much diversity present in the subjects' responses as shown by the frequency tables, it was obvious that the subjects were not all categorizing on the basis of the same strategy, but it was also obvious that these differences were not merely noise or random behavior. Dividing the subject pool on the basis of subject response similarities might then give a clearer description of the results.

Subject Group Analysis

The design of the subject group analysis was taken from that proposed by Baker and Derwing (1982). The basic data for this analysis is a coincidence matrix which is derived

from the qualitative responses for each subject. This matrix was constructed by organizing the 128 responses of each subject into a continuous vector, then comparing that vector with itself in an element by element fashion. The example in Table 2 gives partial vectors for Subjects 1, 2, and 3. These vectors represent only the first 10 responses by these three subjects rather than the 128 responses the subjects actually gave. Partial vectors are used in the illustration for ease of computation and to conserve space.

The element-by-element comparison of the vector with itself creates a 128 X 128 matrix with 8128 unique comparisons ($n*(n-1)/2 = 8128$). In the case of the example, a 10 X 10 matrix of 45 comparisons is produced. The comparison is based on the equivalence of any two responses. If both responses were the same, e.g., both were 1's, a 1 was entered into the corresponding element in the matrix; if both the responses were not equivalent, e.g., a 1 and a 3, a 0 was entered into the element in the matrix. The matrix is called a coincidence matrix because it represents the coincidence of equivalent responses to pairs of sentences by each subject. As the coincidence matrices must necessarily be symmetrical around the main diagonal, only the bottom triangular portions of the matrices are necessary for the analysis. The bottom triangular portions of the matrices for Subjects 1, 2, and 3 in the illustration are seen in Table 2B. For ease of presentation and comparison across matrices, the matrix values for each of the three subjects

TABLE 2

Illustrative Data Using Partial Responses from 3 Subjects

A. SUBJECT RESPONSE VECTORS

Subject 1: 3 1 3 3 1 1 2 2 1 3
Subject 2: 1 2 2 3 3 1 2 2 1 3
Subject 3: 2 2 2 1 1 1 2 2 1 1

B. COINCIDENCE MATRIX VALUES

Subject 1: 0303030100010010000000000002010011003033000000
Subject 2: 0020000003100000220000220002100001000003300000
Subject 3: 2220000001000112220002220002022111000001110001

C. SUBJECT DISTANCE MATRIX

	S1	S2	S3
S1	0		
S2	.42	0	
S3	.51	.33	0

are presented in a linear fashion rather than in the form of a matrix. The non-zero entries indicate the subject put the two sentences indicated by the associated row and column, into the same category, and the zero entries indicate they put them into different categories.

Matrices such as these then represent the basic data for each subject in terms of patterns among sentences within subjects. These are the basic data for the subject group analysis. Each subject's pattern of responding is reflected in these matrices by their indication of whether the sentences were judged to be similar or different from the others in the set.

To investigate the similarity of the response patterns across subjects, each coincidence matrix was compared with the coincidence matrix of each other subject in an element-by-element fashion, and a count of mismatches was made. A score reflecting the distance between each pair of subjects was derived from this comparison by dividing the number of mismatches by the total number possible. This score then reflected the proportion of sentence pairs that the two subjects treated in a differential manner.

Thus the actual computation of these "distance" scores, which could range from zero to one, involved comparing two subjects' coincidence matrices, and counting the entries in the lower triangular section which were not equivalent. Non-equivalence meant either the entry for one subject was a zero and the entry for the other subject was a non-zero, or the entries were non-equivalent non-zero entries. Such entries were labeled "mismatches"; equivalent entries were labeled "matches." It is important to consider that a match reflected consistency in treatment of the sentence pair between subjects.

Distance scores between 1 and 0 were computed for each pair of subjects. A score of one would reflect total disagreement between the two subjects; a score of zero would reflect total agreement. Scores between 1 and 0 reflect partial agreement/disagreement between the two subjects.

Referring again to the illustration in Table 2, the distance scores between S1 and S2, S2 and S3, and S1 and S3

are seen in the SUBJECT DISTANCE MATRIX. S2 and S3 showed the largest degree of agreement on their treatment of these 10 sentences, and therefore have the lowest distance score. S3 and S1 did not treat these sentences in a similar manner, as is shown by the relatively large distance score between them.

A subject distance matrix was constructed for the comparison of all 94 subject coincidence matrices in the same fashion as in the example. This matrix included the total n(n-1)/2 (4371) pairwise comparisons for all these matrices. This completed matrix indicated the relative distance between every possible pair of subjects.

The final step in the computational component of this analysis was to input the subject distance matrix into a hierarchical clustering analysis. Hierarchical clustering, using Ward's method (see D. Wishart, 1978 for details), takes the matrix of distance scores and converts it to a diagrammatic representation of the distances among the subjects. The result is a hierarchical or tree-like structure, hence "hierarchical analysis." The diagram reflects the distances between subjects. Patterns that appeared in the structure were used to distinguish groups of subjects who were relatively similar to each other in their treatment of the sentences.

Figure 1 presents the hierarchical structure for the subject group analysis. The height of the "branches" in the structure reflect the joining of subjects based on their

FIGURE 1

Subject Group Hierarchical Structure

distances from each other. Subject pairs with the lowest distance scores are joined at a low level in the structure. The lowest branch in this structure joins Subjects 4 and 14. This indicates these two subjects were the most similar pair in their pattern of responding. Branches are created joining subjects with greater distance scores higher in the tree structure, until finally the most dissimilar groups are joined by the highest branch of the tree. In Figure 1, the highest branch joins the 34 subjects on the right of the diagram with the rest.

Subject groups are suggested when groups of subjects are joined at a low level amongst themselves, but do not join with other groups until much higher in the structure. Inspection of the diagram suggests three subject groups were present in this sample, consisting of 42, 18, and 34 subjects respectively. A statistical analysis was also obtained with the result. The STOPPING RULE statistic reported in the hierarchical package (Wishart, 1978) indicates these three groups deviate significantly from each other. Statistical and diagramatic evidence led to the conclusion that there were indeed three groups of subjects who differed from each other in their treatment of the sentences, but were relatively homogeneous among themselves within these groups.

Strategy differences were discovered for the three groups. Using the SPSS package CROSSTABS, the data in Appendix C were derived. The table gives the percent of

subjects in each group who categorized a given sentence as a Type 1, 2, or 3. This information is given for each sentence; each row of data represents one sentence tabulated by subject groups. Profile differences in the responses of each of the subject groups become evident upon inspection of the table. It should be kept clearly in mind, however, that these groups were not formed on the basis of this data. Subjects were grouped in terms of similarity of patterns within subjects across the entire set of 128 sentences. These individual sentence profiles can now aid in clarifying group strategies.

It is clear that the profiles are not the same across subject groups. Group I subjects generally saw the widest range of differentiation in the sentences. Group II subjects generally showed a tendency to judge the sentences as falling into higher categories, i.e., to have [illegible] semantic cohesion. Finally, Group III subjects s[illegible] general tendency to judge the sentences as falling into the lower categories. These are trends, however. The groups still demonstrate the subject-by-sentence interaction, but a good portion of it seems to be eliminated by these groupings.

A few examples from the tables can be used to illustrate the distinctions being made. The CROSSTABS tables for Sentences 60, 15, and 21 can be seen as such examples in Table 3.

TABLE 3

Percent of Category Responses by Subject Groups
Examples of CROSSTABS Data

A. Sentence 60

Subject Group	Category 1	2	3
I	28	17	55
II	3	18	79
III	83	11	6
Total	30	16	54

B. Sentence 15

Subject Group	Category 1	2	3
I	90	7	2
II	47	20	32
III	83	17	0
Total	73	14	13

C. Sentence 21

Subject Group	Category 1	2	3
I	5	95	0
II	9	59	32
III	28	72	0
Total	10	72	0

The CROSSTABS results for Sentence 60, seen in Table 3A, present the case of a sentence where a 1/3, 1/3, 1/3 split was seen in the overall responses (a strong subject-by-sentence interaction). Group I subjects show the widest variation in their responses, with somewhat of a loading toward Category 3. Group II subjects show a definite preference for Category 3 judgements. For this group of subjects, this is a prototype Category 3 sentence. Quite to the contrary, for Group III this sentence is an prototype Category 1 sentence. While this pattern is not this obvious for all the sentences, it is nevertheless present to some degree for all the sentences. This statement is true even for the sentences previously discussed as being clear category examples for the whole analysis.

For Sentence 15, the total frequencies shown on the bottom of Table 3B indicate that this sentence is a clear Category 1 sentence. Indeed, for Groups I and III it is. For Group II, however, it is not. Their responses show the particular trend characteristic of this group, which was to rate the sentences as being more semantically cohesive.

One final example shows this trend with an extreme Category 2 sentence (prototypic when the analysis was done with all subjects pooled). The responses for Sentence 21 are seen in Table 3C. This table shows Group II's trend toward higher responses and Groups III's trend toward lower responses. Here Group I tended to follow the consistent

Category 2 response. Full data on all 128 sentences is presented in Appendix C.

Discovery of groups that base their judgements on differing strategies precludes any analysis of the results that fails to treat such groups separately. In order to gain a clear understanding of how the subjects treated the sentences, three separate sentence cluster analyses were done.

Sentence Cluster Analyses

Coincidence matrices as described in the Subject Group Analysis were the basic data for these analyses as well. Because these analyses sought differences between the sentences as judged by a particular subject group, however, the matrices were analyzed in a manner which corresponds to such an investigation. For the sentence cluster analyses, the number of zeros across each corresponding entry in the subject matrices were counted. Recalling that the zeros in these matrices represent sentence pairs categorized differently, this count represented how many of the subjects in the subject group saw a given sentence pair as differing from each other (cf. Table 2D, p. 32). If all subjects' matrices contained a zero for a pairwise comparison of sentences, the distance between the sentences would be represented by a score of one. If none of the subjects saw these two sentences as differing from one another, therefore no zero entries, the distance would be represented by a zero

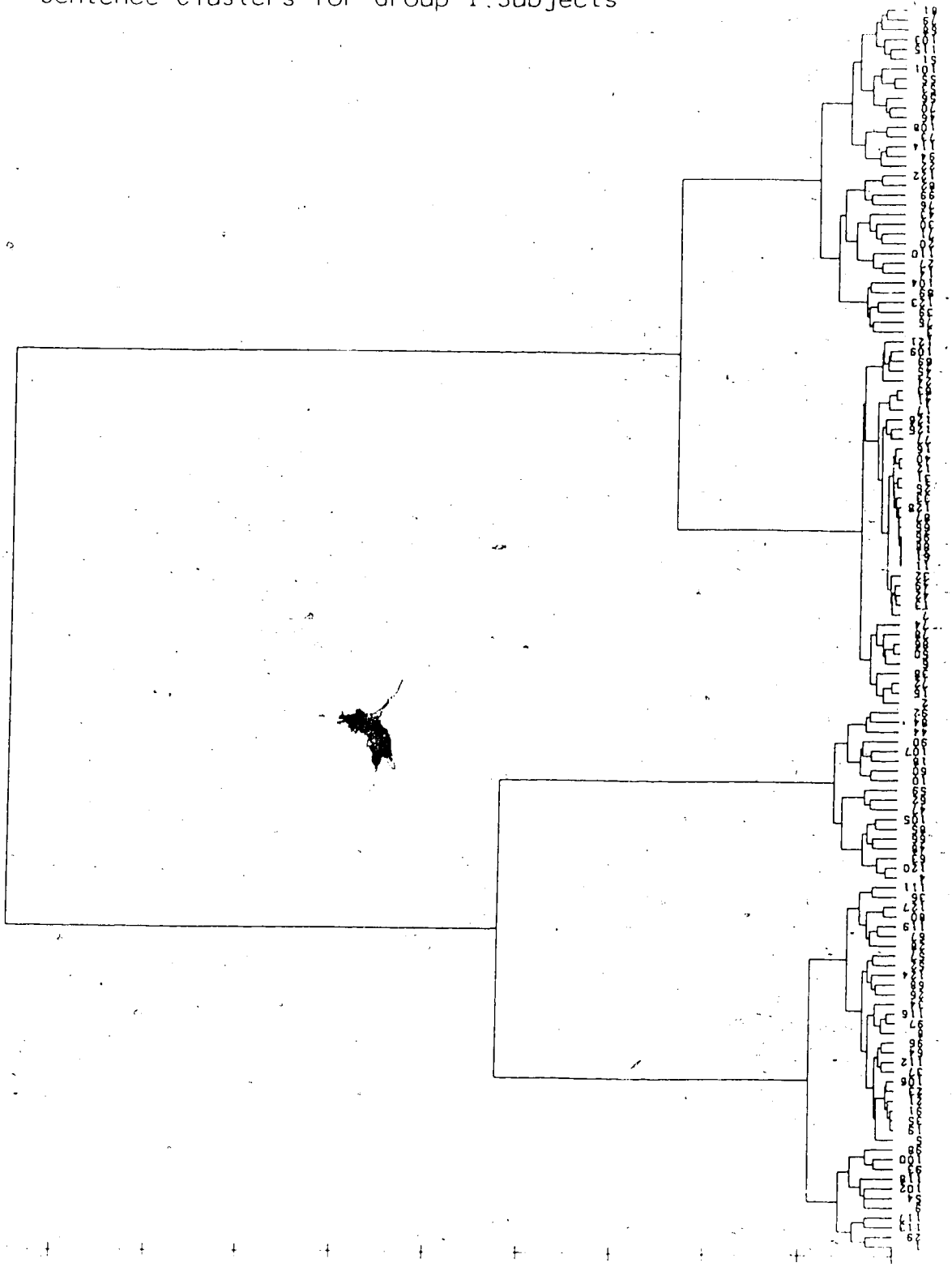
score. In such a case every subject in the Group judged the two sentences as falling into the same category. The resulting distance matrix then represented the degree to which the subjects in the Group treated the sentences in a like manner.

Referring again to the illustration in Table 2, one needs to count down over the corresponding entries in each row. The entries representing comparisons of Sentences 1 and 2 contain a 0, 0, and 2 respectively (for the example it is assumed these three subjects are all members of the same Subject Group). The distance score would then be .66, as two of the three subjects treated the sentences differently. The entries for the Sentence 1 and Sentence 3 comparison are 3, 0, and 2 repectively, which leads to a distance score of .33. In this case two subjects treated the sentences in the same way.

For each of the actual analyses the result of these tallies was a 128 by 128 matrix of distances based on 42, 34, and 18 subjects for Groups I, II, and III, repectively. Each these matrices was input to hierarchical clustering. Three hierarchical diagrams were obtained, and are presented in Figures 2, 3, and 4. Figure 2 presents the Sentence Clustering for Subject Group I; Figure 3 presents the Sentence Clustering for Subject Group II; and Figure 4 presents the Sentence Clustering for Subject Group III. The results of the Sentence Clustering were investigated seperately for each Group and will therfore be presented

FIGURE 2

Sentence Clusters for Group I Subjects



seperately.

Sentence Clusters for Subject Group I

On the basis of the STOPPING RULE statistic (cf. Wishart, 1978), four sentence clusters were found to be distinguishable from each other. This four way cluster division is presented diagramatically in the hierarchial structure of Figure 2. The four clusters have 38, 38, 34 and 18 sentences within them.

Recalling the logic behind this clustering, these clusters represent groups of sentences that the subjects treated in similar manners. The sentences within each cluster group were treated more similarly to each other by Group I subjects than they were to sentences in other cluster groups. This similarity in treatment is represented by the low linkage levels within designated clusters in Figure 2.

Interpretation of the groupings of the sentences was based on the results for Group I as seen in Table 4. This table presents the percent of sentences from each cluster that fell into each response category. This information is given for each subject group. Group II and III results will be discussed later in the paper. Response categories have been labeled in these tables as high, medium, and low. These labels represent the numerical categories 3, 2 and 1 respectively, based on the semantic cohesion levels these categories represented.

TABLE 4

Percent Category Representation for Sentence Clusters by Subject Group

Group	N	Sent. Cluster	Response Category L	M	H	n
I	42	1	17	73	10	38
		2	88	10	2	38
		3	55	34	12	34
		4	18	22	60	18
			48	37	15	128
II	34	1	16	29	56	36
		2	20	60	20	44
		3	55	30	15	48
			32	40	28	128
III	18	1	54	39	7	37
		2	87	10	3	64
		3	35	28	37	14
		4	22	71	6	13
			65	26	8	128

Inspection of Group I's clusters in Table 4 show that Cluster 1 sentences were predominantly seen as having medium semantic cohesion (i.e., falling into Category 2). Cluster 2 sentences were predominately seen as having low semantic cohesion, falling into Category 1. The fourth cluster was comprised of sentences primarily judged to have high semantic cohesion, Category 3 judgements. The third cluster of sentences does not show a predominant single categorization but rather is comprised of sentences that

show a diversity of opinions among the subjects.

Sample sentences from each cluster illustrate the rationale behind the groups. These sample sentences are presented in Table 5. The first cluster contains sentences which seem to have three related lexical items. For example, in Sentence 5, these lexical items are driver, parked and limousine. There is a general semantic relation underlying these three words relating to vehicles and what is done with them. Samples from the second cluster show that the relations indeed involve only pairs of lexical items. In Sentence 2 the pair related seems to be puppy and collar, for example. Moving to the last cluster of sentences, it can be seen that these sentences involve four minimally related words. What seems evident is that these sentences describe a theme or event that causes the subjects to allow the words to all be seen as somewhat related to each other. The cohesiveness in meaning of these four sentences is strong.

Finally, the third cluster sample shows sentences that did not generally fall into one group. The samples show how the different judgements of the subjects could, in fact, come about. For Sentence 3, for example, 55% of these subjects treated this sentence as only having pairs of related words. Perhaps these would be car and accident. Another 34% of Group I subjects saw up to three words related in the sentence. In this case perhaps accident, hit and car. The final 12% of the Group saw at least four of

TABLE 5

Example Sentences from Each Group I Sentence Cluster

Cluster 1 (medium semantic cohesion):	
5.	The driver who saw the woman parked the limousine.
23.	The singer who despised the drummer left the band.
100.	The parson wrote the sermon that the congregation heard.
116.	A woman took the drink that the bartender spiked.
Cluster 2 (low semantic cohesion):	
2.	The girl who adored the puppy bought the collar.
31.	A tourist who visited the doctor had an infection.
33.	The bird that the man bought liked the cage.
49.	A silence that the teacher imposed lasted the hour.
Cluster 3 (non-categorizable):	
3.	The car that caused the accident hit the lamppost.
43.	The politician whom the people elected proposed a change.
76.	The window illuminated a room that needed the light.
99.	The designer created the gown that the Queen wore.
Cluster 4 (high semantic cohesion):	
4.	The student who failed the test questioned the professor.
47.	The criminal who the policeman shot had a record.
66.	The sergeant dismissed the troops who raided the barracks.
92.	The student wrote an essay that the professor graded.

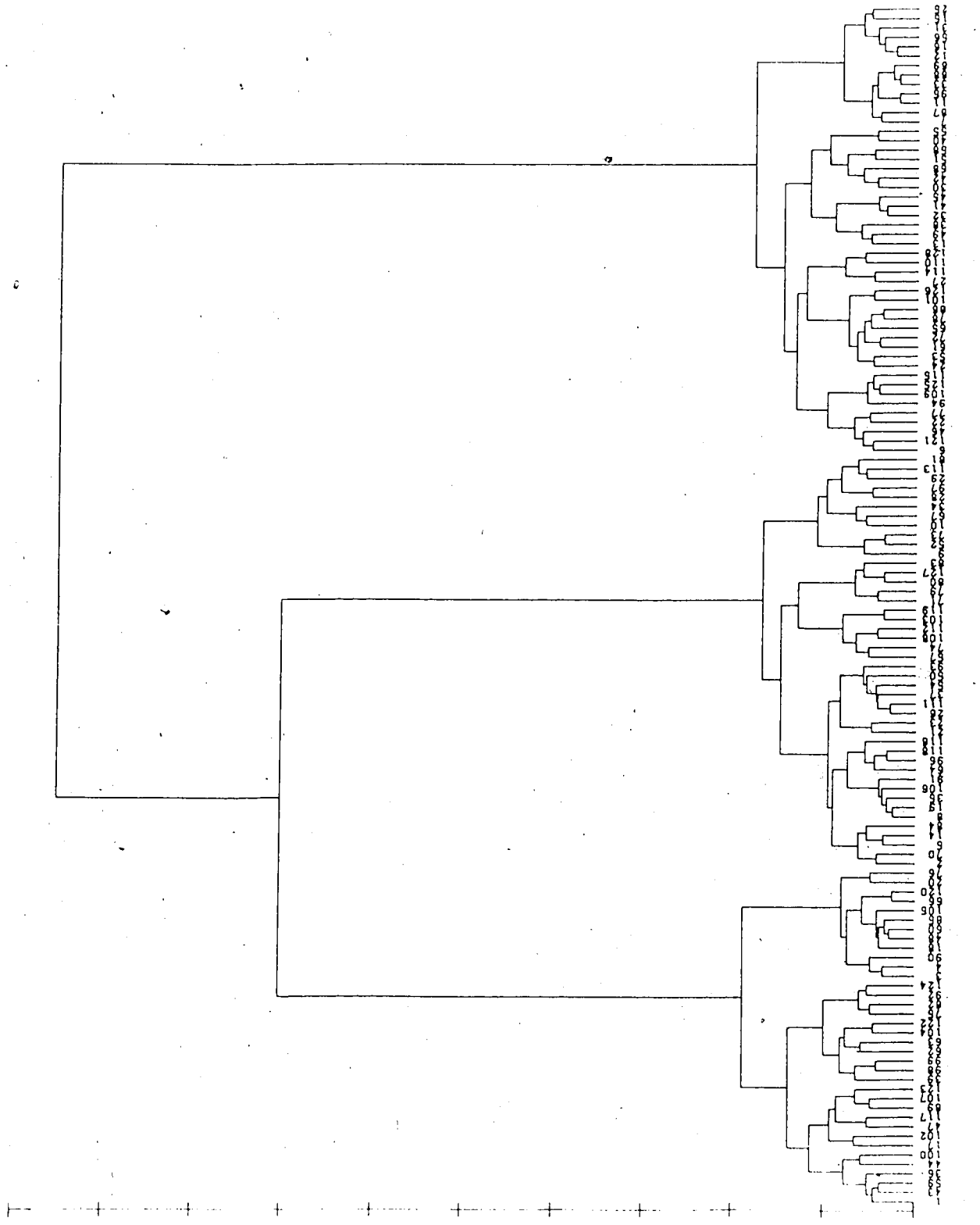
the words being related. It seems clear they would have to have related the words on the basis of experience, not necessarily on the basis of general semantic relations of the words as such. Sentences in this clustering are grouped together because the subjects in Group I did not agree into which category they fell. As it is difficult to really find outstanding relations when the samples are examined, this could well be seen to represent sentences which defy overall categorization. The semantic cohesion in this cluster is based strongly on individual differences of Group I subjects.

Sentence Clusters for Group II

Applying the STOPPING RULE statistic to the clustering of the sentences on the basis of treatment by Group II subjects suggested three distinct sentence clusters. The hierarchical pattern in Figure 3 shows these three clusters, based on the logic presented in the discussion of Group I's results. Cluster 1 for Group II contains 36 sentences. The Subject Group II results in Table 4 show them to have been predominantly judged to be high semantic cohesion sentences (56% Category 3 membership). The results also show Cluster 2 to be comprised of 44 medium semantic cohesion sentences (60% Category 2 membership). The third and final cluster contains 48 sentences predominantly judged to have low semantic cohesion (55% Category 1 membership). As in Group I's results there is one cluster where the subjects'

FIGURE 3

Sentence Clusters for Group II Subjects



judgements correspond to each cohesion category.

Group II subjects' agreement upon categorizations was not as strong as that seen for the three categorized groups in Group I's results. The clusters, however, do show predominant category membership that is significantly different from the overall categorization pattern of all the sentences.

What can also be seen is Group II's response strategy bias. There are larger percentages of sentences that are judged to have high semantic cohesion in each cluster. But only the percentage in Cluster 1 is drastically different from that of the combined sentence pool percentage of 28.

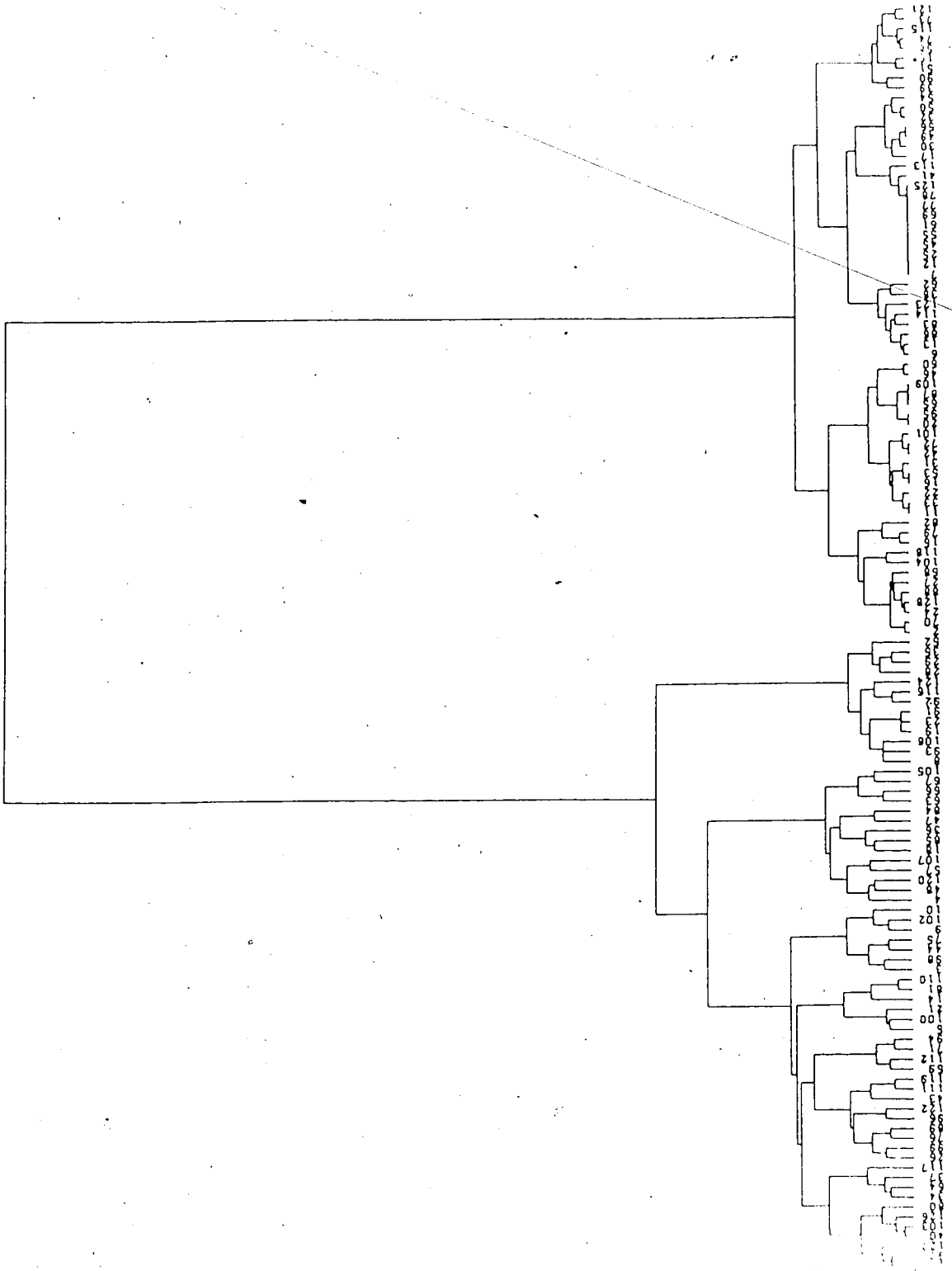
Sentence Clusters for Group III

Hierarchical clustering analysis resulted in four differentiable clusters for Group III subjects. Again three clusters showed clear predominance of sentences belonging to one semantic cohesion category.

Refering to Table 4 once again, but this time under the Subject Group III section, the two easily interpreted clusters can be found. Cluster 2 is predominantly made up (87%) of sentences judged to have low semantic cohesion. Cluster 4 is the other cluster with a marked predominant category. Seventy-one percent of the subjects judged these sentences to have medium semantic cohesion (Category 2 response).

FIGURE 4

Sentence Clusters for Group III Subjects



The response bias of Group III becomes evident in the overall percentage of Category 1 (low semantic cohesion) responses. Sixty-five percent of subject responses fell into Category 1. Cluster 2 actually contains 64 sentences or one-half of the sentences within it. Group III subjects obviously saw few semantic relations above the level of pairs in any of the sentences.

Because this response bias is so strong, Cluster 3 sentences can be seen as representing sentences Group III saw as having high semantic cohesion. Although Cluster 3's results show three equal percentages across response categories, the 37% of the subjects which rated these as high semantic cohesion sentences represents a significant percentage when compared to the overall 8% Category 3 response of the entire pool.

The final cluster to be presented is Cluster 1. The percentages here indicate that about half these subjects treated these as low semantic cohesion sentences and about half treated them as being medium semantic cohesion sentences. As in the results of Group I there appears to be a group of sentences where the subjects did not agree as to how they should be categorized.

Four samples from this cluster group show the sentences are similar to Cluster 3 sentences for Group I:

44. The street that the workman paved was a deadend.

75. The milktruck hit a pedestrian who crossed the

road.

89. A woman bought a ticket that won a prize.

119. A play depressed a critic whom the star invited.

Keeping in mind that the response strategy of Group III generally resulted in their finding fewer relations among the words of the sentences, these sentences could be judged as having no related lexical items or they could be judged as having up to three related lexical items. Again the clustering of this group of sentences is based on sentences which the subjects in Group III did not see as falling mainly into one of the three semantic cohesion categories. There was no general consensus about the sentences in this cluster.

Between Subject Group Comparisons

The results from each of the Subject Groups clearly indicated that there were clusters of sentences seen to fall into the three semantic cohesion categories. This suggests that even though the subject groups differed in their basic tendency towards high or low responses, there were enough general differences seen in the sentences to allow them to be categorized with some limited consistency by the Groups. As similar categorizations appeared to have been made by each group, it seemed reasonable to suppose there should be a good many sentences that fell into the corresponding category across groups. If the sentences were judged to

have a level of cohesion that overrides the group differences, they should be found in corresponding sentence clusters across the Groups.

To investigate this a crosstabulated table was created which compares the number of sentences in each cluster for each Subject Group with the number in each other Subject Group. Table 6 presents this information. For ease of comprehension, the information regarding the interpretation of the sentence clusters has been used to label the clusters instead of numerical labels based on the number of clusters for each subject group, the clusters in Table 6 have alphabetic labels based on the semantic cohesion classification they were found to have in the previous section. For example, Group I's first cluster was interpreted as containing sentences which these subjects saw as having medium (M) semantic cohesion. In Table 6, therefore, this cluster is labeled M. In the same manner Subject Group I's Cluster 2 is labeled L for low semantic cohesion and Cluster 4 is labeled H for high semantic cohesion.

The same logic applied to the labeling of clusters found by Groups II and III. The "extra" cluster found in the Group I and Group III results was labeled N-CAT. These were the sentences for which these subjects were inconsistent in category judgements, so the label was chosen to stand for <u>non-categorized</u> sentences. The cluster ordering has also been changed in Table 6. The order in

TABLE 6

Between Subject Group Comparisons of Sentence Cluster Membership

		Group II Clusters			
Group I		L	M	H	n
Clusters	L	33	4	1	38
	M	1	30	7	38
	H	0	2	16	18
	N-CAT	14	8	12	34
	n	48	44	36	128

		Group III Clusters				
Group I		L	M	H	N-CAT	n
Clusters	L	36	0	0	2	38
	M	4	12	3	19	38
	H	3	1	11	3	18
	N-CAT	21	0	0	13	34
	n	64	13	14	37	128

		Group III Clusters				
Group II		L	M	H	N-CAT	n
Clusters	L	44	0	0	4	48
	M	11	11	3	19	44
	H	9	2	11	14	36
	n	64	13	14	37	128

which the clusters are presented for each group corresponds to the increasing amount of semantic cohesion the subjects saw in the sentences. This changed presentation order helps in comparing the groups' clustering patterns as the corresponding low, medium, high, and N-CAT cluster comparisons fall along a diagonal line in the cross-tabulated pattern.

Looking first at the comparison of Subject Groups I and II, these subjects can be seen to have been quite consistent in their treatment of the sentences. Thirty-three of the same sentences were present in both Group I and Group II's low cluster. This represents a large degree of overlap (87%) as the L clusters in these Groups had 38 and 48 sentences in them in total. There were 30 sentences out of 38 in Group I's M cluster and Group II's M cluster (79%). Finally, out of the possible 18 H sentences from Group I's cluster pattern and 36 from Group II's, 16 sentences occur in both (89%). In these cross cluster comparisons, the number of sentences in the smallest cluster determines the upper limit of sentences which can be members of both Groups' clusters. The percentage of overlapping sentences in this comparison therefore, represents a large portion of the possible overlap.

There is not, however, complete consensus across these two groups. The sentences that fall in one type of cluster in one group but in another type in the other group are also of interest. Some differences are necessarily seen by

virtue of the differential clustering pattern in the two Groups. The fact that Group I subjects did not agree on the categorization of one group of the sentences leads to an explanation of much of the disagreement upon the clustering of the sentences.

Table 6 shows how Group II subjects categorized the N-CAT sentences of Group I. These 34 sentences were basically divided up among the three Group II clusters. Indeed there was nearly a three-way split of these sentences with 14 being members of Group II's L cluster, 8 being members of Group II's M cluster, and the final 12 being members of Group II's H cluster. Group II subjects were able to agree on which category these sentences should be put into, where Group I was not.

Not all the differences in clustering of the sentences by the two Groups are explained by this N-CAT cluster difference. There are sentences that change semantic cohesion cluster membership across groups. Changes from Group II patterns to Group I's are largely explained by the extra cluster, but changes from Group I to Group II require a different explanation. Inspection of the Table shows most of these changes involve Group II treating these sentences as having a higher degree of semantic cohesion than did Group I. Group I's L cluster had 38 sentences. Thirty-three of these were also seen as L's by Group II. Four of the five remaining Group I Cluster L sentences were put into Cluster M by Group II. Movement from Group I's

medium cohesion cluster also tends to be movement in the direction of higher semantic cohesion. Seven of the eight Group I Cluster M sentences were seen as having high sematic cohesion by Group II.

This trend makes sense considering the overall strategy trend seen in Group II's pattern of responding. These were the subjects who tended to judge the sentences as having more related lexical items than did the other two groups. Changes in clustering of the sentences from Group I to Group II logically should involve some sentences being treated as having higher semantic cohesion.

The second portion of Table 6 compares Group I cluster membership with that of Group III. Again a high degree of cross group consistency is evident when looking at correspondences in L, M, and H clusters. This comparison involves the Subject Group that demonstrated the widest range of judgements with the Group that was biased toward giving low judgements to the sentences. Changes from Group I clusters then should generally involve movements to Group III clusters where the sentences were seen to have lower semantic cohesion. For movements from Group I H cluster this appeared to hold true to some extent. Four of the seven Group I H sentences that were not H sentences for Group III were M, and L sentences for Group III. The other three were found in Group III's N-CAT cluster.

These two subject groups both presented a N-CAT cluster. It is interesting to see that the agreement across

the two N-CAT clusters was not that high. These two clusters contain only 13 common sentences out of 37 Group III N-CAT sentences and 34 Group I N-CAT sentences (i.e., 38%). The changes in cluster membership are again quite predicatable when Subject Group strategies are brought to light. The Group I N-CAT sentences which are not Group III N-CAT sentences are generally Group III L sentences. In fact, the majority of Group I N-CAT sentences are members of Group III's Cluster L (21 out of the possible 34).

The Group III N-CAT sentences which are not Group I N-CAT sentences are generally Group I M sentences. Again, this change actually involves half of Group III's N-CAT sentences (19 out of 38). Recalling that Group III was the group with the low response bias, the differences make sense. This bias in Group III's responses allows these subjects to treat some sentences that Group I was indecisive about as having low semantic cohesion. Their bias also seems to hamper the amount of agreement about sentences Group I saw as having more semantic cohesion. Some Group III subjects are able to see three word relations in their N-CAT sentences, but others, more profoundly affected by their strategy, seem not to be able to see these relations.

The final comparison involves the Subject Group with the high response bias strategy (Group II) with the Subject Group with the low response bias strategy (Group III). To avoid being overly repetitous, it is sufficient to point out that Table 6 again shows a great amount of consistency

across these two Groups. The changes in cluster membership follow those described in the comparison of Groups I and II. Group II sentences that do not fall into the corresponding cluster when rated by Group III subjects, generally are members of Group III's N-CAT cluster, or are members of a cluster of sentences Group III treated as having less semantic cohesion. Sentences which changed categorization from Group III ten[illegible] be put into clusters representing higher semantic cohesion by Group II. These changes are again consistent with the general group strategies.

IV. DISCUSSION

It has been demonstrated that subjects see semantic relation differences among the lexical items within sentences. The conclusion which follows is that semantic differences seen in sentences must be considered when using sentences as stimuli in psycholinguistic experimentation. Consensus limited to syntactic differences is not enough. The experimental paradigm presented suggests an approach to the investigation of semantic differences which has been labeled "semantic cohesion." Beyond this and most significantly, the approach presented considered the fact that the subject, not the sentence, "has" the sematic cohesion.

Subject differences have been shown to be important. The preliminary CROSSTABS analysis showed a profound subject-by-treatment interaction. This demonstrated that the sentences, while seen as being different from each other, were also seen differently by different subjects. Rather than follow the usual practice of treating this interaction as part of the error term, it was in fact treated as an important variable using the coincidence analysis. The results demonstrated subject differences were present and interpretable. Further, the differences seen in the sentences remained, and were to a large degree reasonable across the strategically different subject groups.

Other studies of association values and meaningfulness have, as discussed in the introduction, been done under the tacit assumption that meaningfulness was somehow a component of the stimulus itself. They therefore sought the degree of meaningfulness for that stimulus. The introduction also presented some arguments against this assumption. The results from this study support those arguments. Different subjects saw the sentences differently; therefore, the relationships among the lexical items must be seen as their personal perception of them.

The subject-by-treatment interaction seen in the frequency analysis has been seen in an analogous fashion in the studies discussed in the introduction. These investigators, however, did not see the interaction as the result. Glaze's association value and the Keppel and Strand norms both ignored the significance of the interaction by aggregating over subject differences. Their results were average values which meant little for an individual subject. This type of aggregation of the results could have been done with the frequency results obtained in this study as well. For each sentence, the average or mean value of semantic cohesion could have been determined. While this certainly seems a straightforward method, it would yield values that would mean little to any subject in the sample (let alone any other subject that might see the sentence as a stimulus).

It might be useful to illustrate this important point with respect to the problem for more conventional analyses of such data. The categories used here are an ordered set, and one might be tempted to compute a "mean" cohesion score for each sentence, which would be restricted to fall between 1 and 3. Referring back to Table 3, Sentence 60 would then receive an overall mean of 2.24. This value is close to the Category 2 value. The mean for Group I subjects is 2.27, close to this value in spite of the fact that only 17% of the subjects put it in Category 2. For Group II the mean is 2.76, close to Category 3 which is appropriate for this group. For Group III the mean is 1.23, close to Category 1, again, where is should be for this group. What, then, is "the" mean for this sentence. Notice that overall, only 16% of subjects placed it in Category 2. The problem should be obvious.

Beyond demonstrating the fallacy in looking for characteristics of sentences as a component of the sentence itself by such aggregation, this paper demonstrated the viability of seeking to determine some measure of semantic differences seen by subjects in different sentences. This means that semantic cohesion must be seen as a variable of import. Sentences which are syntactically equivalent are not necessarily seen as semantically equivalent. While this may seem a trite statement, it is one that needs not only to be made but also to be acted upon by subsequent researchers.

Rosenberg (1969) and Rosenberg and Jarvella (1970a, 1970b) proposed similar notions. It is important to see, however, how different the methodology presented here is from theirs. Creating sentences from norms of word associations and giving them a semantic integration value which is presumed valid for any subject is quite different from obtaining judgements from subjects on prescribed sentences, looking for subject differences within that sample of subjects, and then obtaining information about semantic cohesion which is only valid for the group of subjects who were found to treat the sentences is a similar manner. Their normative information was not even from the same subjects who were supposed to be seeing the produced sentence as semantically well or semantically poorly integrated.

Further, a stimulus created from a combination of other stimuli does not necessarily entail the same qualities. This can even be seen for simple stimulus items such as shapes. Two triangles put together can create a square. The subject viewing two triangles as separate entities would, in all likelihood, see them as much different from the square which could be created from them. When linguistic units are the stimuli in question, the perception of the component stimuli (lexical items) certainly seems different from the perception of the composite stimulus (the sentence).

It would be interesting to take Rosenberg's semantically well integrated and semantically poorly integrated sentences and analyze their semantic cohesion based on this design. The sentences used here, it has been pointed out, were not created for the semantic cohesion task. Therefore, a wide range of perceived diversity in semantic cohesion may not have been present. Rosenberg's sentences, on the other hand, were created so that they would be seen as semantically unequivalent. A coincidence analysis done on such judgements about such sentences might lead to differences in the subject groups as well as differences in the clustering of the sentences as compared to Rosenberg's sentence groupings. Such a study may also confirm the differences Rosenberg which suggested were present in his stimuli.

One possiblity would be that the subject groups would be less distinctive. If the sentences presented to the subjects were written to encorporate a wide variation in semantic cohesion, rather than the generally low semantic cohesion of the sentences in the present study, the subject strategy differences might be outweighed by the more strongly perceived differences in the sentences.

Indeed, duplicating the present study using sentences which were judged to be of high, medium, and low semantic cohesiveness (e.g., the prototype sentences of Table 1), would represent a similar approach. The sentences could be perceived as prototypic high, medium, and low semantically

cohesive sentences. It would seem likely that subjects should show more agreement in their treatment of them. That is not to suggest, however, that by using the sentences which fell into the same type of cluster for each subject group that subject differences would become negligible and unworthy of investigation. Rather, it suggests that subject group differences are potentially affected by the degree of generally seen semantic diversity in the stimulus.

The subject groups found here are probably generally representative of strategy differences in subjects at large. The three groups were found to show different trends in their treatment of the sentences. Group II and Group III subject trends were presented as giving respectively higher and lower response values to the sentences. Group I showed a pattern which ranged over the three categories to a larger degree.

These trends have been referred to as strategy differences among the three groups of subjects. Group II's strategy appears from the data to be that of looking for a theme in the sentence. These subjects, it appears, saw the sentence as an important thematic unit by virtue of its being a sentence. They therefore created or perceived more semantic relations based to some degree on an overall semantic relation due to the sentence form of presentation. It can be suggested that Group II subjects are working with the basic assumption that words in sentences are necessarily related to some degree; they perceive less obvious meaning

relations as stronger relations induced by the sentence frame.

Group III subjects appear to have been working with a word list strategy. That is, Group III subjects did not consider the sentence frame as being necessarily a relation determining or inducing unit. They seemed to judge words strictly against each other. If this is the case, Group III subjects followed the instructions to the closest detail by comparing the underlined words to each other and judging the meaning relations among them. Not being governed in their judgements by the sentence frame would lessen the degree to which their judgements were affected by the context or theme of the sentence.

Finally, Group I's strategy could be said to combine elements of both Group II and Group III strategies. Explanations for this combined or "middle of the road" strategy could be proposed in at least two not dissimilar hypotheses. Group I subjects may have been chaining. This would mean they would begin with words and then build relationships among them, allowing more of the items in the sentence to be joined into the relationship. Such chaining could be affected by the sentence frame. If the sentence was such that relations among the words could be built, the sentence context could have allowed for more words to be related by Group I subjects. It was not necessarily the case that the sentence frame always allowed for a judgement of more relations, as it did for Group II. Group I subjects

seemed to begin with word relations and build upon them, rather than begin with the premise that constituents of sentences are, by definition, related.

Another explanation for Group I's results might be that this group of subjects was governed to the largest extent by experiential factors. If they could create a picture of the sentence where the lexical items would be related, then they would be led to judge them as being more related. This idea is similar to the chaining hypothesis as well as to the theme hypothesis for Group II. It is likely that a theme is also experiential in nature. Group I subjects were more idiosyncratic in their theme building as evidenced in the sentence clustering results. Group I's results demonstrated a cluster that did not seem to be readily categorizable. Group II's results demonstrated no such category; rather, they saw three definable categories of sentences.

While the strategy hypotheses are certainly just that, hypotheses, it is evident that the three groups were using some different measure of semantic relatedness. An interesting method of investigating the strategies further would be to have these same subjects judge the meaning relations among lists of words not embedded in sentences. Instead of the sentence:

76. The window that illuminated the room needed the light.

the subjects would receive:

window room illuminated light need

or some such combination of these words. They would be asked to categorize the words based on the categories given to subjects in this study.

First of all, it would be questionable to suppose the seven categories could be transposed into three interpretable categories as was found to be warranted in this study. The three categories the subjects seemed to be using here could be due in a large sense to the sentence frame. Four or more related words could be full sentence relations; three related words could be clausal or full sentence relations; finally, two or fewer related words were non-sentential relations. Because predetermined sentential relations would not be presented to the subject in a word list study, the subjects could well differentiate among more categories by building more context-free relationships and/or not allowing some which were context determined.

Secondly, and more to the topic of differentiation in subject strategies, if the strategies follow the explanation proposed above, the word list type of study would differentiate among subjects who were building a theme based on the relations of the words and those who were building relations based on the theme or context of a sentence. The difference in strategy between Group II and Group III should therefore become more evident.

The grouping of these subjects may represent some basic cognitive strategy which underlies the processing of language. More research into subject differences needs to

be done to discern if this is the case. As long as psycholinguists fail to recognize this as an important issue, however, no differences will be sought, much less be interpreted. This methodology presents only a first step in this process by looking at subject grouping before looking at how these subjects treated the sentence stimuli.

The differences in the strategies here were differences in magnitude of relationships to a great extent. The sentence clustering comparison data showed that many of the sentences fell into corresponding high, medium, and low clusters. However, high sentences for Group II received more 2 and 3 judgements than did the high sentences for Group I or Group III. There was agreement across subject groups as to the degree of semantic cohesion of the majority of the sentences. The group strategies that they worked from resulted from a difference in judged magnitude.

For the sentences where this correspondence was not the case, the sentences that did not fall into corresponding semantic cohesion level clusters, the group strategy differences were seen to account for the differences. This means that apart from subject group differences per se, semantic cohesion was found to be a viable and largely consistent measure. This creates the need to consider this variable as a covariate in any study where sentences are used as stimuli.

Studies employing sentences as stimuli have used sentences with very little real control over the sentence's

perceived uniqueness. There has been control over the length of sentence, and over the syntax of the sentence, but little or no control over the semantic parameters. Semantics has been disregarded mainly because the field has been seen as one which is too difficult to control. Part of this difficulty has been the problem of reification of meaning. There is no method by which one can find meaning as a component of a linguistic unit that will not lead to complex results, because the meaning is not there. Instead of doing away with the semantic perceptions of subjects who participate in sentence-based experiments, psycholinguists must consider these idiosyncratic percepts as basic data.

Experimental linguistics has been using sentences as stimuli for grammaticality judgements since the field began around 1960. These studies incorporate sentences which are controlled over syntactic variables, but which are uncontrolled over semantic variables. Due to this lack of control over perceived semantic relationships in the sentences, the results obtained from the study of grammaticality have been profoundly confounded with those differences.

For example, the sentences in this study were composed within the realm of strict syntactic control. Part of this control involved position of the relative clause in the sentence. The two sentences:

2. The girl who adored the puppy bought the collar.

4. The student who failed the test questioned the

professor.

both have an interupting relative clause which modifies the subject of the main clause. The two sentences:

116. A woman took a drink that the bartender spiked.

66. The sergeant dismissed the troops who raided the barracks.

both have a non-interupting relative clause which modifies the object of the main clause. But while these pairs of sentences are syntactically equivalent, at least concerning the position of the relative clause, Table 4 showed that for Subject Group I, they are semantically unequivalent. Sentence 2 fell into Group I's low semantic cohesion cluster, while Sentence 4 fell into Group I's high cohesion cluster. Sentences 116 and 66 fell in Group I's medium and high cohesion clusters repectively. these subjects then, these sentences are not equivalent.

It is quite reasonable to assume that this perceived semantic cohesion difference would affect subjects' judgements on the naturalness or acceptability of the sentences, since naturalness and acceptability are the factors which subjects are asked to judge. Differential perception of semantic cohesion would certainly confound the results. In the study from which the sentences employed here were obtained, acceptablity judgements were sought. Speculation on how the differences in perceived semantic cohesion by the subjects in that study affected the results

further illustrates the problem of ignoring this variable.

First and foremost the relative clause processing study, reported by Prideaux and Baker (1984), treated sentences with the same syntactic pattern as replicates. The results presented here have been shown to refute that assumption once semantics is introduced as an essential consideration. Syntactic equivalence alone cannot guarantee equivalence of such stimuli. Failing to consider semantic parameters as variables in a study that purports to study processing of sentences suggests that investigation into language can be carried out by investigation of the syntactic variables of the language product itself. It has been argued earlier in this thesis and elsewhere, that semantic and syntactic variables both affect processing of linguistic forms and, therefore, cannot be investigated independently of one another. From the results presented here it must be further argued that the investigation must first consider subject differences. Then and only then can further investigation be logically undertaken.

Consideration of semantic cohesion in the relative clause study may well have given a clearer picture of the results. Subject judgements of acceptability would most likely be influenced by the semantic cohesiveness they perceived in the sentences. If a subject perceived a high degree of semantic cohesion in a sentence, it would seem likely that he might judge that sentence as being relatively more acceptable than a sentence in which he saw a lower

degree of semantic coheion.

It is interesting to speculate on some of the results reported in Prideaux & Baker (1984) while keeping this in mind. They found, for example, that their subjects tended to judge sentences with non-reversible relative clause verbs as more acceptible than sentences with reversible relative clause verbs. That is, a sentence of the form:

1. The country that signed the treaty broke the alliance.

was more acceptible than a sentence of the form:

5. The driver who saw the woman parked the limousine.

In Sentence 1 the verb signed is non-reversible in that the noun phrase country must be the subject and the noun phrase treaty must be the object. (A treaty cannot sign a country but a country can sign a treaty.) In Sentence 5, on the other hand, the verb saw is reversible. Either noun phrase could be the subject or the object of the verb saw. It can be argued that the differences in the acceptablity judgements found in the relative clause study are due, at least in part, to the fact that the non-reversible sentences were perceived as having higher semantic cohesion by the subjects that the reversibles.

Subjects may have perceived the role assignment of non-reversible verbs as building cohesion into these sentences. Again referring to the example Sentences 1 and 5, the lexical items country, signed, and treaty may have

been seen as more related due to the role assignment perceived in the non-reversible verb. On the other hand, the verb saw in Sentence 5 does not relate woman and driver in this manner. The point then is that perceived semantic cohesiveness may be a measure of importance in studies such as the relative clause processing study. Syntactic variation cannot be studied irrespective of the perceived semantic variation.

Subject differences are, of course, also important considerations for experimental linguistics. Group II subjects, for example, may well differ in their judgements of acceptability from Group III subjects. These subjects may see that more sentences are acceptable based on their general perception of greater semantic cohesiveness. If in fact perceived semantic cohesion leads to judgements of greater acceptability, then subject strategy differences would also become important for studies seeking judgements of acceptability.

Running a group of subjects in both a semantic cohesion study and a study of grammatical acceptability, should be done in order to investigate the interrelations of these two variables. Again, it is important to note that the same subjects must be used in both components of such a study so as to compare each subject's perceptions of semantic cohesion with his judgements of acceptability.

Linguists' studies of grammaticality are certainly not the only studies done using sentences while ignoring

subjects' perceptions of the semantic cohesion of these sentences. Numerous studies in human memory have employed sentences as stimuli in the same manner, and there the fallacy is even more serious. Many studies have looked at the relation between syntactic form and memory (e.g., Savin & Perchonock (1965)), or the effect of syntactic complexity on short-term memory. Other studies have found the length of a sentence to be a determining factor in ease of memorization of sentences. There have also been numerous studies done that demonstrate that semantics is an important variable in memory. Sachs (1967), for example, demonstrated the idea of gist memory or memory for meaning. This is the idea that the meaning will be recalled better than the syntax which is more readily forgotten. The Rosenberg studies demonstrated the effect of differential semantic integration on sentence memorization.

It has yet to be demonstrated what differential effect perception of semantic cohesion might have on subjects' ability to recall and/or recognize sentences. The likelihood of an effect, however, seems great. Even with the problems associated with the association value and meaningfulness ratings that verbal learning and word norm data have been shown to present, these measures have been demonstrated to have significant effects on the memory studies where these stimuli have been employed. (See Rundquist (1966) for a review of this literature.) Mere extrapolation from these findings would lead to the

hypothesis that semantic cohesion, as presented here, would have an effect on the memorizability of sentences. Further, this effect would clearly be quite different for different subjects.

It is conceivable that Group II subjects, who saw the sentences as having generally more semantic relations, would behave better in a sentence memory study than Group III who saw fewer relations. In fact, the results could be differential in quality as well as quantity. Recall that Group II subjects seemed to be strongly influenced by the overall theme or context of the sentence. In a recall test, these subjects might well create a sentence based on this theme. The result could be a sentence which meant basically the same thing but which was not made up of the exact same lexical items. In the same test, Group III subjects might be specifically correct on some of the lexical items, but not as governed by the gist of the sentence. The implications of this for probe latency studies and the treatment of synonynms as responses is quite profound.

Within the same subject group, there could be differences in recall based on the semantic cohesion categorization of the sentences. A sentence seen as having high semantic cohesion might be recalled better than one which is seen as having low semantic cohesion. That would be the predicted result considering the results from the Rosenberg and Jarvella study where it was found that semantically well integrated sentences were recalled better

than were semantically poorly integrated sentences. The hypothesis would then be that the higher the degree of semantic cohesion the subject perceived in the sentence, the easier it would be for him to recall the sentence.

Pilot studies were undertaken early in the development of the present study to investigate the affect of semantic cohesion on memory. In one such study subjects were asked to memorize sentences seen as being high, medium, or low in terms of semantic cohesion. The results showed more shifts to synonyms in the recall data for sentences seen as semantically cohesive. On the other hand, the recall data showed exact recall or no recall at all for the sentences seen as less cohesive. Therefore, in terms of exact recall, sentences perceived as having low semantic cohesion demonstrated the best results. In terms of gist recall, however, subjects performed best with sentences perceived as having higher semantic cohesion. Similar results were found in a visual display study which was a component of the relative clause study discussed earlier (cf. Prideaux & Baker, 1984). The logic of these results follows from the idea of memory for gist. If the subjects saw a theme across a sentence, as they would in a sentence judged as being semantically cohesive, they would forget the lexical detail and recall only the gist or theme. Predictably, their recalled sentences would have more lexical changes which would not alter the meaning of the sentence. If the subjects saw the sentence as being low in semantic cohesion,

it would be more difficult for them to create a theme and, therefore, they would have to recall the exact lexical items or nothing.

The pilot studies cited here did not take subject differences into consideration. This kind of experiment should be done with the same subjects employed in the memory test and for judgements of semantic cohesion. Because these measures of semantic cohesion are specific to the subjects who gave them, they can only be valid for those same subjects. A possible way out of this problem here, and for the studies of grammaticality, would be to determine subject parameters which lead to these differential perceptions. Potential candidates would be coding strategies (Paivio & Harshman, 1983), personality factors, field dependence/independance, or other such parameters of individual differences. At any rate, the subjects' recall results would have to incorporate subject group information as well as semantic cohesion information. The subject groups explained some idiosyncratic responses to sentences which did not correspond across all subject groups.

Future research must include an analysis of the type presented here as a preliminary step in any study which involves the processing of sentences. The results for each subject must be considered as an important variable both with respect to his overall treatment of the sentences and with respect to his perception of the individual sentences compared to each other. Only then can a study using

sentences as stimuli be done without confounding the results with the subjects' perception of differential semantic relationships in the sentences.

V. SUMMARY AND CONCLUSIONS

First and foremost this thesis presents a methodology for finding an effective measure of semantic cohesion to use as a covariate in studies using sentences as stimuli. In order to do this, the focus must be on the subjects' treatment of the sentences, not on the sentences themselves. Subjects do see a wide amount of diversity in sentences in terms of the semantic relatedness of the lexical items within them. Moreover, subjects vary in their overall approach to such a task. This variation in turn affects their perception of the semantic interrelations. Importantly, these subject differences did not constitute "error" or "noise" in the data. The differences among subjects are empirically and demonstrably real. They therefore constitute "facts" to be accounted for in psycholinguistic theory.

These results should have profound impact on future studies. Subject determined semantic relations are impossible to extract out of an experiment. There can be no sentence that does not mean something to someone. Similarly, there is probably no sentence that means exactly the same thing to everyone either. Finally, there are probably no two subjects who react to a sentence in an experimental setting in exactly the same manner. The coincidence analysis employed here presents a method to approach these differences. This method is novel in that it

does not ignore the differences, but rather investigates them. For the present purpose it demonstrated that such differences do exist. For future purposes, it should be used so that some degree of control over such differences can be obtained and so that investigation into the ramifications which these differences have on psycholinguistic studies can be determined.

Both of these ideas require thought changes in the minds of many researchers. The basic change is one of focusing on the subject rather than the stimuli. If, in fact, psycholinguistics is the study of humans' use and understanding of language, there can be no other logical focus to have.

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VII. APPENDIX A
Sentences in Standard Order

1. The country that signed the treaty broke the alliance.
2. The donkey that ate the straw won the race.
3. The car that caused the accident hit the lamppost.
4. The student who failed the test questioned the professor.
5. The driver who saw the woman parked the limousine.
6. The girl who adored the puppy bought the collar.
7. The man who knew the diplomat bought the document.
8. The hunter who killed the wolf impressed the princess.

9. The salesperson who served the customer suggested a color.
10. The woman who read the article wrote a letter.
11. The minister who wanted a reduction told a lie.
12. The boy who visited the factory gave a presentation.
13. The girl who hit her brother received a spanking.
14. The man who kissed the woman got a surprise.
15. The boy who bit his friend remained a bully.
16. The fellow who saw the astronaut owned a telescope.

17. A passerby who saw the mugging helped the victim.
18. A guard who stopped the robbery arrested the theif.
19. An artist who painted the portrait won the honors.
20. A driver who ran the light killed the cyclist.
21. A rancher who found the bull recognized the brand.
22. A dog that followed the detective bit the mugger.
23. A singer who despised the drummer left the band.
24. A woman who chased the milkman spilled the cream.

25. A mother who watched the serial saw a disaster.
26. A director who wrote the script loved a joke.
27. A policeman who walked the beat received a promotion.
28. An engineer who operated the train avoided an accident.
29. A chipmunk that noticed the hawk climbed a tree.
30. A professor who rated the student discovered a mistake.
31. A tourist who visited the doctor had an infection.
32. A teetotaler who married the harlot needed a drink.

Sentences in Standard Order (cont.)

33. The bird that the man bought liked the cage.
34. The journalist whom the editor fired invented the story.
35. The building that the architect designed won the award.
36. The story that the author wrote made the news.
37. The guest whom the hostess disliked left the party.
38. The gangster whom the agent saw destroyed the evidence.
39. The man that the chairman nominated declined the job.
40. The twins whom the couple befriended fought the decision.

41. The car that the couple bought required a tuneup.
42. The team that the country selected had a coach.
43. The politician whom the people elected proposed a change.
44. The street that the workman paved was a deadend.
45. The dress that the shoes matched cost a fortune.
46. The movie that the cartoon followed had a moral.
47. The captain whom the pirate murdered buried the treasure.
48. The criminal whom the policeman shot had a record.

49. A silence that the teacher imposed lasted the hour.
50. A child whom the accident crippled painted the picture.
51. A tank that the specialist designed leaked the poison.
52. A sketch that the designer drew inspired the buyer.
53. A child whom the teacher liked became the monitor.
54. A swindler whom the man imitated stole the money.
55. A renter whom the owner cheated sued the company.
56. A damsel whom the vampire threatended fled the scene.

57. A tree that the pioneer planted shaded a pond.
58. A meter that the repairman fixed cost a lot.
59. A storm that the meteorologist predicted caused a disaster.
60. An accident that the dirver caused killed the pedestrian.
61. A woman whom the mamager knew bought the document.
62. A novice whom the champ beat sought a rematch.
63. A passenger whom the pilot distrusted hijacked the plane.
64. A patient whom the nurse noticed stole a syringe.

Sentences in Standard Order (cont.)

65. The woman scolded the boy who ate the pie.
66. The sergeant dismissed the troops who raided the barracks.
67. The singer sang the number that enraged the audience.
68. The economist suggested the tax that hurt the industry.
69. The boy kicked the girl who saw the dog.
70. The owner sold the car that hit the child.
71. The spinster disliked the boy who kissed the girl.
72. The lion ate the people who visited the herpetologist.

73. The generator ran a machine that finished the job.
74. The battery powered an alarm that saved the family.
75. The milktruck hit a pedestrian who crossed the road.
76. The window illuminated a room that needed the light.
77. The assignment baffled a technician who hated the boss.
78. The airport impressed a tourist who saw the statesman.
79. The woman bought a cat that chased the dog.
80. The thesis pleased the student who married the professor.

81. A teller discovered the mistake that caused the imbalance.
82. A bouncer punched the drunk who created the disturbance.
83. A dentist scolded the patient who ignored his advice.
84. A bullet wounded the soldier who protected the monument.
85. A judge sentenced the man who murdered the actor.
86. An accident hospitalized the boy who hated the coach.
87. A friend borrowed the book that inspired the movie.
88. A priest recognized the woman who knew the premier.

89. A woman bought a ticket that won the prize.
90. A skier took a fall that injured his leg.
91. A writer wrote a novel that boosted his prestige.
92. A workman excavated a ditch that drained the lagoon.
93. An ambulance carried a patient who dated the nurse.
94. A commission tried a private who assaulted the civilian.
95. A photographer saw a woman who knew the doctor.
96. A lunatic threatened a pilot who radioed the controller.

Sentences in Standard Order(cont.)

97. The foreman finished the job that the worker started.
98. The pressure broke the pipe that the plumber fixed.
99. The designer created the gown that the Queen wore.
100. The parson wrote the sermon that the congregation heard.
101. The director knew the applicant whom the secretary called.
102. The gunfire worried the rebels whom the police surrounded.
103. The strike crippled the company that the bank owned.
104. The game upset the athletes whom the spectators watched.

105. The student wrote an essay that the professor graded.
106. The cowboy found a horse that the Indian lost.
107. The tree shaded a flower that the housewife planted.
108. The baker made a cake that the bride hated.
109. The teacher helped the boy whom the squirrel bit.
110. The record featured a performer whom the writer sued.
111. The stewardess served a passenger whom the woman slapped.
112. The agency found a consultant whom the executive liked.

113. A spinster broke the record that the champion held.
114. A burglar stole the silver that the butler polished.
115. A storm destroyed the cabin that the family built.
116. A woman took the drink that the bartender spiked.
117. A magazine printed the list that the book contained.
118. A policeman chased the robber whom the teller questioned.
119. A play depressed the critic whom the star invited.
120. A specialist examined the patient whom the doctor sent.

121. A student took a job that the newspaper advertised.
122. A clerk filed a contract that the banker rejected.
123. A teacher suggested a program that the children followed.
124. A lawyer wrote a document that his client requested.
125. A flower entranced a baby whom the aunt loved.
126. A bee stung a cow that the farmer heard.
127. A question disturbed a student whom the teacher disliked.
128. A grocer served a man whom the housewife saw.

VIII. APPENDIX B
SEMANTIC RELATEDNESS INSTRUCTIONS

Sentences may differ in how their words relate to each other in meaning, that is, in their semantic relatedness. Some sentences are made up of words that are very similar to each other in meaning as follows:

The farmer who plowed the field harvested with a combine.

where all the underlined words are related in meaning to each other. Other sentences such as:

The minister who preached the sermon built the chruch.,
The salesman who sold the camera met the photographer.,
and
The daschund that broke the umbrella saw the elevator.,

have different degrees of relatedness or similarity between the underlined words.

You will be given a list of 128 sentences in written form. Your task will be to categorize the sentences as to the similarity in meaning of their major words (the underlined words).

Before you begin the experiment, you should familiarize yourself with the categories that you will be using. These categories are as follows:

A. (5--0) All five of the underlined words are related in meaning
B. (4--1) Four of the five underlined words are related in meaning but, the fifth "doesn't belong"
C. (3--2) There are two groups of words that are related in meaning with one group made up of three related words and the other made up of two related words
D. (3--1--1) Three of the five words are related in meaning, but the other two are not related
E. (2--2--1) There are two pairs of words that are related in meaning but the pairs are not related to each other nor to the fifth word
F. (2--1--1--1) Two of the five words are related to each other, but the other three are not related
G. (1--1--1--1--1--1) None of the words are related in meaning to each other

As examples, the sentences above would be categorized as A,B,E and G respectively. The second sentence receives a B rating because, while "built" is a possible verb for the sentence, it doesn't have as strongly established or as meaningful a link as that which exists among the other four terms (minister, preached, sermon, church) in the sentence. The third sentence has two pairs of related words (salesman,sold and camera, photographer) with the word "met" not having as strong a link, and so therefore I would give it an E rating.

Please read each sentence and assign it to one of the categories above. In order to familiarize yourself with the types of sentences you will be categorizing you should read through the first page of sentences before you actually begin the task. You should then begin the task in earnest, actually categorizing the sentences as described above. The sentences may not belong so obviously to any one category as did the examples, however you must attempt to put each sentence into one of the categories. If you cannot decide exactly how to classify a sentence, give your "best guess". Guessing is okay when necessary. You may use any category as often as you wish, although all categories need not be used. There are no "right" answers but rather I am interested in your honest, subjective judgements as to the semantic relatedness of the words in each sentence.

In general, try to avoid going back to change a category or to determine where you put an earlier sentence. You are not being rated on your accuracy or literacy. This is a study of the sentences, not of you.

Are there any questions?

If not, please begin.

IX. APPENDIX C

Crosstabs Results

Category Use, in Percents for Each Subject Group

Sent.	Group / Cat.	I			II			III			Total		
		1	2	3	1	2	3	1	2	3	1	2	3
1.		27	52	21	6	26	68	61	28	11	29	38	36
2.		69	31	0	23	62	15	83	17	0	55	39	5
3.		54	29	26	20	9	71	67	22	11	40	20	39
4.		7	14	79	3	21	76	39	11	50	12	16	72
5.		14	81	5	15	68	18	39	61	0	19	72	8
6.		83	14	2	41	32	26	89	0	11	69	18	13
7.		90	7	2	65	18	18	100	0	0	83	10	7
8.		19	81	0	0	82	18	22	72	6	13	80	7
9.		40	45	14	32	44	24	50	39	11	39	44	17
10.		43	12	45	18	41	41	61	11	28	38	22	40
11.		100	0	0	82	11	6	94	6	0	93	6	2
12.		95	2	2	73	12	15	100	0	0	88	5	.2
13.		93	7	0	41	23	35	94	0	6	74	12	14
14.		50	48	2	26	53	21	50	33	17	41	47	12
15.		91	7	2	65	21	15	83	17	0	73	14	13
16.		93	5	2	65	21	15	89	11	0	82	12	6
17.		79	17	5	41	32	26	83	11	6	66	21	13
18.		24	9	67	12	15	73	50	17	33	24	13	63
19.		2	95	2	0	68	32	11	89	0	3	84	13
20.		52	31	17	15	21	65	89	6	6	46	22	32
21.		5	95	0	9	59	32	28	72	0	10	78	12
22.		67	31	2	38	50	12	89	11	0	61	34	5
23.		9	90	0	21	53	26	11	89	0	14	77	10
24.		69	31	0	50	41	9	89	11	0	66	31	3
25.		93	5	2	59	29	12	100	0	0	82	13	5
26.		21	76	2	6	82	12	33	67	0	18	77	5
27.		48	45	7	29	26	44	83	17	0	48	33	19
28.		24	69	7	9	50	41	39	56	6	21	60	19
29.		36	55	9	15	59	26	39	61	0	29	57	14
30.		57	29	14	44	41	14	89	11	0	58	30	12
31.		95	5	0	73	9	18	83	11	6	85	7	7
32.		88	9	2	68	21	12	89	11	0	81	14	5

Category Use in Percents for Each Subject Group (cont.)

	Group	I			II			III			Total		
Sent..	Cat.	1	2	3	1	2	3	1	2	3	1	2	3
33.		95	2	2	76	18	6	94	6	0	88	8	3
34.		7	79	14	26	53	21	39	44	17	20	63	17
35.		5	95	0	9	82	9	28	72	0	11	86	3
36.		2	71	26	0	44	56	17	44	39	4	56	39
37.		14	86	0	18	68	15	61	39	0	24	70	5
38.		71	21	7	32	35	32	78	11	11	58	24	17
39.		38	38	24	15	38	47	72	17	11	36	43	30
40.		95	2	2	58	29	12	78	22	0	79	16	5
41.		93	7	0	50	32	18	94	6	0	78	16	6
42.		95	5	0	59	29	12	89	11	0	81	15	4
43.		38	29	33	6	35	59	50	28	22	29	31	40
44.		19	38	43	15	29	56	50	44	6	23	36	40
45.		79	17	5	44	29	26	100	0	0	72	18	12
46.		69	31	0	15	26	59	79	17	6	67	27	6
47.		21	33	45	15	26	59	39	22	39	22	29	49
48.		5	24	71	15	9	76	56	6	39	18	15	67
49.		95	5	0	59	23	18	94	6	0	82	12	6
50.		90	9	0	32	62	6	83	11	6	68	19	3
51.		16	19	5	44	34	18	89	11	0	67	24	8
52.		7	74	19	6	56	38	22	56	22	10	64	26
53.		71	29	0	50	44	6	89	11	0	67	31	2
54.		31	59	9	21	64	15	79	22	0	36	54	10
55.		76	21	2	53	23	23	100	0	0	72	18	10
56.		71	26	2	73	12	14	94	6	0	77	17	6
57.		12	71	17	12	59	29	39	33	28	17	60	23
58.		57	31	12	38	41	21	83	11	6	55	31	14
59.		12	33	55	12	26	62	56	33	11	20	30	49
60.		29	17	55	3	18	79	83	11	6	30	16	54
61.		100	0	0	65	29	6	100	0	0	87	11	2
62.		21	26	52	23	23	54	78	0	22	33	20	47
63.		5	19	76	15	29	56	28	33	39	13	25	62
64.		17	84	0	23	65	12	56	44	0	26	69	4

Category Use in Percents for Each Subject Group (cont.)

	Group	I			II			III			Total		
Sent.	Cat.	1	2	3	1	2	3	1	2	3	1	2	3
65.		98	2	0	53	35	12	94	0	6	81	14	5
66.		0	33	67	12	9	79	17	44	39	7	26	66
67.		17	64	19	12	56	32	44	33	22	20	55	25
68.		29	69	2	35	41	24	83	11	6	41	48	11
69.		88	10	2	74	26	0	100	0	0	85	14	1
70.		67	31	2	20	65	15	89	11	0	54	39	6
71.		60	33	7	44	44	12	67	28	5	55	36	9
72.		84	14	2	59	29	12	89	11	0	76	19	5
73.		60	38	2	12	68	21	83	17	0	47	45	8
74.		67	28	5	26	53	21	89	11	0	56	34	10
75.		43	41	17	18	47	35	56	39	5	36	42	21
76.		50	21	29	23	12	65	50	44	6	40	23	37
77.		86	14	0	38	47	15	100	0	0	71	23	5
78.		83	12	5	68	29	3	100	0	0	81	16	3
79.		55	40	5	38	50	12	72	28	0	52	42	6
80.		24	76	0	38	59	3	78	22	0	39	60	1
81.		67	33	0	21	41	38	72	28	0	51	35	14
82.		43	19	38	18	38	44	61	22	17	37	27	36
83.		88	12	0	41	41	18	78	17	6	69	23	7
84.		17	24	59	15	59	26	44	28	28	21	37	42
85.		24	7	69	15	21	65	33	28	39	22	16	62
86.		86	14	0	53	47	0	89	6	0	75	24	1
87.		98	2	2	71	23	6	94	0	6	87	10	3
88.		100	0	0	73	24	3	69	11	0	86	11	1
89.		31	45	24	18	38	44	50	50	0	30	44	27
90.		50	14	36	12	26	62	67	28	6	39	21	29
91.		0	100	0	6	68	27	6	89	7	3	86	11
92.		17	36	48	6	50	44	28	67	6	15	75	38
93.		2	69	29	6	59	35	11	78	11	5	67	28
94.		62	29	9	50	32	18	67	28	6	59	30	12
95.		100	0	0	88	12	0	89	6	6	94	5	1
96.		12	86	2	18	76	6	39	56	6	19	77	4

Category Use in Percents for Each Subject Group (cont.)

Group	I			II			III			Total		
Sent. Cat.	1	2	3	1	2	3	1	2	3	1	2	3
97.	12	86	2	18	50	32	61	33	6	23	63	14
98.	26	48	26	12	38	50	56	33	11	27	41	32
99.	36	36	29	12	44	44	50	44	6	30	40	30
100.	7	76	17	21	38	41	17	72	11	14	62	24
101.	60	40	0	50	35	15	83	17	0	61	34	6
102.	17	62	21	29	24	47	61	33	6	30	42	28
103.	55	36	9	41	47	12	78	22	0	54	37	9
104.	26	43	31	29	35	35	72	28	0	36	37	27
105.	10	26	64	6	18	77	39	33	28	14	25	61
106.	7	93	0	9	76	15	22	72	6	11	63	6
107.	19	21	60	21	47	32	33	39	28	22	34	44
108.	62	36	3	27	62	12	78	22	0	52	43	5
109.	86	14	0	62	35	3	94	0	6	79	19	2
110.	43	38	19	32	41	27	56	39	6	42	39	19
111.	29	62	9	12	85	3	44	50	6	26	68	6
112.	17	83	0	18	59	24	61	39	0	26	66	8
113.	43	38	19	27	38	35	89	6	6	46	32	22
114.	55	45	0	32	44	24	83	11	6	52	38	10
115.	74	24	2	50	32	18	83	17	0	67	26	7
116.	14	86	0	23	62	15	33	61	6	21	72	6
117.	19	48	33	41	18	41	33	33	33	30	34	36
118.	26	57	17	17	71	12	61	28	11	30	56	14
119.	21	74	5	41	50	9	50	50	0	34	61	5
120.	0	14	85	9	12	80	17	22	61	6	15	79
121.	76	24	0	47	44	9	83	17	0	67	30	3
122.	36	38	26	21	35	44	39	44	17	31	38	31
123.	60	38	2	18	38	44	78	11	11	48	33	19
124.	12	71	17	9	38	53	17	67	17	12	59	30
125.	86	12	2	65	27	9	100	0	0	81	15	4
126.	83	10	7	68	29	3	78	17	6	77	18	5
127.	31	69	0	35	62	3	61	33	6	38	60	2
128.	98	2	0	56	38	6	94	6	0	82	16	2