

Strategies of More Competent and Less Competent Problem-Solvers in a Problem-Solving Task of Sorting a Scrambled Passage

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Two teachers, two competent students and two less competent students were given two similar problem-solving tasks of sorting out scrambled sentences so as to reconstruct complete stories. All the subjects were novices in the problem-solving tasks. It was found that each of the subjects used a different strategy, and there was no indication of a consistent difference between the effectiveness of the strategies used by novices of varying problem-solving competence. The results suggest that even within the category of novices, there could be a wide range of competence and a variety of strategies used. Five out of six subjects used working backward strategies, and only one of them used a working forward strategy. Four out of six of these novices made use of surface features in the sorting tasks. Even the more competent novices who understood the principle for solving the problem used surface features when they were in difficulty. It seems that when in difficulty, a more competent novice would use more general strategies which are not different from those of a less competent novice. More competent novices used a tighter monitoring system during the problem-solving procedure, and even the least competent novice exhibited an acquisition of better monitoring through practice.

In recent years, there has been an increasing interest in the theories of problem-solving. A lot of research literature has indicated a keen interest in finding major differences between experts and novices when they solve the same problem (e.g. Chase & Simon, 1973; Chi, Glaser, & Rees, 1984).

Problem-solving involves the interaction between the individual problem-solver and the problem to solve (Newell & Simon, 1972; Simon, 1978). Research findings have suggested that there could be great differences between experts and novices in both of these two

elements.

Although differences between the expert and the novice were found in problem-solving, the definition of an expert and that of a novice may not be very clear. Some studies made a clear distinction between the categories of expert and novice. For example, in Chase and Simon's (1973) study of chess masters versus novice chess players, and Feltovich's (1981) study of doctor versus medical students (cited in Gagne, 1985), the distinction was virtually between professionals and laymen. A lot of other studies used much looser definitions. The

findings of some studies may be actually those of the differences between more competent and less competent experts (e.g. Chi, Feltovich, & Glaser, 1981); others may be those of more competent and less competent novices (e.g. Simon & Simon, 1978).

Most of the research literature about problem-solving has concerned problem-solving tasks in science and mathematics (e.g. Chi, Feltovich, & Glaser, 1981; Kintsch & Greeno, 1985; Relf & Heller, 1982), and the differences between the best able and the least able problem-solvers. This study is an attempt to examine the differences in strategy between the more competent novice and the less competent novice in a reading task in which the subjects had to sort out scrambled sentences to form a continuous passage.

Expert-novice Differences

First, the expert problem-solver and the novice may have great individual differences. At the outset, they may not possess similar prerequisite capabilities to solve the same problem (Gagne, 1985). The expert may possess more relevant declarative knowledge for the problem-solving task; but even in cases where the novice possesses a similar amount of declarative knowledge, the knowledge structure between the expert and the novice may not be the same (Chi, Feltovich, & Glaser, 1981; Glaser, 1986). In other words, there may be either or both quantitative and qualitative differences between the individual expert and novice problem-solvers.

Second, the expert and the novice problem-solvers may not perceive the problem in a similar way (Chi, Feltovich, & Glaser, 1981; Glaser, 1986). When both the expert and the novice encounter a problem, they may interpret it differently and form qualitatively different internal representations (Gick, 1986; Glaser, 1986). It has been suggested that the problem-solver first translates the input of the problem-solving task into his own internal representation of the task before going on with subsequent problem-solving procedures (Gagne, 1985). If the expert and the novice formed qualitatively different internal representations of the problem, they would probably choose

rather different methods to attempt to arrive at a solution.

Even with small individual differences between two problem-solvers in their background knowledge, because of the difference in internal representation, the approaches they take towards the solution could be completely different. Research findings suggest that experts seem to organize their representations in terms of principles and applicability of the principles in the problem-solving task whereas novices seem to attend more to the surface features (Chi, Feltovich, & Glaser, 1981).

Despite an increasing amount of research literature on expert-novice differences, the definition of the expert and the novice has been rather loose and perhaps controversial. First, there may not be a clear-cut distinction between the expert and the novice because there could be a wide range of competence within each of the two categories itself. Second, there may not be a continuum between the extremes of the expert and the novice (Silver, 1985). Although a number of researchers have attempted to find the differences between experts and novices, few have addressed the differences within each of the categories.

In a real classroom situation, when a problem is new to the learners, all the learners are virtually novices, although some may be more competent than the others. Among these novices, there may be some who are more competent, or more experienced (Silver, 1985).

On the one hand, the more competent novices may perceive the problem differently from the less competent novices, either because they have a different knowledge structure or because they have a different internal representation of the problem. On the other hand, it may be expected that if a more competent novice found difficulty in employing specific strategies to solve the problem in a manner similar to that of an expert, i.e. working forward based on principles (Chi, Feltovich, & Glaser, 1981), there would be a tendency to use a means-ends strategy which would generally be more powerful.

In other words, in case of meeting with difficulty, even the more competent problem-solver would tend to use more general

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strategies. Elstein, Shulman, and Sprafka (1978) have indicated that experts and novices may not differ in their general problem-solving strategies. It would then be expected that more and less competent problem-solvers would not differ too much in their general strategies when they encountered difficulties during the problem-solving procedures.

It will be worth an attempt to find out both the differences and similarities between the more and the less competent novices in their strategies to solve a problem as well as the possible changes in their strategies when they solve similar problems repeatedly.

Sorting a Scrambled Passage as a Problem-Solving Task.

In this study, the problem was a card sorting task in which the problem-solver put a number of sentences into correct order such that they formed a meaningful passage.

This story-sorting task possesses the characteristics of a problem-solving task (Mayer, 1983), namely, (a) given information and conditions, (b) a desired goal, and (c) uncertainty of procedures to follow. Indeed, many tasks involving reading comprehension may also be taken as problem-solving tasks as long as they have these characteristics.

Like other problem-solving tasks, to be successful in this story-sorting performance, one has to possess certain prerequisites. These prerequisites may be an understanding of the meaning of individual sentences, and a mastery of knowledge about the structure of that particular type of passage.

Similar to the expert-novice differences in other problem-solving tasks, an expert in this story-sorting task may have a better mastery of these prerequisites. Since the purpose of this study is to find the difference between more competent and less competent novices in their strategies due to their different internal representations, it would be necessary to control the individual differences in prerequisite mastery at the outset.

Different structures of text may have different effects on comprehension (Richgels, McGee, Lomax, & Sheard, 1987). Therefore, the factor of text structure needed to be

controlled. It may be assumed that the subjects should have acquired adequate knowledge about the structure of narrative texts through previous exposure to stories, which are usually presented in this style (Spyridakis & Standal, 1987). A narrative text was thus used in the story-sorting task so that individual differences in knowledge of text structure would be minimized. The next factor that needed control may be familiarity with the lexical items in the passage. In this study, all words in the passage were familiar words to the subjects in order to ensure every subject's understanding of the meanings of all the sentences.

Expert-novice Differences in the Story Sorting Task

It has been found that expert problem-solvers usually work forwards applying specific strategies according to the applicability of certain principles but the novices often work backwards based on a means-ends analysis (Simon & Simon, 1978), and also with the application of surface features (Chi, Feltovich, & Glaser, 1981).

It may be expected that experts in a story-sorting task would apply working forward strategies whereas novices would more likely apply working backward strategies. It may also be expected that the novices would rely much on surface features whereas the experts would keep to the principles. It was expected that a more competent novice would apply strategies similar to that of an expert, and thus it was expected that a more competent reader would keep to the meaning of the continuous passage whereas the less competent reader would rely more on the surface features of the passage, such as punctuation marks and wordings, while they sorted it out.

METHOD

Subjects

The subjects were two teachers and four Form three students in a secondary school of Hong Kong.

The two teachers were teachers of Chinese, mathematics and social studies in separate

primary schools. They were not teachers of English, so they would not have come across the stories which were found in an English textbook for the secondary students. The inclusion of these teachers was to ensure that the strategies of more competent readers and more competent novice problem-solvers, if not experts, could be investigated.

The scores of three Form three classes ($N = 106$) in a JSEA subtest of English comprehension were used to categorize the students into more and less competent readers (Mean = 4.94, S. D. + 2.25).

Poor readers may not find it easy to form a coherent representation in order to comprehend even a coherent text (Bransford, et al., 1982), so a subject who scored low in the standardized comprehension subtest would not be expected to perform well in the story-sorting task. It was expected that subjects who scored high in comprehension would have a higher probability of performing well in the story sorting task.

First, one student was randomly chosen from those who gained scores 1.5 S.D. above the mean score in the standardized comprehension subtest and another student was randomly chosen from those who gained scores 1.5 S.D. below the mean score in the standardized comprehension subtest.

There was, however, no guarantee that the students who scored high in the subtest would be more competent in the problem-solving task, so if one of them did not perform well in both of the two story-sorting tasks, then that subject would be taken as a less competent problem-solver and another high scoring subject would be tested. This would go on until there was at least one subject in each of the competence levels.

Materials

1. A standardized English comprehension subtest of the JSEA.
2. Thirty sheets of paper numbered 1 to 30.
3. Two sets of story-sorting problems, Tasks one (as shown in the appendix) and Task two, each set pertaining to one story – Each story was presented in twelve sentences, each on one card. The words of the stories were within the level of the First Certificate of

English, and so all of them were found in Cambridge English Lexicon (Hindmarsh, 1980), and most of the words were taken from the recommended word list of the English Syllabus for Hong Kong Primary Schools. Jokes adapted from a textbook for teaching English as a second language at an intermediate level were used. Jokes were used because they may be more demanding as a problem solving task because the sentences in a joke would hardly be sorted correctly purely by the use of surface features such as the time phrases and the connectives in the sentences.

Procedure

A standardized English comprehension subtest of the JSEA was conducted with three Form 3 classes.

Number-sorting task: The number-sorting task was used as practice for the subjects to talk about what they were thinking while they were performing a sorting task. Each subject put a randomly shuffled pile of numbered paper into correct order such that number one was placed on top and number 30 was placed at the bottom. Subjects were asked to comment on why a certain action was done. A brief demonstration of performing the thinking-aloud protocol was done by the experimenter before each subject started.

Story-sorting task one: Each subject was given story sorting task one with 12 sentences in the same randomly scrambled order. They were asked to put the sentences into correct order so as to make a complete continuous story. They were told that they would be timed, so they had to do it as fast as they could. They were told that they had to indicate when they had finished. They were told to comment on what they were doing during their sorting task and their thinking-aloud protocols were recorded with a tape recorder.

Interview one: Immediately after story-sorting task one, the subject was interviewed. The interviewer asked what strategy had been used, and what procedures had been taken to solve the problem. The interview was recorded with a tape recorder.

Story-sorting task two: One day after story-sorting task one, each subject was given story

Table 1. Subjects in three categories and their problem-solving results.

GROUP	SUBJECT	SEX	READING SCORE	TASK 1	TASK 2
Teacher	1	F		succeeded	succeeded
	2	M		succeeded	succeeded
Less competent student problem-solver	3	F		failed	failed
	4	F	Low	failed	failed
More competent student problem-solver	5	F	High	succeeded	succeeded
	6	M	High	failed	succeeded

sorting task two. The procedure was similar to story-sorting task one, and the thinking-aloud protocol was recorded.

Interview two: Immediately after story-sorting task two, each subject was interviewed. The interviewer asked what strategy and what procedure had been taken, and whether there had been any difference between the strategies used in the two sorting tasks. The interview was recorded with a tape recorder.

RESULTS AND DISCUSSION

As expected, both of the two teachers sorted out both of the stories correctly. Subject 3, though a competent reader, did not sort out either of the stories correctly, and could only be taken as a less competent problem solver. Subject 4 who was categorized as a less competent reader failed in both of the story sorting tasks, as expected, and she too was categorized as a less competent problem-solver. Subject 5, a competent reader, sorted both of the stories correctly, and she was taken as a more competent problem-solvers. Now that there were two less competent problem-solvers. Subject 6 was chosen randomly from the group of competent readers hoping to obtain another competent problem solver. The result was that Subject 6 sorted out Task two successfully but failed to do it correctly in Task one. Despite his failure in Task one, he was categorized arbitrarily as one of the more competent problem solvers.

As a result, the subjects were categorized as shown in Table 1.

Although subjects were told that they would be timed, the time element was not included in the analysis because the amount of time used may be more related to individual differences and it was not expected to reflect the effectiveness of a strategy.

The Number Sorting Task

Although the number sorting task was primarily used as practice for the subjects to produce thinking-aloud protocols, it was interesting to note that even in a simple task like this, not all subjects used the same strategy. Subject 1 used a different strategy from all the other subjects. She first put all the single numbers in one group, tens in another, and twenties in yet another. Then she sorted the order of each group, and finally put the three groups into order. All the other subjects started with any number and put the next number before or after the previous one according to its order, and went on until the whole pile was completed.

Strategies in the Story-Sorting Tasks

The results indicate that even between the two teacher subjects, the strategies employed were rather different. The student subjects also employed rather different strategies among themselves.

The Teacher Group

The strategies that the two teachers used

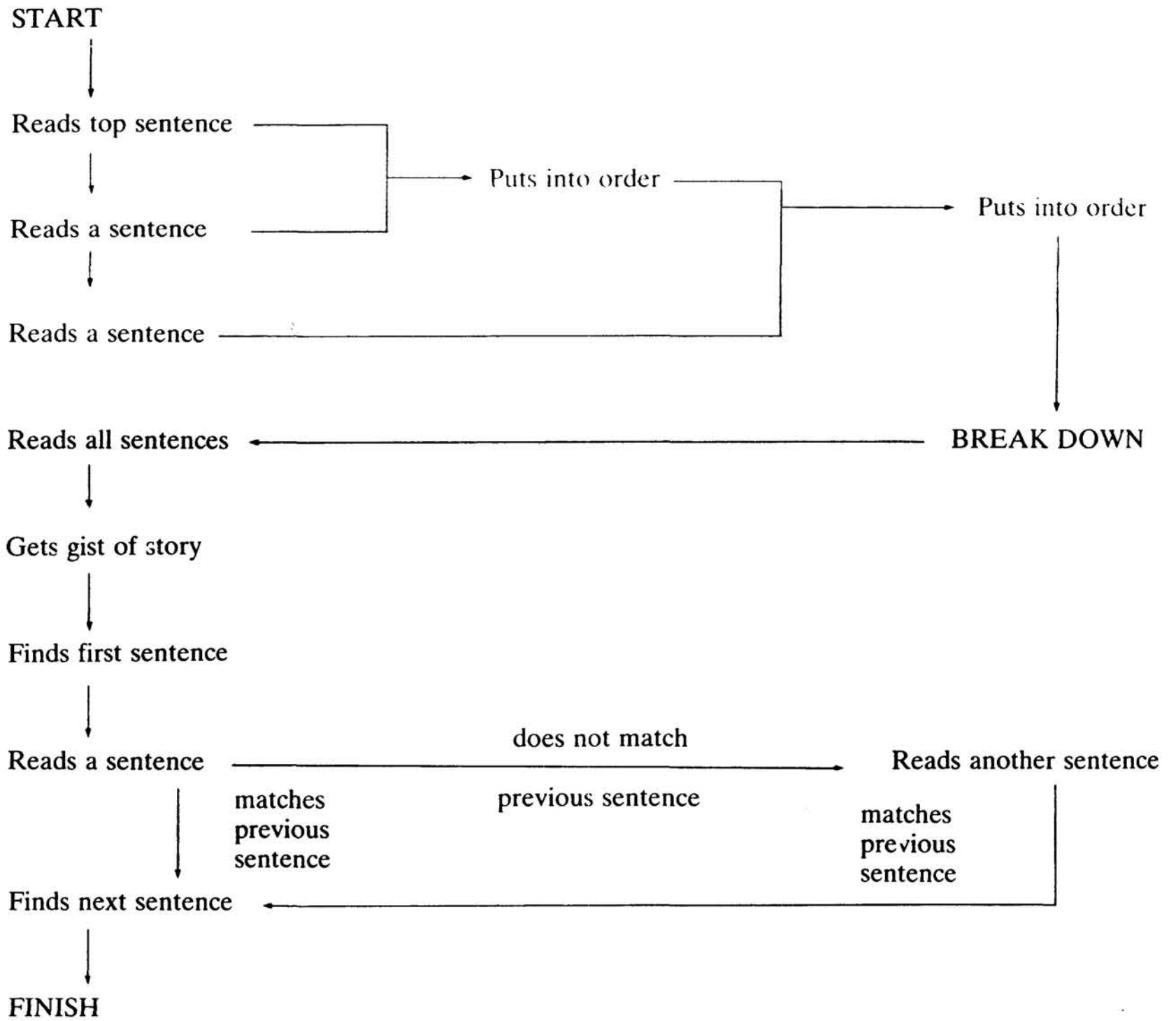


Figure 1. Strategy in Task One of Subject 1 in Teacher Group

were rather different. Subject 1 started with an intention to put sentences into order as soon as she had read a few sentences. When she found that it did not work, she read all the sentences once, got the meaning of each of them, and then put the sentences into order according to

the meaning. In Task two, she found difficulties in dealing with parts of the story. She made use of the wordings to pair up sentences and then inserted them into the sorted pile (see Figures 1 and 2).

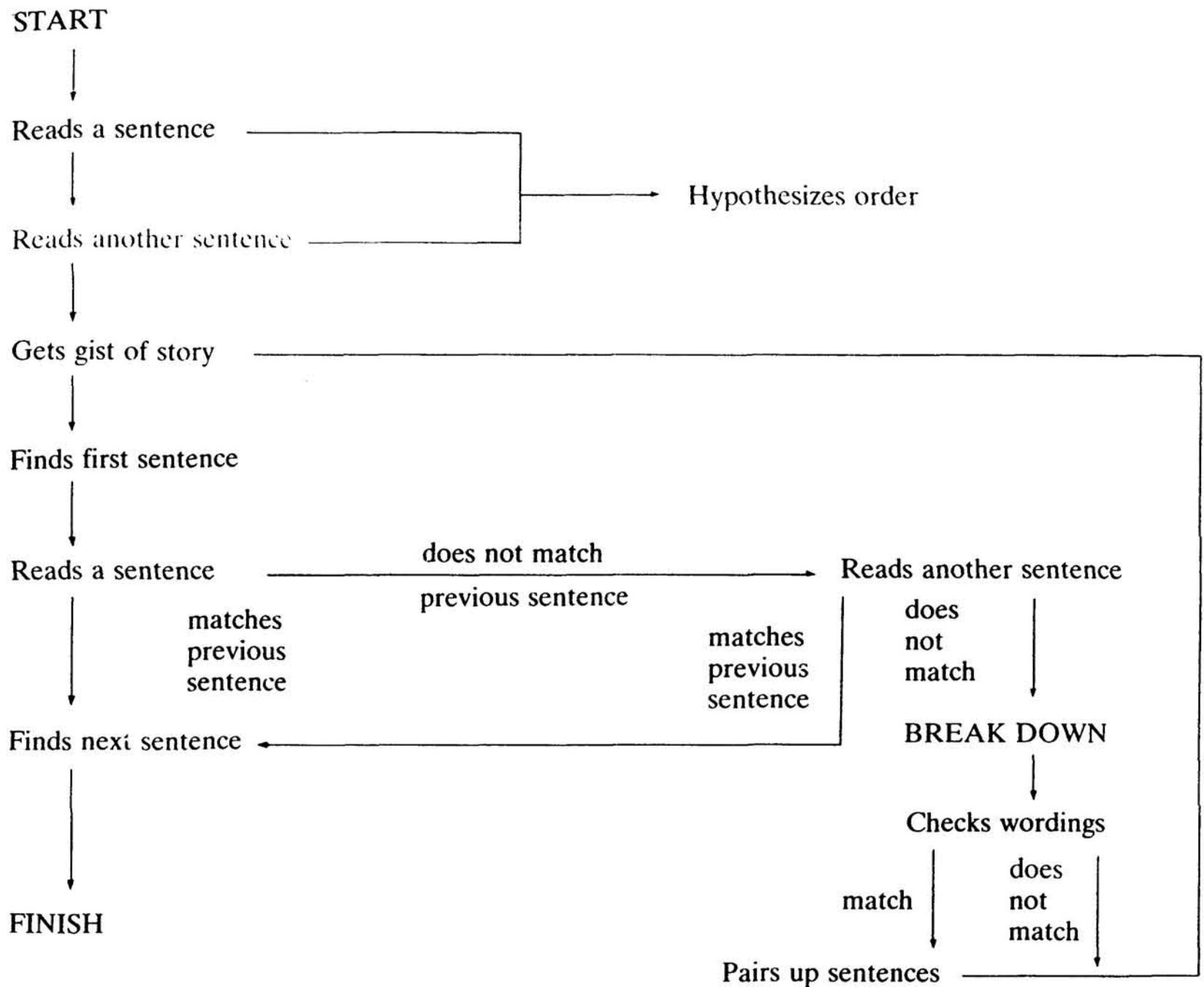


Figure 2. Strategy in Task Two of Subject 1 in Teacher Group

Subject 2 seemed to have kept to the same strategy throughout the two sorting tasks. He first tried to identify the first sentence after reading all the sentences, and then went on to look for the sentence that followed it. When this did not work, he checked the previous sentence in the sorted sequence and restarted at that point.

The Less Competent Student Group

The strategies that the two subjects in this group used were rather different. Subject 3

started with a strategy rather similar to that of Subject 2, but when it did not work, she started to look for the ending sentence of the story and tried to work backwards. When she found that it did not work either, she tried to go on working with the sorted sentences as a base. When she found that her strategies did not work, she relied on the wordings and tried to pair up sentences and insert them into the sorted pile (see Figure 3). Change of strategy in case of difficulty during problem-solving procedures has also been reported in other studies (e.g. Heyworth, 1989).

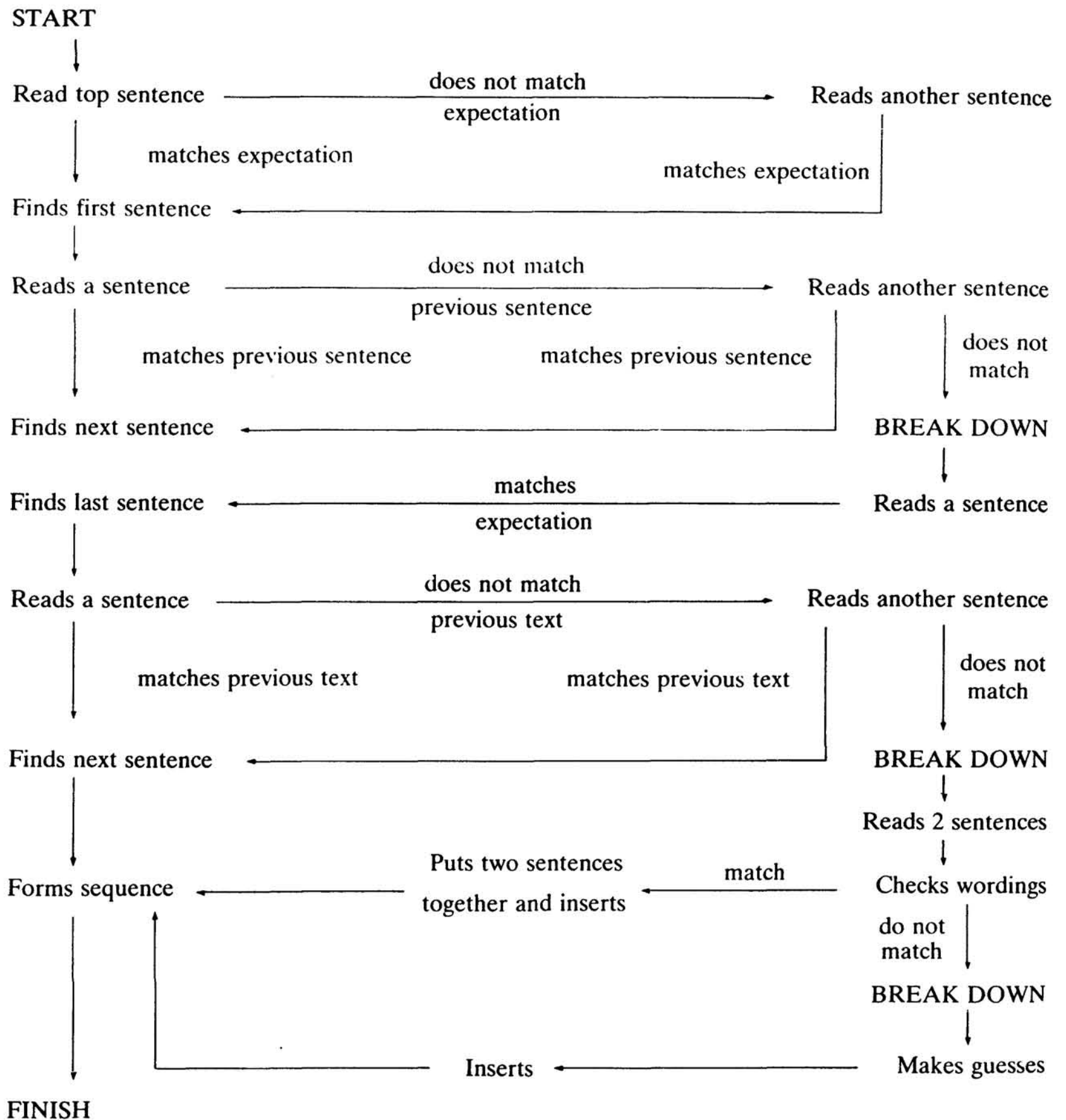


Figure 3. Strategy in Task One of Subject 3 in Less Competent Student Group

For sentences that did not go together, she made guesses and tried to insert each of them into the sorted lot hoping to make sense. In Task two, Subject 3 could not find the expected

ending sentences, so she went on looking for sentences following the previous ones, and she relied on the wordings when she found difficulties in the task (see Figure 4).

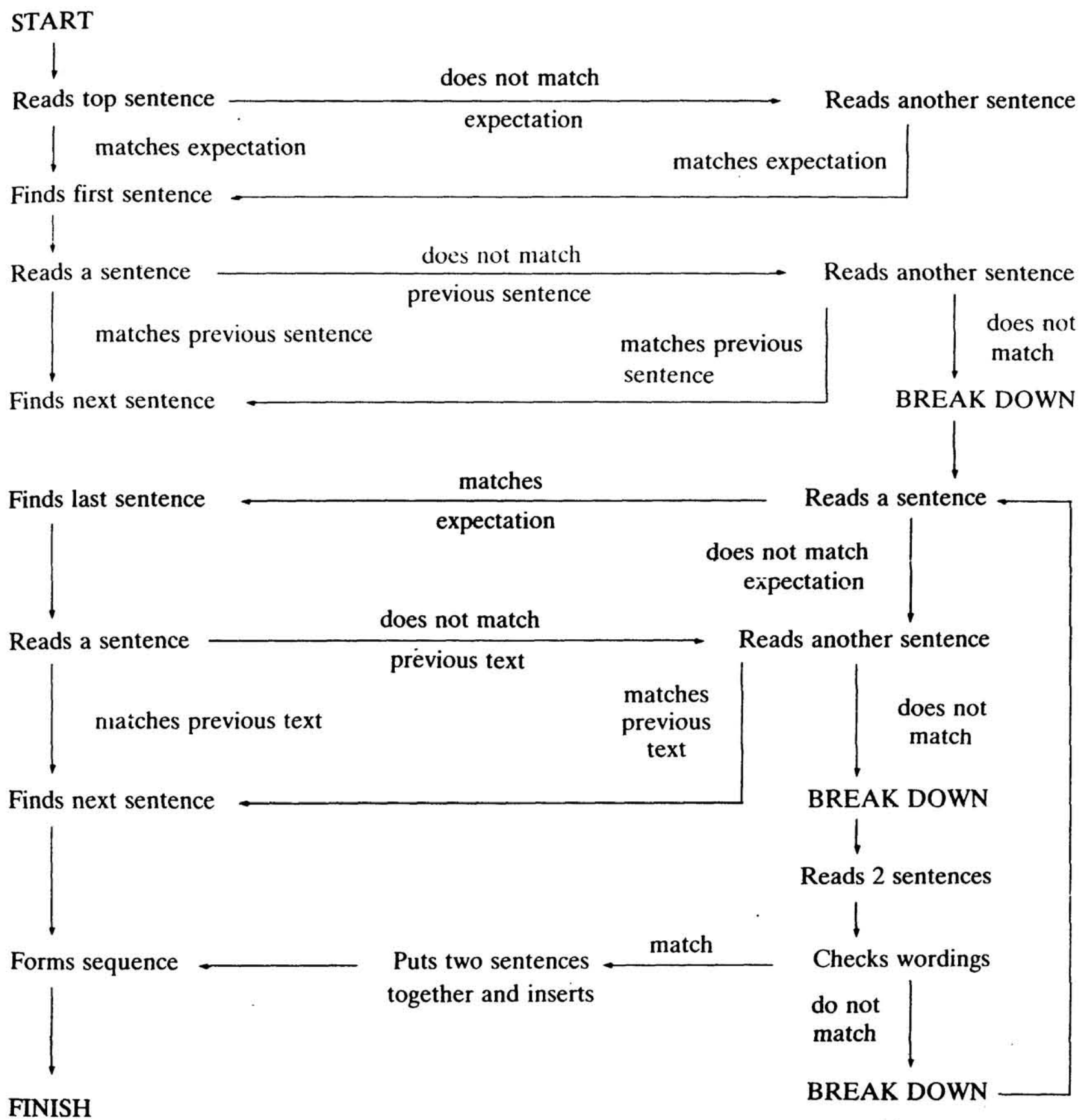


Figure 4. Strategy in Task Two of Subject 3 in Less Competent Student Group

Subject 4 started with a strategy similar to that of Subject 2, but when she found that it did not work, she immediately made use of the wordings in the sentences to make guesses. Then she inserted the sentences into the sorted

pile, hoping to make sense. However, in Task two, when she found that this still did not work, she employed a strategy rather similar to that of Subject 2 in Task two, i.e. she checked the previous sentence in the sorted sequence

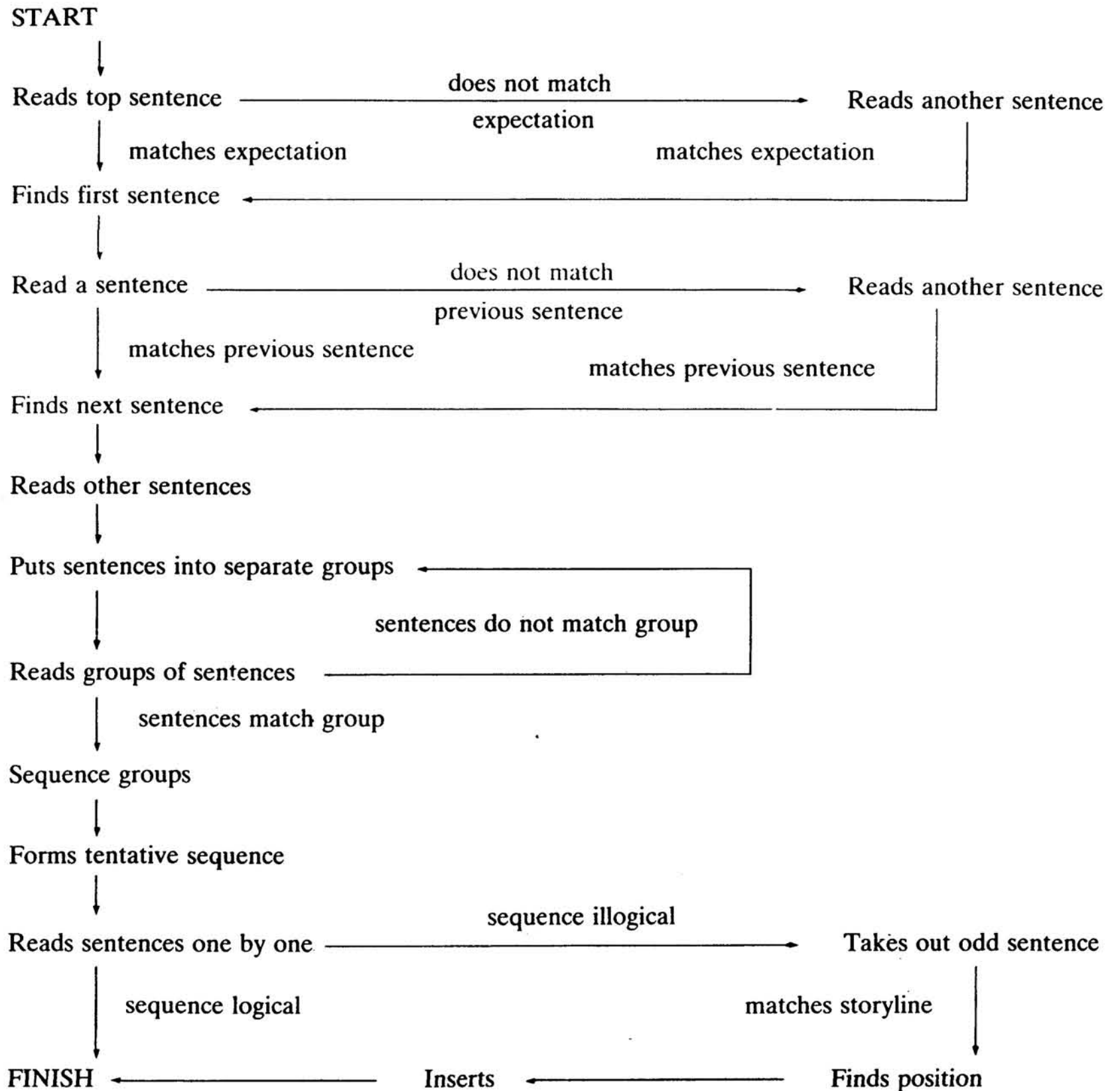


Figure 5. Strategy in Task One of Subject 5 in More Competent Student Group

and restarted at that point.

The More Competent Student Group

It may be controversial to have categorized the two subjects here into the same group because Subject 5 performed both tasks

correctly whereas Subject 6 failed to solve Task one correctly.

Subject 5 started with a strategy rather similar to that of Subject 2. At the point when she found that it did not work, she tried to put sentences into separate groups according to their meanings. Then she tried to sequence the

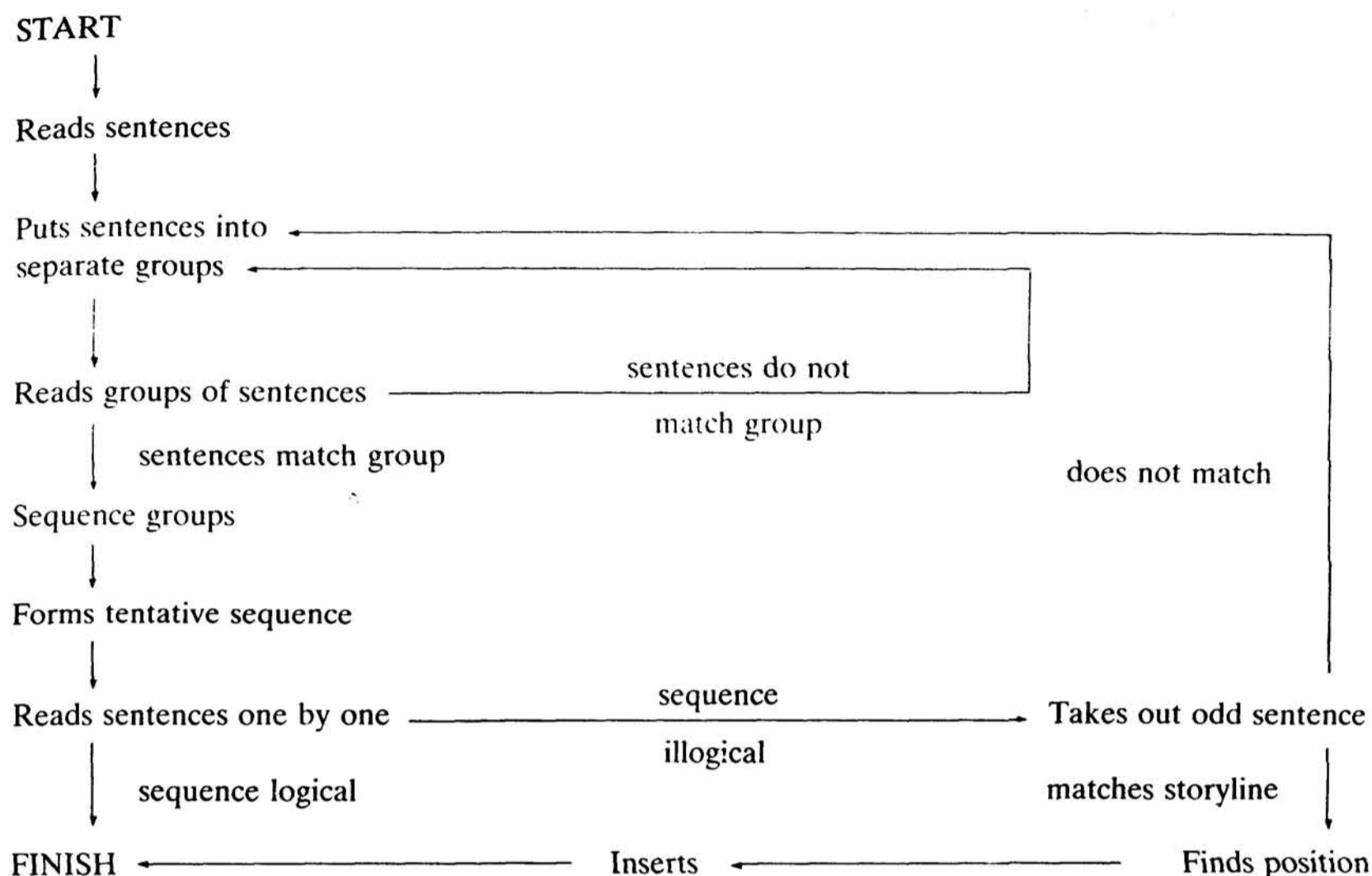


Figure 6. Strategy in Task Two of Subject 5 in More Competent Student Group

groups. When they did not form a logical sequence, she took out the odd sentences and inserted them into the sorted pile in order to make sense. In Task two, she abandoned the strategy she started with in Task one and started by putting sentences into separate groups according to their meanings. Then she tried to put the groups into a meaningful sequence. When she found that the sequence did not make sense, she started the whole process of grouping the sentences all over again. This took a lot of time, but finally she got all the groupings correct and the sequencing done without error (see Figures 5 and 6).

It may be taken that Subject 5 was employing a strategy more like a working-forward strategy as she did not try to put the sentences into sequence immediately, but rather to put sentences into meaningful groups before

the sequencing. The other subjects seemed to use a strategy more like a working-backward strategy and started to put the sentences into sequence right away.

Subject 6 started with a strategy rather similar to a combination of those of Subject 1 and Subject 2. He started by trying to put sentences into order as he was reading the sentences one by one and at the same time to find the first sentence of the story. When this did not work, he tried to make use of workings and other features such as quotation marks to put sentences into their places, hoping to make sense. In Task two, he started with a similar strategy as he used in Task one, but when it did not work, he made use of a strategy similar to that of Subject 2, i.e. he checked the previous sentence in the sorted sequence and restarted at that point.

Principles or Surface Features

The principle of the story-sorting tasks was presumably the adherence to the storyline; in other words, the meaning of the story as it went on. It was found in the interview¹ that Subjects 1, 2, 3, and 5 were trying to make use of the meanings of the sentences as a basis for the decision of the sentence sequence whereas Subjects 4 and 6 made use of the wordings and other surface features to decide which sentence might come first. For example, when they were asked if there were certain words or phrases that made them think that the cards should be sorted in that order, the following replies were obtained:

Subject 1 (S1): No wordings. I mainly did it by whole sentences.

¹Thinking-aloud protocols and the interviews were originally in Cantonese. For the sake of analysis and report, they have been translated into English.

Interview (1): You mean you would not find a certain word

S 1 : No. No.

I : For example, wordings like "as soon as"?

S 1 : No, never.

I : Which do you think is more important, the wordings or the story itself?

S 2 : The sequence of the story is more important than the wordings after all, because even when certain wordings were told, when they're wrong in sequence, it's still wrong.

I : Did you find the first card because of certain wordings or because of the meaning?

S 3 : The meaning.

I : You did it according to meaning too in the last time, didn't you?

S 3 : Yes.

I : And you made use of meaning again this time. But did the wordings help?

S 3 : No, I don't think they did.

I : How about such wordings such as "when" or other words like that?

S 5 : No, I didn't notice them.

Even when a competent problem-solver

admitted that surface features were used for the sorting task, the basis of judgment was still the meaning of the story rather than the surface feature itself. For example:

I : When you started, did you base your judgment on wordings? Say for example the first sentence?

S 2 : Yes, I started by recognizing the wordings.

I : Can you give an example of such wordings?

S 2 : For example, Mrs Black was old and rich. This is of course the beginning of the story. It tells about a lady who was old and rich. Then she was an old and rich person, of course a lot people would like to be her friends and relatives. Then after reading the whole story, I found a lot of people wanted to be her friends and relatives, and of course they wanted to show something.

To a competent problem-solver, certain wordings might be confusing and they might cause trouble rather than render help.

For example:

I : Did certain wordings make you see it that way?

S 2 : A little.

I : For example?

S 2 : For example, words such as T-0-0 "too", and also "or", these two words. They were the most troublesome words. I mean I didn't know how to sort them out.

I : Do you mean the most important part of your way to work it out was using these wordings, or not using these wordings?

S 2 : Mainly of course I wanted the story to be smooth, the problem of the sequence of every sentence. Secondly, because some wordings were confusing, for example, where the word "too" was used, the situation was unreasonable for this word to appear. Finally, I decided with my own judgment.

To a more competent reader, even though she did not perform well in the problem-solving task, she might find the meaning of the story more important than the surface features as a basis of her judgment in the order of the sentences. Her failure in the sorting task might

therefore be attributed to her failure to understand the meaning of the story. Had she understood the story itself, she could have sorted it out. For example:

S 3 : There were parts in the middle I knew they must be correct in order, but I didn't know where they should be put. For example, it says the funeral started, and then when the funeral started, all this. That one must follow this. Then the first cards should be correct, but what followed at last I made a mess of it.

I : You mean you knew their order but you didn't know which position to place them?

S 3 : That's right.

I : And not because of certain words?

S 3 : No.

I : So you mean you based on the meaning of the story?

S 3 : Yes, the meaning of the story.

I : Then do you understand the meaning of the whole story?

S 3 : Not very clear.

I : Because of a certain word that caused trouble?

S 3 : No, the problem is in the story.

A less competent reader may tend to rely on surface features such as certain wordings that may indicate the sequence of sentences in addition to the understanding of the meaning of the story. For example:

I : Are there any wordings such as "as soon as", these kind of words, that made you say which position it should be placed?

S 4 : It told me it should follow that, I think.

I : Did you sort the cards according to these wordings or according to the meaning of the story?

S 4 : It depends. Maybe the story too.

I : You mean you used both. Well, which was more important?

S 4 : Of course the words.

A more competent reader may also tend to rely on surface features in the sorting task if he is a less competent problem-solver. For example:

S 6 : First, I saw how the story happened. It won't start with a conversation, and there won't be "he" because it hasn't mentioned who it was.

I : Do you mean you paid attention to these

wordings, such as "he", or things like the quotation marks in the conversation? Did you sort out the cards by paying attention to these signs?

S 6 : Yes.

I : What did you use mainly for sorting them?

S 6 : The words.

I : Then you started. What did you look for as soon as you started?

S 6 : I looked for the beginning of the story.

I : Beginning of the story?

S 6 : Things like "Once upon a time".

It is also interesting to find that even to the competent problem-solvers, when there was difficulty in applying the principles to solve the problem, there would be a tendency to use surface features to help solve the problem. The use of surface features such as wordings and punctuation marks was found in Subject 1 in the teacher group and Subject 6 in the more competent student problem-solver group. For example, in Task two when she found difficulty in sorting by meaning, Subject 2 made use of surface features, such as the wordings, in order to help her:

I : Do you mean you did it according to the meaning of the story?

S 1 : That's right.

I : And not because of a certain word or phrase there.

S 1 : No.

I : Such that the wording makes you think one card should follow another?

S 1 : Yes, yes. There may be. Here's a "bath", and then there's a "bath". And also, this "outside" and that "outside".

Learning through Practice

There was no major change in the strategy itself for any of the subjects over the two story-sorting tasks, but it was obvious that five out of six subjects exhibited a tighter monitoring system in Task two than in Task one even though they had not been given any feedback of whether had been successful in Task one or not.

The major similarity between the more competent students and the teachers is that both had a tighter monitoring system during the

process of problem-solving than the less competent students (see Figures 1 to 6 for a comparison of the monitoring procedures of each category in two successive sorting tasks).

Similar to general comprehension monitoring procedures (see Gagne, 1985, pp. 173-189), a problem-solver may monitor the procedures to sort out a scrambled passage by making use of all sorts of remediations when there is a break in the comprehension of the passage. Less mature readers may not be aware of their failure to comprehend as may the more mature readers (Markman, 1979), and less mature readers are less able to identify the point of failure when they fail in comprehension (Harris, Kruithof, Terwogt, & Visser, 1981). Gagne (1985) has also cited Garner and Reis's (1981) findings in comprehension monitoring as an indication that high-ability readers are more able to recognize their problems in comprehension and to look for remediation when such problems arise, while low-ability readers are less able in both problem-identification and remediation.

The results of this study seem to suggest that there may be a similar distinction between the more and less competent problem-solvers in their monitoring systems during their problem-solving procedures. The more competent problem-solvers seemed to have a better monitoring system such that they could both identify the cause for the failure to continue with the task and seek remediation when there was a break down whereas less competent problem-solvers failed either in identifying the cause for the failure to proceed or in finding appropriate remedial actions to rectify their errors.

One major difference found between the more competent and the less competent problem-solvers in this study is that the former was quite sure whether the sorting task had been successfully done or not, irrespective of their understanding of the whole story. For example, the less competent student problem-solvers explicitly stated their uncertainty about their solution:

- I : Did you feel that the story was not a complete one at first?
S 3 : Not very complete, even now.

I : Since I told you it was a complete story, if you felt that it was not complete, do you mean you thought there should be some problem?

S 3 : I think it is not complete.

I : Do you mean it is really a complete story?

S 4 : Not very complete, but I don't know how to sort it.

I : Then you think, well, let's try our luck. Is that right?

S 4 : Yes.

I : It might be right, you thought? Have you considered that it must be correct?

S 4 : Only the first few sentences.

I : The first few sentences you know must be right. How do you know the following sentences must be wrong?

S 4 : I don't understand their meaning.

CONCLUSIONS

It was expected that problem-solvers of different levels of competence would employ different strategies. It is, however, rather difficult to draw such a conclusion from the results of this study where subjects used a large variety of strategies. It may be taken as support to Silver's (1985) suggestion that even within the category of novices, there could be a wide range of competence. It is also found that even within each of the categories of more competent or less competent novices, a large variety of strategies may be used, and it would be difficult to justify which strategy should be more effective.

It could be concluded that five out of six subjects used a mean-ends analysis and sorted the sentences one by one from beginning to end, and only one of them worked forward by putting sentences into groups before sequencing. It was also found that four out of six of these novices made use of surface features in the sorting tasks.

Even though the more competent novices understood that the principle was to stick to the meaning of the passage, when they were at a loss, they would tend to resort to the use of surface features to help them solve the problem. It seems that when in difficulty, a more competent novice would tend to use more

general strategies than specific ones, and then the general strategy a more competent novice uses may not be much different from that used by a less competent novice. This may be taken as an extension of Elstein, Shulman, and Sprafka's (1978) finding that there may not be a great difference between the general strategies of the expert and those of the novice.

It was an interesting finding that more competent novices used a tighter monitoring system during the problem solving procedure, and even the least competent novice exhibited an acquisition of better monitoring through practice. This may imply that in some problem solving tasks, the difference between the more and the less competent problem solvers may not lie in the difference in their strategies, but rather the monitoring systems they employ. Further studies comparing the differences between experts and novices in their monitoring procedures during problem-solving tasks will be necessary to confirm this.

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APPENDIX

Sentences for Story-Sorting Task One

Sequence	Card No.	Sentence
1	6	Mrs. Black was old and rich.
2	12	She lived in a beautiful house and had a lot of valuable things.
3	4	When she died, there was a big funeral.
4	2	Her relatives and friends received notices about her death.
5	1	They came from far and near to the church.
6	8	When all the people had gathered there, the service began.
7	7	As soon as the service began, some of them started to cry.
8	11	Mrs Black's cousin noticed a poorly dressed man crying bitterly.
9	10	"Were you a relative of the dead woman, too?" he said to him kindly.
10	5	"No," the man answered.
11	3	"Then why are you crying?" the dead woman's relative asked.
12	9	"That's exactly why I'm crying," the poorly dressed man said.

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