Research on Interpretation Process of Bridging Reference in English Discourse with Think Aloud Protocol

Daqing Zu & Shuying Xia

School of Foreign Studies, China University of Mining &Technology, Xuzhou, P.R. China

Received: November 29, 2012 Accepted: December 8, 2012 Published: December 11, 2012

doi:10.5430/elr.v1n2p119 URL: http://dx.doi.org/10.5430/elr.v1n2p119

Abstract

Bridging reference (BR) refers to the relationship between a linguistic expression and its intended referent not explicitly mentioned in previous context. It has been studied for more than three decades with various approaches. However, limitation exists in those approaches except the relevance theory (RT) which suggests that each affecting factor is necessary for the cognitive effects and processing effort required to reach an acceptable overall interpretation. BR interpretation process has seldom been explored and only some questionnaires were adopted in earlier studies. This thesis tentatively approaches BR interpretation process by adopting the think aloud protocol (TAP). In addition, retrospective interview is used to complement TAP. Results from this research indicate that contextual assumptions with cause-effect relation are more accessible in BR interpretation. Contrary to findings from previous researches, contextual assumptions with contrast relation are not considered in this experiment. Encyclopedic information is not always used to test the acceptability of bridging referents. Subjects make choices in order of accessibility of contextual assumptions even though the referent is inconsistent with one's general knowledge. It supports RT in that one stops inferring once a cognitive effect is achieved. Sometimes one's activated general knowledge plays a decisive role in BR interpretation. Moreover, encyclopedic information, temporal sequence and syntactic position are taken into consideration in some cases. The constraint of discourse connectives on BR interpretation is proved again in this experiment. It also proves that backward inference is the only comprehension strategy employed by the subjects. The discussion of BR is within the framework of relevance theory. The exploration of BR within RT again verifies the explanatory power of this theory. Moreover, many factors affecting BR interpretation have been studied, but how does each of them work on interpreting BR remains unclear to us. The present study will not only focus on crucial factors affecting BR interpretation but also include other important factors in the analysis. The results from this experiment confirm the validity of TAP in examining BR on the one hand, and suggest alternative research method for later empirical studies of BR on the other hand. It reveals English majors' cognition process of interpreting BR in English discourse in particular, and their cognition model in second language acquisition (SLA) in general. Analyzing TAP data within RT again validates the great explanatory power of this theory.

Keywords: Bridging reference, Think aloud protocol, Relevance theory, Interpretation process

1. Introduction

This thesis aims to explore the process of interpreting bridging reference (BR used later) in English discourse. Since the intended referent is not explicitly given in the previous discourse, the hearer has to bridge a connection between a bridging noun phrase (NP) and its referent. How the two parts are linked together in BR is our main concern in this thesis.

The study of BR is in relation to such many fields as linguistics, psychology, philosophy, artificial intelligence and logics. The author explores this language phenomenon based on an experimental design. Based on the application of the TAP method (think aloud protocol method), this thesis is to have a process-oriented study of the interpretation process in dealing with referents in BR. Retrospective interview is applied as well as a supplement to TAP. The present study explores how people solve problems and understand the sequence of thoughts people experience as they work through a problem. So far, the TAP method has been widely used in psychology and linguistics where it has enlightened researchers in many ways. It has, however, received much criticism. Whether the researcher can understand what happens in the participants' psychological process and whether the data can objectively reflect the participants' real psychological activities are the most questionable aspects. In this research, the researcher has endeavored to explore the subjects' mental process of dealing with BR in English discourse, aiming to discover some new aspects of TAP.

A great many approaches have been adopted to account for BR interpretation, however, only relevance theory (RT) is proved to be an efficient framework to contain all the other approaches by providing a full explanation to BR. Thus the experimental data are analyzed within the framework of RT to validate again its great explanatory power on BR.

BR appears when the interpretation of one bridging expression needs to infer from the preceding utterance. As the subject's mental process is rather complicated and invisible, it is a challenge to study the process of interpreting BR by analyzing the recordings of their verbalizations. Compared with former researches, this process-oriented research is of great significance mainly in the following three aspects.

Firstly, this thesis focuses on the exploration of human's interpretation process of BR. Many product-oriented studies on BR have been conducted in the cognition field, but very few of them are process-oriented. Holmes (1988) has stated that "the nature of the product cannot be understood without a comprehension of the nature of the process" (1988, p.80). Process-oriented studies play an important role in studying BR. A process-oriented study of handling BR may provide lots of clues to study the interpretation strategies for finding the referents.

Secondly, it is an empirical study of BR via the TAP method. Most traditional studies examine BR through questionnaires and neglect what the subjects are really thinking during their understanding process. This thesis is more experiment-evidenced by providing more verbal data of interpreting BR. Because of the complexity and abstraction of human mind, it is difficult to probe into their thinking process with other methods. TAP has proved to be an effective method to obtain such data. The interpretation process will be described with the help of the research material obtained from TAP. The research results will shed some light on the study of utterance interpretation in general. People provide various answers to the same question due to their different background knowledge. Even when their answers are unified, various strategies have been adopted to arrive at the same answer. Moreover, it should be pointed out that more accurate answers can be obtained with TAP than with questionnaires. Because the subject may mistakenly tick an answer on the paper different from what they really think. This point will be explained in the later part. The present study will adopt TAP to study BR and will provide further reference for future empirical studies of BR. On the basis of the results obtained from the TAP research, researchers can study BR more scientifically and efficiently. Furthermore, it is necessary and meaningful to adopt a second method in this thesis as a supplement to TAP because of the complexity of human cognition.

Lastly, the discussion of BR is within the framework of relevance theory. Various approaches have been applied to studying BR, among which the most influential one is relevance theory. The exploration of BR within RT again verifies the explanatory power of this theory. Moreover, many factors affecting BR interpretation have been studied, but how does each of them work on interpreting BR remains unclear to us. The present study will not only focus on crucial factors affecting BR interpretation but also include other important factors in the analysis.

2. Literature Review

Bridging reference has been researched since the late 1970s and many vital achievements have been made from different angles. In this chapter, the author will only introduce some major figures in this field together with their researches of BR relevant to this thesis. Some modern researchers interested in this discipline are discussed as well.

2.1 Definition of Bridging Reference

"Bridging" was originally introduced in the work of Clark and Haviland (1977; Clark, 1977a, 1977b) to refer to the following expression:

(1) We bought some food for the picnic. The beer was warm.

To interpret the expression "the beer", the reader has to find a referent not clearly expressed in the previous discourse, but can be inferred from what is given already. Here, although it is not explicitly said that we bought some beer for the picnic, the first assumption is that we did, and the beer mentioned in the second part of the utterance is included in the food which the speaker bought.

What is involved in the interpretation of utterance such as this is not only encoding and decoding of syntactic and semantic information, but also pragmatic inferences to identify the intended referent of the definite noun phrase in the second sentence.

Up till now BR has been studied for more than three decades, but an agreement on its definition has not been reached. Different authors use it in different ways. According to Clark & Haviland (1977), bridging implicature appears when the listener can not find a direct antecedent for a reference in his memory. By direct antecedent, Clark means an antecedent explicitly mentioned in the previous discourse, and indirect antecedent means a case where the existence of an antecedent has to be inferred. They define bridging as "when the listener cannot find a direct antecedent, most commonly he will be able to form an indirect antecedent by building an inferential bridge from something he already knows" (ibid. p.6). Based on their account, the following two referring expressions in (2) and (3) are both cases of bridging involving indirect reference:

(2) I looked into the room. The roof was very high.

(3) John was murdered yesterday. The murderer got away.

However, Clark (1977a) views bridging differently. He treats reference assignment generating bridging implicatures as bridging, regardless of whether the reference is direct or indirect. That is, examples from (4) to (6) are also cases of bridging.

(4) I met a man in the morning. The man told me a joke.

(5) I met a man on Sunday. The bastard stole all my money.

(6) I met two people. The woman told me a story.

Clark introduces direct reference as "given information often makes direct reference to an object, event or state just mentioned. These always force an implicature of some sort, even though it may be trivially simple. This class of bridging is well known" (1977a, p.414).

Since Clark uses the term bridging either widely or inconsistently, Matsui thinks it should be tightened and proposes an alternative definition by restricting bridging implicature to "contextual assumption, warranted by the explicit content of previous discourse, needed to introduce an intended referent which has not itself been explicitly mentioned" (2000, p.199). On this account, only (1), (2) and (6) are cases of bridging, when a new contextual assumption is needed to introduce the intended referent. By a new contextual assumption, she means a new premise to be created by the listener to establish the existence of the intended referent that has been not explicitly mentioned before. In (1), the antecedent of the beer is not explicitly mentioned. Instead, the existence of the antecedent must be inferred from the explicit content of the previous discourse. In (1), the mention of the food enables the listener to make the assumption that the food included the beer. (3) is named entailment or logical inference not bridging, since the verb "murder" entails "the murderer and the victim". (5) is not a case of bridging for "the bastard" is just a description of the man, without introducing a new entity (Sanford & Garrod, 1981, p.104).

Matsui does not solve the problem of entailment in her study, but she thinks that entailments are different from bridging implicatures. That is, (1), (2) and (6) are not the same as (3), because in the above three expressions, "what is involved is not an entailment based on word meaning, but the general encyclopedic information" (Matsui, 2000, p.21).

Mo Aiping modifies the definition in his dissertation (2003) as: BR refers to a relationship between a bridging expression and its intended referent not itself explicitly mentioned in context (including the preceding discourse, subsequent discourse, etc.), but can be inferred via the addition of contextual assumptions. His definition is mainly based on the use of Chinese discourse, and this study is on English discourse, thus Matsui's definition of bridging will be adopted in the following discussion. And by BR, she means the definite noun phrase whose referent is identified by use of bridging implicature. In other words, BR can be defined as: the relationship between a linguistic expression and its intended referent that has not itself been explicitly mentioned in the previous context, but can be inferred from the context. BR interpretation lies on the proper identification of an assumption introducing the intended referent. The linguistic expression is named bridging NP, and the assumption is contextual assumption.

2.2 Previous Studies

The problem of bridging reference has been examined extensively with many different approaches. As the purpose of the present research is to explore the interpretation process of BR in English discourse, relevant studies in cognitive fields are going to be focused here.

2.2.1 Given-New Contract

Clark concerns bridging reference in different ways, and proposes the Given-New Contract:

The speaker agrees to try to construct the Given and New information of each utterance in context (a) so that the listener is able to compute from memory the unique Antecedent that was intended for the Given information, and (b) so that he will not already have the New information attached to the Antecedent (Clark & Haviland, 1977, p.9).

It can be inferred that Clark and Haviland hold that there are linguistic constructions marking information as given rather than new. One such construction is the definite article that Chinese lacks. What is linguistically marked as

Given should be information the hearer already has, and what is linguistically marked as New should not be information the hearer already has. They take bridging as a special form of expressing old information. Their basic idea is that reference assignment succeeds when the listener has in working memory a representation of the intended referent (Matsui, 2000, p.7). At most times, such a representation will be available to the subject, since there is an intended referent in the previous discourse. But in BR, an intended referent has to be introduced by the hearer himself. Their studies on this language phenomenon provid e a solid foundation for later researches.

Clark further claims that although bridging is different from other cases of reference assignment, the interpretation of BR is still constrained by the Given-New Contract (Matsui, 2000, p.7). The following rule for appropriate BR assignment is suggested: build the shortest plausible bridge that is consistent with the Given-New Contract. That is, a hearer is suggested to "take the one that requires the fewest assumptions as the intended implicature, given that all assumptions are plausible based on the (hearer's) knowledge of the speaker, the situation, and facts about the world" (Clark, 1977a, p.420).

Even though Clark's thoughts about constructing bridging assumptions seem to be on the right track, his account falls short of becoming an explanatory theory. It can be seen that this contract only develops Grice's Co-operative principle, yet it is not an adequate theory. Furthermore, it is really hard to define a bridge as both short and plausible.

2.2.2 Scenario-based Approach

Sanford & Garrod (1981) propose a scenario-based account in comprehension. Their main proposal is that the reader/hearer uses the previous discourse to identify a proper domain of reference, loosely corresponding to what the text is about, which he then uses to interpret the subsequent discourse. The domain of reference is a scenario, conceived of as a particular part of the knowledge-base. Taking the following sentence as an example:

(7) They walked into a house. The window was open.

According to them, the antecedent (here, a house) activates a scenario with many slots in it, such as roof, wall, door and so on. The bridging NP (here, the window) is definitely activated among them. When the reader encounters the antecedent, those slots are activated in his mind. In that case, when he reads the bridging NP, the connection between the antecedent and it can be quickly bridged. Such a direct interpretation process is named primary processing. When a currently operating scenario does not include the intended referent, secondary processing is required and the search domain has to be extended into the entire knowledge-base, thus the resulting process is time-consuming.

Although their account of reference assignment is plausible and comprehensive, there are also shortcomings in Sanford & Garrod's approach. Firstly, according to them, the antecedent activates a scenario with lots of slots in the hearer's mind. That would be a big waste of effort in the real situation, since too many things will be activated together.

Secondly, it cannot deal with cases wherein there is more than one candidate for a proper scenario or more than one candidate referent in the search domain extended into the whole knowledge-base (Matsui, 2000, p.9).

2.2.3 Focus–based Approach

Focus-based approaches to reference assignment are mainly studies of the factors that affect the accessibility of candidate referents, and that a pragmatic criterion is needed to evaluate these candidates as accepted or rejected.

Sidner's (1983) approach is simple and direct. She proposes that the constituent in focus is the most accessible linguistic antecedent for reference assignment, and would also be the most accessible antecedent in BR assignment (Matsui & Wilson, 2003). On this account, the constituent in focus is the bridging referent. She puts forward an algorithm to compute the expected focus: (as cited in Matsui, 2000, pp.9-10)

The Expected Focus Algorithm:

1) The subject of a sentence if the sentence is a 'is-a' or 'there'-insertion sentence.

2) The first member of a default expected focus list, ordered as follows:

-theme, unless the theme is a verb complement, in which case theme from the complement is used.

-all other thematic positions with agent last.

-verb phrase.

Sidner holds that the expected focus should be the first candidate to be tested in reference resolution, and no more searches are necessary if the result is successful. In case that the first selected referent is denied, the next possible candidate needs to be tested, and so on until the right one is found. Thus, she is suggesting that candidates are tested in a certain order as predicted in her algorithm.

Although Sidner's model can handle many cases of reference resolution, there are still some problems in her account. First, a referent selected by the algorithm will be accepted or not depends on whether the resulting interpretation is in accordance with evidence available from the general knowledge. However, the problem appears when more than one equally accessible and plausible candidate referents exist.

Second, the antecedent of BR may not happen to be in the focus position in the preceding sentence. Other affecting factors should also be taken into account. That means the reference cannot be assigned only from the algorithm. This experiment shows that the right referent is not always the first accessible and plausible candidate.

2.2.4 Relevance Theory

Sperber & Wilson propose the following definition of relevance: "An assumption is relevant in a context if and only if it has some contextual effect in that context" (1995, p.122). They propose that in verbal comprehension, it is relevance which is treated as given, and context which is treated as a variable (ibid. p.142). Later, this definition of relevance is improved by adopting two extent conditions:

An assumption is relevant in a context to the extent that its contextual effects in this context are large; an assumption is relevant in a context to the extent that the effort required to process it in this context is small (ibid. p.125).

It is the communicator's responsibility to avoid misunderstandings and to provide the most relevant contextual information to the hearer. Thus the following presumption of optimal relevance is proposed:

(a)The set of assumptions which the communicator intends to make manifest to the addressee is relevant enough to make it worth the addressee's while to process the ostensive stimulus. (b)The ostensive stimulus is the most relevant one the communicator could have used to communicate .

A revision of presumption of optimal relevance is:

(1) The ostensive stimulus is relevant enough for it to be worth the addressee's effort to process it. (2) The ostensive stimulus is the most relevant one compatible with the communicator's abilities and preferences. (ibid. p.270)

An utterance creates a presumption of optimal relevance does not suggest that it is actually optimally relevant to the hearer. The criterion of consistency with the principle of relevance is thus proposed:

An utterance, on a given interpretation, is consistent with the principle if and only if the speaker might rationally have expected it to be optimally relevant to the hearer on that interpretation (ibid. p.162).

In Sperber & Wilson's *Relevance: Communication and Cognition*, two fundamental claims about cognition and communication were made (ibid. p.260):

(1) The First or Cognitive Principle: Human cognition tends to be geared to the maximization of relevance. (2) The Second or Communicative Principle: Every act of ostensive communication communicates a presumption of its own optimal relevance.

The claim that human cognition tends to search for the maximal relevance, means that cognitive efforts tend to be assigned to processing the most relevant inputs available, whether from internal or external sources.

The principle of relevance is a process of ostensive-inferential communication, the speaker and the hearer need not to know this principle. It suggests that the hearer is entitled to search at least adequate cognitive effects for no gratuitous effort. This approach has an implication for processing contextual assumptions that are crucial on BR interpretation (Mo, 2003). Cognitive effects interact with existing assumptions by strengthening, contradicting or eliminating, or combining with them to make new assumptions.

Bridging is a pragmatic phenomenon in nature and thus related to the theory of pragmatics. Among present theories, RT is regarded as the most plausible to account for BR interpretation. In this thesis, RT is referred to interpret BR comprehension process with the data from the experiment.

Relevance theory is first adopted by Matsui (2000, pp.197-198) to account for bridging. Factors affecting the success or failure of BR assignment are examined from two different angles: (a) factors affecting the resolution of bridging; (b) factors affecting the appropriateness or stylistic acceptability of bridging. Two most crucial factors, the accessibility of candidate referents and the accessibility of contextual assumptions, were investigated in detail. Her central idea is that the best way to accommodate all the factors affecting the interpretation of BR is to regard each of them as contributing to the cognitive effects and processing effort required to reach an acceptable overall interpretation, that is, an interpretation consistent with the principle of relevance. To be more specific, in interpreting

BR, one should make a bridging assumption that yields adequate contextual effects without subjecting the language user to unjustifiable processing efforts to get the intended referent.

It proves that RT is by far the most comprehensive framework to account for BR, because it can explain cases for which other alternative criteria failed. On Matsui's account (1993, pp.211-247), contextual assumptions are formed differently in her relevance-theoretic model and the scenario model. In the scenario model, the perception of the antecedent would generally evoke both bridging implicatures and general assumptions that would normally guarantee the semantic status of the noun phrase. This is termed as primary processing in the scenario model. But Matsui argues that selection of the right referent can only be done as part of the overall interpretation process, i.e. "confirmation of whatever tentative choices have been previously made must wait till the whole interpretation has been constructed." On their account, it can be seen that forward inference is emphasized in the scenario model, while backward inference is adopted by the relevance model. But unfortunately the plausibility of backward inference has never been proved with any convincing data or experiments, and any credible explanations have not been given by Matsui. Consequently, it is required to conduct the research with TAP on the subjects' internal mind to survey their psychological process of interpreting BR.

3. Methodology

TAP is a data elicitation method originating in psychology field. It has been used widely and many valuable achievements have been obtained. This method has been applied in research on reading, writing, listening and translation in foreign language studies. However, it has never been used in exploring BR interpretation. Since the interpretation process is a psychological activity, it is feasible to adopt TAP to study BR. The cognition is abstract by nature, thus difficult to derive with other methods. This thesis endeavors to adopt the TAP method to obtain data related to the cognition process. The interpretation of BR can be analyzed in depth with this method. The experimental procedure is shown in the following section.

3.1 Research Questions

The test is designed to explore the following questions concerning the interpretation process of BR.

(1) What are the factors affecting the interpretation of BR? And which is the dominant factor?

(2) What effect do discourse connectives have on the interpretation of BR?

(3) What are the interpretation strategies in BR interpretation?

3.2 Think Aloud Protocol

As one of the measures of verbal protocol or verbal reports, think aloud means that the subject keeps on talking, i.e. speaking out loud whatever thoughts come to mind, while performing the task at hand. It has been widely used and accepted in research to reveal in detail the process of thinking while performing tasks, to obtain information that is otherwise lost to the investigator (Ericsson, 1979). Reading comprehension, writing and translation, etc. have been chosen as testing grounds for TAP. In the present experiment, the think aloud method is adopted for the subjects to report the concurrent thinking on what is occurring in their minds. Success or failure in this study will provide implications for later empirical studies of BR.

In this experiment, the TAP method is used to explore the process of interpreting bridging reference. It consists of asking people to think aloud while bridging two expressions together. This method has been applied in psychological and educational research not only on cognitive processes but also for knowledge acquisition in the context of building knowledge-based computer systems. In many cases the think aloud method is a unique source of information on cognitive processes. The progressive process of thinking over a problem needs to be known. That involves information on how the answers are arrived at, the logical reasoning process, the difficulties encountered, and how conflicts between referents are resolved. This research method then represents a more direct way to gain an insight into the mechanism of bridging reference interpretation. In order to increase the validity of TAP, we should focus on at least two aspects: decrement of intervention of the experimenter into the process of verbalization, and adoption of a second method as a complement to TAP.

3.3 Retrospective Interview

Although TAP's validity has been widely tested, there are still concerns, particularly those related to the subject's verbalizations. Therefore, in order to obtain more reliable data from the experiment, it is very necessary to introduce a second method-retrospective interview to supplement the TAP method. It is better to make the review with the subject immediately after the think aloud session. In the interview afterwards, subjects are requested to look at their testing paper while listening to the recorded verbalizations. Any unclear verbalization on the tape is to be addressed in the interview. The researcher seeks clarification from the subjects without altering previously collected data on the tape. The interview is also recorded for the accuracy of the experiment.

3.4 A Description of the Experiment

There are many factors to be considered while doing a TAP experiment. Here are some instructions to be followed.

3.4.1 Subjects

In earlier studies using the TAP method, the number of subjects is no more than twenty in order to make the analysis convenient and efficient. Twenty subjects were randomly selected in this research. They are all freshmen from the School of Foreign Studies in China University of Mining and Technology (CUMT). This research is conducted at the end of their freshman year when they have received almost one-year college education. They are at the age of 19 to 20 and with at least 9 years' English learning experience. They are all English majors willing to participate in this experiment. Because five of them cannot provide a useful think aloud protocol in their practice period, they are not invited to take part in the main task. Finally altogether fifteen subjects numbered from S1 to S15 are tested.

3.4.2 Materials

The test materials are 22 sentences in English containing BR with respective questions. The data are mainly extracted from other relevant questionnaires in previous research of BR and some of them are changed a little by the author. The materials contain three types: BR with only one accessible candidate referent (Q3. Mary and John moved into a new house. The living room is very big.); BR with two accessible candidate referents (Q12. He had worked in Guangzhou for 5 years before he worked in Beijing. The bad weather really bothered him.); and BR with discourse connectives (Q15. Xiao Zhang prefers apples to watermelons, although the fruit has a lot of water.)

3.4.3 Setting

The first thing to make a subject think aloud is to make sure that the subject feels at ease. The experiment is carried out in a small language lab, with only the researcher and the subject. The door and the windows in the room are all closed. By doing this, the subject is provided with a quiet and comfortable environment to ensure that no other things will disrupt the experiment.

3.4.4 Procedures

Subjects were instructed to speak either Chinese or English as they liked. What they said was tape-recorded and used as data for the later analysis of the interpretation process. The subjects were also required to provide reasons for their choices during the test. They just needed to tick their choices on the testing paper and could write or make any remarks on it. The experimenter just sat quietly in the classroom without any interruption except making some attention by saying "keep talking" when the subject stopped talking for more than 5 seconds. In order to guarantee scientific data could be elicited from the experiment, a "one subject one time" measure was adopted, which meant that the subjects were required to do the given material one by one, and the researcher recorded their verbalizations accordingly. The testing procedures were as follows:

(1) The subjects were given instruction of the experiment. At first, it was explained to them what TAP was and the experimenter did the think aloud as a model. They were informed that the main purpose of this experiment had no effect on their course score, just for the research of psychological activities while solving a problem on the test. Therefore they should faithfully verbalize all the thoughts coming into consciousness in the process of working out the questions. Secondly, dictionaries were not allowed to be used if they encountered new words in the test, but they were permitted to say "I do not know this word" or something like that. Thirdly, once the experiment began, no communication with the researcher was permitted. Finally, No time limit was imposed, with the purpose of guaranteeing that the subjects verbalize as much information as possible about their inner world. They should write down their choices on the test paper and they could speak in Chinese, but English was also allowed to be spoken if they thought it easier to verbalize their thinking.

(2) Warm-up training. This phase is particularly important for getting a useful think aloud protocol. A practice task with eight sentences similar to the main task was given to the subject training the think aloud in the light of the instruction before they began the test. The tips here were the same as in the main test. The practice not only let the subject familiarize with the think aloud, but gave the researcher a chance to train the subject to reveal the thinking rather than interpret it as well. The experimenter could correct the subject and explain again what was required to do and not to do. It usually took a few minutes to a quarter of an hour to talk automatically. If a subject still found it hard to verbalize his thoughts after a period of time, it was better to stop him since he was likely to end up with ineffective protocols.

(3) After the subject doing some TAP practices and could think aloud, he/she was given the testing material with twenty-two sentences printed on the paper. Pens were available. Subjects began verbalizing, and they were able to draw some marks or write down some notes on the paper as usual. Once they began, the researcher recorded their verbalizations. In the whole process, the researcher never interrupted their verbalizing except saying "keep talking" when subjects stopped talking for more than 5 seconds.

(4) Afterwards, the retrospective interview was carried out. The subject was requested to listen to his/her protocol with the experimenter and answer some question if there were uncertainties on the tape. A change of the original answer in the protocol was not accepted and only explanations to it were allowed. Volunteer comments on the protocol were also welcomed if the subject had a will to do this. This session was recorded as well to be fully transcribed later on.

(5) After the subject had finished the whole experiment, the researcher stopped recording and took back their test materials. Sincere thanks were given to them for their cooperation and effort. After the experiment, the utterance recorded (including their pauses) would be completely transcribed into text-based data in the computer.

3.5 Data Coding

Two types of data are obtained through the entire experiment. The first one is the data collected from the recordings of the subjects in the test, including the think aloud and retrospective interview, which will be transcribed into texts on the computer. Each subject's protocol will be given the serial number with S1, S2…and S15. The interview is numbered as the same to the think aloud protocol.

The second one is the answer of the fifteen subjects on the test paper. Their answers are not evaluated as good or not good, for they are only studied as supplementary to the think aloud protocol for getting more data (remarks made on the test). Their answers are also given the numbers with Q1, Q2…and Q22.

Once the subject's automatic process is disrupted, he/she will be forced to stop before the problem. According to the previous research, there are some indicators to show the subject has encountered some problems, and these indicators make great convenience for the author to study the subjects' psychological activities.

With regard to Löscher's research, Krings (1986) puts forward 11 problem indicators on the basis of his TAP experiment. In the following part, a few problem indicators adopted in this experiment are presented, together with some examples obtained from this TAP experiment to illustrate them further.

1. The subject's explicit statement of problems

When the subject comes across an understanding problem, he/she speaks out the problem consciously or unconsciously. The explicit statement of a problem reflects that some problem breaks off the understanding.

e.g. Q9—S15 says: "我不知道 dialect 的意思" (I do not know dialect.)

2. The underlining of unclear points

Sometimes when a problem occurs, the subject will emphasize it consciously or unconsciously together with some markers, such as underlining or encircling the unclear point.

e.g. Q5—S12 underlines the word "grocery store".

3. The semantic analysis of text items

When a problem occurs, the subject analyzes it semantically. The semantic analysis manifests that something is troublesome to deal with.

e.g.Q6—S3 analyses: "nevertheless, in spite of, however".

4. Hesitation phenomenon in the search for a potential replacement

When the automatic process is broken off, the subject hesitates for a short period, and sometimes he/she murmurs something or sometimes just keeps silent for a short period.

e.g. Q7—S10: "根据常识可判断出…" ("It can be inferred from general knowledge that…") (Five seconds' hesitation)

5. The assessment of the quality of the chosen answer

Although one of the competing replacements is affirmed as a temporary solution, the subject makes comment on the choice with his/her assessment system. Such assessment behavior is also an indicator of difficulty.

e.g. Q8—Having worked out a solution, S6 says "但常识上是说不过去的，所以还是选 watermelon." (But it is inconsistent with the general knowledge, so it should be watermelon.)

6. Paralinguistic or non-linguistic features

A few paralinguistic features, such as a change of pitch, volume, speed and repetition are all problem indicators.

e. g. Q5-S14 reads "commodities" at a slower speed.

These are six of the problem indicators put forward by Krings on the basis of his TAP experiment. They contribute a lot to the TAP process research and provide very useful guidelines for subsequent researchers to probe into the problem-solving process (X.L.Yang, 2009). According to these six problem indicators, the analysis of TAP data becomes much easier.

3.6 Transcription

Think aloud protocol should be completely typed out without deletion or addition, that is, everything said during the test session should be typed out. A difficult problem is transcribing a subject's "humming and hawing" as most people utter things like "Er, I er…". The suggestion is typing them out as verbatim as possible (Someren, Barnard & Sandberg, 1994). Recognizable pauses between two words are noted down by special marks, conventionally by dots, for example: "I think the answer is … A". A long silence could be transcribed as "silence" or with more dots (adopted in this thesis), say, more than five seconds. Punctuation is another point to be considered here. A stop or comma could be used if a complete and grammatically correct sentence is uttered. However, lots of sentences in the think aloud protocol are not organized well. It is better not to use any punctuation at all, and to write down each new sentence in a new line. Research on language production and language understanding shows that in speech the boundaries of phrases are usually marked by pauses (Ericsson & Simon, 1993). Therefore, a comma is used after every short pause in the protocol. Question marks should be avoided because it is not easy to be sure whether some sentence was meant to be a question or a positive remark. Interpretation of the verbal recordings should be avoided if something appears unclear on the tape. The main principle to bear in mind is that the transcription should differ as little as possible from the real protocol recorded on the tape.

4. Results and Discussion

Before the analysis of the experiment is dealt with, some relevant notions should be made clear. RT is so far the most explanatory framework to account for BR, so it will be also adopted in this thesis to analyze the research data on the one hand, and verify its explanatory power on the other. Results from this experiment are discussed and factors affecting BR interpretation will be analyzed with both TAP and retrospective interview data.

4.1 Experimental Results and Analysis

There is actually an underlying structure in the thought process. Think aloud protocol gives information about the subject's reasoning that cannot be obtained merely through the answers on the test. It also provides data about strategies and the knowledge that the subject uses to solve a problem. When different subjects make the same choice, it cannot just be assumed that their techniques and strategies are unified, for they may arrive at the same answer in various ways. More reliable data can be gained with TAP than that with questionnaires, because sometimes the subject utters one answer but ticks the other on the paper by mistake. In our experiment, it did happen that the subject uttered A or said something corresponding to A, while ticked B on the test paper. Such a mistake can be detected with the TAP method for the researcher to obtain more reliable data.

Since inferences are the products of individual minds, they can be generated in highly idiosyncratic ways. However, people are often able to communicate successfully, it seems reasonable to assume that communicators do not always generate inferences randomly, but may do so in a principled way (He, 2006). It is considered that they are guided by Sperber & Wilson's criterion of consistency with the principle of relevance. Sperber & Wilson hold that human cognition and communication are relevance-oriented. Relevance theory provides a guide to the principles underlying the inference processes involved in communication: they are geared to the search for relevance (1986). That is, People look for relevant information in social interactions and every utterance creates an expectation of relevance in the hearer's mind. The hearer makes an effective cognitive processing and gives up that requires more processing effort. This is true in reading comprehension that the reader regards the discourse as relevant and does not stop inferring until he finds some cognitive effect. For example, all subjects provide the same answer to each of Q3, Q16, and Q19 in the test. A justifiable explanation is that the subjects are willing to relate the bridging NP to the concept that is just mentioned in the previous discourse, because the activated concept in the preceding utterance is most likely to yield cognitive effects connecting with the concept that is represented by the bridging NP. It is consistent with RT that the subject reaches a cognitive effect with least effort.

There is ample evidence that several different factors affect the degree of accessibility of discourse entities. However, at this stage, no fully comprehensive account is available of how these different factors interact. Perhaps the following generalization offered by Asher & Wada (1991) is the best guess: salience is the result of adding up the various preferences so that each adds something to the overall salience ranking, but none alone is decisive (as cited in Matsui, 2000, p.72).

Most of the subjects' answers are unified, but differences among their answers are to be noticed particularly. All the subjects' answers to the 22 questions in the test were the same except 8 ones shown in Appendix Ⅴ. It showed that people reached an agreement on interpreting bridging reference in most cases. Even in the 8 questions, most people held the same viewpoint despite the differences, i.e. more than half of the subjects chose the same answer in each question. However, differences among them should be discussed here.

Although most people may attribute an explanation to one's preference, S7 thought in a contrary pattern that the second sentence was an explanation to one's dislike of something, i.e. the speaker disliked apples because they had a lot of water. In Q8, according to the general knowledge about "watermelon" and "apple", one should choose "watermelon" as the fruit that has a lot of water compared to "apple". The subjects who chose "apple" as the answer attributed the second sentence as an explanation to one's preference in the first sentence. It again proved that a contextual assumption with cause-effect relation was more accessible in interpreting BR, and encyclopedic information was not always taken as an effective criterion to test the appropriateness of one candidate referent. Sometimes subjects just made a decision with least effort required and stopped inferring once a cognitive effect was achieved, which is consistent with the relevance-theoretic comprehension procedure, i.e. follow a path of least effort in computing cognitive effects:

(a)Consider interpretive hypothesis (disambiguations, reference assignments, contextual assumptions, implicatures, etc.) in order of accessibility; (b) Stop when the expected level of relevance is reached.

If there was an unknown word to the subject, the word usually did not hinder the subject from making a choice. In the following examples, S3 did not know the word "Edinburgh" in Q11and Q18. However, she gave such think aloud protocols:

Q11: 和伦敦相比起来我更喜欢 E 这个地方，我喜欢有雪的冬天，所以应该是 E 这个地方有有雪的冬天

(I prefer the place E to London, and I like the snowy winter. So the snowy winter should be in place E.)

Q18: 我更喜欢 E 这个地方和伦敦比起来，而且我喜欢有雪的冬天，应该是喜欢 E 这个地方的这个冬天，因为它这有雪

(I prefer the place E to London. Moreover I like the snowy winter. It should be the winter in E that is preferred, because there is snow.)

4.2 Factors Affecting Bridging Reference Interpretation

Two crucial factors, accessibility of discourse entity and accessibility of contextual assumptions affecting bridging reference interpretation are discussed in Matsui's research. Discourse entity refers to a candidate referent mentioned in the same discourse. A great number of past researches try to account for how candidate referents are formed and tested. Some other factors such as syntactic position, order of mention are explored in Matsui's and Mo Aiping's studies as well. In this thesis, some affecting factors appearing in the experiment will be dealt with in the following part.

Individual differences in preferred interpretation could be explained in terms of different accessibility of contextual assumptions and varying degrees of sophistication with which the expectation of relevance is formulated by the hearer (Matsui, 2000, p.200). The criterion of consistency with the principle of relevance can explain the subjects' preferences when there are two accessible candidate referents in the preceding discourse. Optimal relevance proposes such a comprehension strategy as: at every stage in the interpretation process, the hearer should follow a path of least effort, producing cognitive effects in order of accessibility until he has at least enough to make the utterance worth his attention. All other means of interpretation should be disallowed (Matsui, 2000). Factors affecting BR interpretation in this test are given in the following table1.

From Table 1, it can be clearly seen that cause-effect relation affects bridging reference interpretation greatly. In questions 5, 7, 9 and 11, all subjects make their choices based on cause-effect relation between the preceding and subsequent discourses. It shows that contextual assumption with cause-effect relation is the most accessible in interpreting BR with two candidate referents.

Moreover, the encyclopedic information will be taken into account if subjects think of the information while interpreting the utterance, otherwise not. This can be seen from Q5 and Q11, there are respectively 20 percent and 7 percent subjects make use of encyclopedic information while making choices. In addition, in Q13, 47 percent of subjects use encyclopedic information that “a new house has a big living room” to make a choice between two candidate referents “a new house” and “their old apartment”. Encyclopedic information or background knowledge may play a decisive role in choosing a referent in some cases. This can only be inferred from TAP. Taking Q12 for example, S4’s think aloud protocol of it was as follows:

他这个人是在广东首先工作了 5 年，在他在北京工作之前，它就问是哪个地方的天， 天气比较坏，哪个地方的坏天气比较烦扰他，呃，因为感觉来说，就常识来说北京的天气不会像广东那么好，夏天很热冬天很冷，所以应该是北京的

(The person firstly works in Guangdong for 5 years before he works in Beijing. It asks where the bad weather is. Where does the bad weather bother him? Er, according to my feeling, i.e. my common sense, the weather in Beijing is not good as that in Guangdong. The weather in Beijing is very hot in summer while very cold in winter. So it is in Beijing.)

From the above protocol, it can be known that S4 just chose Beijing as the referent according to her knowledge of the weather in the two places. Here the subject’s encyclopedic information played a decisive role without other factors being considered.

The transcribed data suggest that a subject may adopt one or several factors in interpreting BR, which explains why the total percent of affecting factors in some question is more than 100 percent. It can be seen from the above table that temporal sequence, syntactic position or encyclopedic information are not considered in all the sentences. In Q13, 13 percent who attribute to temporal sequence think that “Mary and John find the living room in the new house is big after they move into it.” 20 percent of them think Q13 emphasizes on the new house according to syntactic position. In Q8, 27 percent subjects make use of syntactic position on deciding the referent. They choose watermelon as the referent because “the fruit” is closer to “watermelon” in the sentence “Xiao Zhang prefers apples to watermelons. The fruit has a lot of water.”

In the think aloud protocol, no contextual assumptions containing contrast relation was adopted as a means of interpreting BR, which is contrary to previous researches based on questionnaires. In earlier experiments, it was simply inferred from the subject’s answer that contrast relation was taken into consideration during the interpretation, which was proved false with the TAP method in this experiment.

4.2.1 Syntactic Factors

Some central studies of factors affecting accessibility of discourse entities are classified into the following categories (as cited in Matsui, 2000, p.53):

(a) Order of mention (Mc Whinney, 1977; Brennan, Friedman & Pollard, 1987; Gernsbacher, 1990; Gernsbacher & Hargreaves, 1988; Gordon, Grosz & Gilliom, 1993)

(b) Syntactic position (Sidner, 1983a, 1983b; Erku & Gundel, 1987; Matthews & Chodorow, 1988; McKoon, Ratcliff, Ward & Sproat, 1993)

(c) Recency of mention (Caplan, 1972; Clark & Sengul, 1979; Chang, 1980; von Eckhardt & Potter, 1985; Gernsbacher, Hargreaves & Beeman, 1989)

(d) Semantics of main verb (Garvey & Caramazza 1974; Garvey, Caramazza & Yates, 1976)

(e) Parallel function & choice of conjunction (Sheldon, 1974; Grober, Beardsley & Caramazza, 1978; Ehrlich, 1980; Ehrlich & Rayner, 1983)

(f) Manner of mention (Garrod & Sanford, 1988; Sanford, Moar & Garrod, 1988)

(g) Overall salience (Asher & Wada, 1991)

Only factors appearing in this experiment are discussed here. In Q1, 13 percent of them chose apple as the referent. Since the discourse connective “because” constrains the interpretation of the bridging reference, there was definitely just one accessible candidate referent in the sentence. Moreover, the answer “apple” was inconsistent with the encyclopedic information that “watermelons have more water than apples”. One of the two subjects who chose B made a choice according to syntactic position of the sentence. She thought that “apple” was closer to “the fruit” and thus was chosen as the answer, despite the fact that “watermelon has more water than apple” was available to her. Twenty percent chose “Guangzhou” in Q6 and all of them made the choice based on syntactic position. They chose the candidate that was the focus of the sentence as the referent despite knowing the connective “nevertheless” or not.

In the experiment, S3 makes use of the position between the bridging NP and its antecedent to give an answer. Part of the think aloud protocols of two questions are illustrated below.

Q8 Xiao Zhang prefers apples to watermelons. The fruit has a lot of water.

Think aloud protocol: …而且 "the fruit" 离 "watermelon" 是最近的…;

(…Moreover, "the fruit" is closest to "watermelon"…)

Q17 Mr. Li ran from the classroom to the playground. The students were too noisy.

Think aloud protocol: … "the children"紧接在 "playground" 后面…

(…"The children" is next to "playground"…)

The following is another example to explain this.

E.g. Q13 Mary and John moved into a new house from their old apartment. The living room is very big.

Where is the living room?

A. in the old apartment B. in the new house

All of the subjects make the same choice B as their answer. Although there are two candidates for "the living room", namely, a new house and their old apartment, most subjects claim that the living room is intuitively interpreted as the living room in a new house. Most subjects' think aloud protocol is as follows: 强调的是他们搬进了新家；后面讲的是新家的情况；而且一般新房肯定比旧房的起居室大；人们都是从不好的地方搬到好的地方。(It emphasizes on moving into a new house. It is about the new house in the second sentence. Generally, the living room is bigger in a new house than that in an old apartment. People usually move from somewhere not so good to a good place.)

The explanation for their preference in interpretation goes as follows. Following Sidner, it suggests that: (a) an anaphoric expression will be interpreted as referring to the topic of the sentence (i.e. the item that is currently "in focus"); and (b) the topic for the following discourse is typically introduced in the verb phrase of the main clause (in direct object position, if there is one) (as cited in Matsui, 2000, p.63). Therefore, after hearing the first sentence in Q13, the hearer should expect that the next sentence will be about a new house.

4.2.2 Pragmatic Factor

When the hearer encounters the bridging NP, he will automatically relate it to the concept which is activated by the previous discourse. This is because the activated concept is most possible to yield cognitive effects with the concept the bridging NP represents. This gives an answer to Blakemore's question in the following example.

(8) Mark bought a fridge. The door fell off three weeks later.

"Why is the correct bridge the one that links the door to the door of the fridge that Nigel bought, but not, say a bridge linking to the door of his house?" (Blakemore, 1992, p.315)

There are some more examples in the test.

Q16: The old couple went out for a walk in the early morning. The park was beautiful and the air was fresh.

Q19: Mary bought a lot of things for Christmas Day. The tree is lovely.

All the subjects in our experiment choose the park as where the old couple went for a walk, and the tree as one thing belongs to a lot of things Mary bought. Sperber & Wilson propose that relevance is given in verbal communication. There exists no doubt in such cases, since they are guided in their mind by relevance between the two sentences.

However, in all the above examples, there is only one candidate referent. When there are two accessible referents, the interpretation must depend on the selection of contextual assumption.

Linguists, philosophers and researchers in artificial intelligence all assert that contextual or background assumptions play a vital part in interpreting BR. It is the key point in selecting a referent most accessible to the subject, i.e. what assumption is firstly activated in one's mind. There are many types of contextual interpretations, while some represented by coherence relations, or expectations of relevance are going to be emphasized here. This can be explained with the example below.

(9) Miss Wang prefers Beijing to Shanghai. She does not like the weather there.

There are two possible contextual assumptions, (a) one likes a place because she likes the weather there, and (b) one likes a place although she does not like the weather there. They correspond to two types of coherence relations or expectations of relevance, cause-effect relation and contrast relation.

However, in the TAP data, contrast relation never appears even when a cause-effect relation could not apply, and the subject just stops referring once a cognitive effect is achieved. That is, contextual assumptions with contrast relation are not accessible at any time. Some experimental results are shown here.

Q9 Zhang Ming left Guangdong for Sichuan. He does not like the dialect.

In this sentence, there are actually two accessible candidate referents with two respective interpretations: a. Zhang Ming left Guangdong for Sichuan because he does not like the dialect in Guangdong; b. Zhang Ming left Guangdong for Sichuan, but he does not like the dialect in Sichuan. In the test, all subjects choose the first assumption by putting the second sentence as an explanation to the first one: one left a place because he did not like something there. Their choice just indicates that the cause-effect relation is more accessible for them to achieve a cognitive effect. Although assumption b is much harder to produce, it is acceptable in communication. Some of their thinking processes are:

S1: Zhang Ming 离开了广东去四川，他不喜欢 dialect，哦他不喜欢广东的方言，他既然离开广东去四川就应该是不喜欢广东的吧，要不他为什么离开呢

(Zhang Ming left Guangdong for Sichuan. He did not like the dialect. Oh, he did not like the dialect in Guangdong. Since he left Guangdong for Sichuan, it should be the dialect in Guangdong that he did not like. Otherwise, why did he leave?)

S2: Zhang Ming 从广东离开到了四川，因为他不喜欢那个方言，所以 Zhang Ming 应该是因为广东的方言不好，所以他才想去四川的，他讨厌的是广东的方言

(Zhang Ming left Guangdong for Sichuan, because he did not like the dialect. It is because the dialect in Guangdong is not good, he went to Sichuan. He disliked the dialect in Guangdong.)

S3: 他离开了广东去四川，因为他不喜欢那的 dialect，那就说明他不喜欢广东的 dialect，因为他离开广东了嘛

(He left Guangdong for Sichuan, because he disliked the dialect. This suggests that he disliked the dialect in Guangdong, because he left Guangdong.)

In Q9, there are two equally accessible antecedents, since “the dialect” can be of either Guangdong or Sichuan. However, in the following Q8, there are two unequally accessible antecedents wherein the subjects still interpret it in this way: one likes something because of some positive property in it.

Q8: Xiao Zhang prefers apples to watermelons. The fruit has a lot of water.

Some subjects’ think aloud protocols are:

S2: 苹果跟西瓜相比，Xiao Zhang 更喜欢苹果，后边又说这种水果含有很多水分，他既然喜欢苹果多一点，很显然苹果的水分多一点，所以他才喜欢

(Comparing apples to watermelons, Xiao Zhang prefers apples. It says the fruit has a lot of water, and he prefers apples, so it is obvious that apples have more water, which is why he prefers apples.)

S7: 小张喜欢苹果，后面说到这个水果有很多水分，所以我们可以推测水分多可能是小张喜欢苹果的原因，所以我觉得苹果有更多水分

(Xiao Zhang prefers apples, and it is said later the fruit has a lot of water, so we can infer that a lot of water is the reason for Xiao Zhang prefers apples. I think apples have more water.)

S11: 第一句说明小张喜欢苹果胜过喜欢西瓜，然后第二句说 the fruit has a lot of water，在我看来写这句话前后文应该是有联系的，如果没联系这句话纯粹没有用，这句我更倾向把第二句看成对第一句的补充说明，说明他喜欢的理由，所以我选 B

(The first sentence says Xiao Zhang prefers apples to watermelons, and the second sentence says the fruit has a lot of water. In my opinion, the two sentences are relevant, if not the second sentence is useless. I would like to regard the second sentence as an explanation to the first sentence. It explains why he prefers apples. So I choose B.)

The above three subjects make their choices according to the cause-effect relation between the two sentences. That is, the reason for “Xiao Zhang prefers apples to watermelons” is apples have a lot of water. It is known to all that watermelons have more water than apples, and their interview data show that all the three subjects have this knowledge. But they just choose apples as their answer because the contextual assumption with cause-effect relation is more accessible to them.

Even within the cause-effect coherence relation between two sentences; there still exists some difference in accessibility of various assumptions. Q8 is such a case in which the explanation to one’s preference is more accessible than that to the dislike. RT points out that human stops inferring once a cognitive effect is achieved. And the subject chooses the referent that requires the least effort while interpreting BR. In Q8, some subjects choose "watermelons" based on their encyclopedic information rather than the contrast relation or an explanation to one's dislike. Those subjects who choose "apples" just attribute the second sentence as an explanation to one's preference, and think that the speaker intends to communicate such information in this context. They make such an interpretation with least effort since an explanation to one's preference is more accessible to them. The following questions are used as examples to illustrate this.

Q7 I prefer Edinburgh to London. I hate the snowy winters.

Q11 I prefer Edinburgh to London. I love the snowy winters.

Q22 I prefer London to Edinburgh. I hate the snowy winters.

When such sentences are encountered, several assumptions will be formed, the most accessible is (10) someone prefers A to B for certain positive reasons. The hearer expects some positive explanations to the answer A. If there is indeed an explanation in the second sentence, coherence exists in this discourse. However, if the second sentence does not give a positive reason, it can be seen as an explanation of why the speaker does not like B. The contextual assumption in this case is as follows: (11) someone can prefer A to B because of some undesirable properties of B or some undesirable consequences caused by B. Such a contextual assumption is harder to make than (10). In relevance theory, if a cognitive effect can be achieved without so much effort, the hearer should choose it. Q11 is such an example, while Q22 requires more effort to reach a cognitive effect for (11) is not accessed as easily as (10). Can this suggest that Q22 is harder to be accepted than Q11? For Q22, the interpretation needs more effort which is worthy in one of the following two situations: a. the speaker does not have the prediction of more effort needed b. the speaker does not have an effective way to avoid this situation. In any case, the interpretation based on assumption (11) is in accordance with relevance theory. In the experiment, all the subjects make such an assumption to produce a final interpretation: the speaker prefers London to Edinburgh because she hates the snowy winters in Edinburgh, without regarding the style as inappropriate. It suggests that unacceptability is caused by extra and unnecessary effort.

When there are two candidate referents in the previous discourse, the subjects often choose the referent by forming a contextual assumption with cause-effect relation. It is proved that the accessibility of expectation of relevance is different between the cause-effect coherence relation and the contrast coherence relation in the test. Subjects are not willing to make contextual assumptions with contrast relation compared to that with cause-effect relation. It indicates that the accessibility of contextual assumption containing cause-effect relation is higher than that containing contrast relation. This point will be illustrated with the experiment results in the following part.

The interpretation of Q7 is more complicated. It can be understood the same way as in Q22: the speaker prefers Edinburgh to London because she hates the snowy winters in London. In fact, the following interpretation is more feasible: the speaker prefers Edinburgh to London although she hates the snowy winters in Edinburgh. Such an explanation first requires the contextual assumption below: (12) someone can prefer A to B despite some undesirable properties in A or some undesirable consequences caused by A. All the subjects did not choose (12), because it is less accessible than (11). Therefore (12) is never considered. The subjects usually find a more accessible assumption, such as (11), and stop searching further. Although some subjects felt such an interpretation unsatisfactory, they did not go on searching. The reason is their utterance interpretation is guided by relevance theory. Once an explanation that conforms to relevance theory is found, the search is finished. In Q7, the speaker mistakenly predicts that the hearer can easily obtain contextual assumption (12) and approach the interpretation: I prefer Edinburgh to London, although I hate the snowy winters in Edinburgh. If the speaker really intends to express this interpretation, she should add the discourse connective in the discourse.

RT claims that characteristic misunderstandings will occur if the hearer simply chooses the interpretation which is optimally relevant to him, without considering whether it is the one the speaker could plausibly have foreseen. However, it is left to the communicator to make correct assumptions about the codes and contextual information that will be accessible to the audience in the comprehension process. It is also the responsibility of the speaker to avoid misunderstandings, so that the hearer just needs to go ahead and use whatever code and contextual information most accessible to him (Meng, 2006).

If the speaker mistakenly formulates an utterance in a way that puts the hearer to gratuitous processing effort, either because the resulting interpretation yields no cognitive effect at all, or because the utterance provides more than one equally accessible and plausible interpretation, with no way of choosing between them, the result should be either communication failure or a judgment of stylistic infelicity. In the experiment, for example, in Q10, Q12 and Q21, some subjects may not be able to decide on their choices between two equally accessible candidate referents, thus it may be alternatively explained as stylistic infelicity.

4.3 Discourse Connectives

Discourse markers or discourse connectives such as however, moreover, nevertheless, because, etc. are constitutes that constrain the interpretation of BR in this thesis. In relevance theoretic framework, discourse connectives are taken as guiding the search for relevance in constraining the selection of contextual assumptions. Discourse connectives can make propositions clearer, more coherent to convey communicative intentions. The connectives mentioned above indicate diverse relations between sentences. Whether the discourse connectives can constrain BR interpretation or not in this experiment can be seen from the data in Table 2.

As bridging reference is inferential in nature, the relationship between the bridging NP and the antecedent is not settled beforehand. In this experiment, there are totally nine sentences containing a discourse connective in it. Answers to four of these sentences are unified, and more than half of the subjects chose the same answer in each of the other sentences. Only in Q10 and Q21, there was respectively one subject thinking two referents were available in them. In Q10, the discourse connective could not completely constrain the interpretation of it as shown in S5's protocol. Discourse connectives can complement BR to help the subjects interpret it when there are more than one equally accessible candidate referents in discourses. For example:

Q4: Zhang Ming left Guangdong for Sichuan. However, he does not like the dialect.

In Q4 the connective is added and BR is thus constrained. In this question, all subjects chose Sichuan as the referent for "the dialect". Some subjects' think aloud protocols are illustrated below:

S2: Zhang Ming 从广东来到了四川，但是他不喜欢那的方言，中间用了 however 应该是转折关系，所以是四川的方言不好

(Zhang Ming left Guangdong for Sichuan, but he disliked the dialect. It should be contrast relation since there is "however" between them. So the dialect in Sichuan is not good.)

S6: 中间用 however 来连接，however 是转折的嘛，他离开那个地方没有他不喜欢的东西，而去的有他不喜欢的东西，即使那地方有他不喜欢的东西，但还是去了

("However" is used to connect them. "However" indicates a contrast relation. There was something he disliked in the place he went for rather than the place he left. Although there was something he disliked, he still went to that place.)

However, there are some expressions that can not be constrained by the discourse connective. It was noticed that in interpreting Q10, Q12 and Q21, there was respectively one subject who could not make a choice between the two answers. S5 thought both A and B were possible in Q10 and Q12, which would obviously take her more effort to produce the two possibilities. Her think aloud protocol and interview of Q10 were as follows:

Q10: Mr. Li ran from the classroom to the playground, because the students were too noisy.

Think aloud protocol:

他作为一个老师他本来在外面，但是因为他的学生在教室太吵了，所以他跑进了教室，啊，不对，错了错了，他从教室跑到操场因为学生太吵了，因为学生太吵了应该是他跑过去的原因，但是是哪的学生吵并没有说，所以我觉得 A B 两个可能都有

(As a teacher, he was outside at first. His students were too noisy in the classroom, so he ran into the classroom. Ah, no, no. He ran from the classroom to the playground because the students were too noisy. The students were too noisy is why he ran over. But it did not mention where the noisy students were. So I think both A and B are possible.)

Retrospective interview:

R: 你指的两个可能分别是什么？

S: 可能因为操场学生吵，然后，他，他想知道发生了什么事，就从教室跑过去看的，也可能是，因为教室的学生太吵，他受不了了，不过这个可能性较小，但是也有可能的，所以，他跑到操场

(R: What are the two possibilities? S: Maybe the students on the playground were too noisy. Then he wanted to know what happened. So he ran from the classroom to have a look. It also may be the students in the classroom were so noisy that he could not bear it. This is less possible. But it is still possible. So he ran to the playground.)

S8: 李先生从教室跑到操场，因为孩子太吵了，哦，说明原因了嘛，因为（重读）孩子太吵了他才跑过去，所以是操场的孩子更吵闹

(Mr. Li ran from the classroom to the playground, because the students were too noisy. Oh, it gives the reason. Because (stressed) the students were too noisy. So it is the students on the playground were too noisy.)

S9: 他出来的原因就是教室里的学生太吵了，他感觉烦，所以他就出来清静一下，这个 because 就是表原因，就是学生吵就是他出来的原因

(He ran out because the students in the classroom were too noisy. He felt bothered, so he went out for some quiet. "Because" gives the reason. The students were too noisy was why he ran out.)

Although there is a connective "however" in Q10, the subjects' answers are not unified. Even some subjects provided two interpretations in Q10. Here "classroom" and "playground" both make sense as referents with respective interpretations: Mr. Li ran from the classroom to the playground, because the students in the classroom were too noisy; Mr. Li ran from the classroom to the playground, because the students on the playground were too noisy.

There were two reasons for such cases. On the one hand, there indeed existed ambiguity in both Q10 and Q12; on the other hand, the questions were designed not so scientific just for the purpose of comparing the accessibility of different contextual assumptions. S11 provided two explanations to Mr. Li's run in Q21 (Mr. Li ran from the classroom to the playground, even so the students were too noisy.) although he did not understand the phrase "even so" correctly. He gave the two situations: Mr. Li did not stop the students making noise in the classroom and ran to the playground; Mr. Li still ran to the playground although the students there were too noisy.

4.4 Interpretation Strategy

In the previous studies of BR, two interpretation strategies have been put forward, i.e. forward bridging inference and backward bridging inference. The forward inference approach holds that the hearer already entertains a representation of the referent before he meets the bridging NP. While the backward inference approach points out that the hearer does not begin inferring until he encounters the bridging NP. On Sidner's account, it is regarded that the antecedent in the previous discourse activates a scenario, and the inference is forward based on the information activated by the antecedent. But in Matsui's study, the inference is viewed as backward that is based on relevance theory. However, her conclusion is more intuitive rather than empirical. In the thesis, the author agrees with Matsui on this point. Furthermore, evidence collected from TAP is provided to prove it.

From the transcription of TAP, it can be found that all the subjects make inferences after reading the discourse with two sentences, but no one begins inferring at reading the first sentence. It can be concluded that they are guided by relevance theory with the idea that the two sentences are relevant to each other. And they usually regard the latter sentence as an explanation to the first one, which indicates that the subject begins inference after he comes across the bridging NP. The results in this experiment turn out to be consistent with Matsui's viewpoint that can be well illustrated in some examples shown below. More similar data can be got from Appendix Ⅲ of this thesis.

Q4: Zhang Ming left Guangdong for Sichuan. However, he doesn't like the dialect.

S1: 尽管他离开广东去了四川，然而他不喜欢那的方言，尽管他去了四川，但他并不喜欢四川那的方言

(Although he left Guangdong for Sichuan, he disliked the dialect. Although he went to Sichuan, he did not like the dialect in Sichuan.)

Q1: Xiao Zhang prefers watermelons to apples, because the fruit has a lot of water.

S2: 西瓜跟苹果相比，Xiao Zhang 更喜欢西瓜，因为这种水果水分很多，我们知道因为西瓜水分比苹果多，所以他更喜欢西瓜

(Xiao Zhang prefers watermelons to apples, because the fruit has a lot of water. We know that watermelons have more water than apples, so he prefers watermelons.)

Q10: Mr. Li ran from the classroom to the playground, because the students were too noisy.

S4: 有个 because 很显然是因果关系，就知道他为什么从教室到操场上，就是因为教室的孩子太吵闹了，所以是教室的孩子比较吵

("Because" obviously indicates a cause-effect relation. It can be known why he went to the playground from the classroom. It is because the children in the classroom are too noisy. The noisy children are in the classroom.)

In Q4, the antecedents of two provinces may activate a lot of things like weather, food, people, etc., and dialect may be included in them or not. According to the forward inference, the subject begins inference before he encounters "dialect" in this case. Evidence gathered from this experiment contradicts this viewpoint. Actually not any subject adopts the forward inference, due to the fact that it is a waste of effort in some degree.

5. Conclusion

Benefiting from previous researches on BR and TAP, this thesis mainly focuses on BR interpretation process by adopting TAP. Different from other types of reference assignment, BR assignment is more inferential in nature. Encyclopedic knowledge and contextual assumptions play crucial roles in BR interpretation. People may have various interpretations of the same reference assignment as a result of their individual experiences of the world. Like other utterance interpretation, BR interpretation process is considered to follow the same procedure indicated within the relevance theoretical framework. The process is closely related to human cognition that is difficult to be approached. As a scientific method used in reading comprehension, writing and listening, TAP has been proved effective in probing into human cognition. There are some limitations in the present research and any criticisms and suggestions from those who are interested in BR and process-oriented studies are sincerely welcome.

The research on the interpretation of BR is conducted in this thesis with the application of TAP. It provides more empirical evidence on BR interpretation process. The collected data containing both verbal protocols and transcribed texts will shed some light on later empirical studies of BR. It is found that cause-effect relation, syntactic position, temporal sequence and encyclopedic information jointly affect BR interpretation, among which contextual assumption with cause-effect relation is the dominant factor. Moreover, discourse connectives can constrain the interpretation of BR in most cases. Last but not least, only backward inference is adopted by subjects in this experiment which is consistent with Matsui's study. As the subjects in this experiment are all English majors and the test materials are English discourses, this research in some degree reveals English learners' cognition process of interpreting BR in English discourse in particular, and their cognition model in second language acquisition (SLA) in general. From this research, the teacher may recognize how the students interpret BR in English discourse and what problems they encounter. In this way, the teacher can suggest better methods for the students to improve their cognitive ability in English learning.

This project suggests that it is feasible to adopt the TAP method in researching BR interpretation. Human's cognitive activities should be deeply probed with more empirical studies and TAP can be used as an effective method to explore human cognition. RT is so far the most explanatory framework to account for BR, which is supported by empirical data in this thesis. Furthermore, retrospective interview is adopted as a supplement to TAP in the experiment. Some unclear utterances in TAP are examined in the interview afterwards.

In addition to testing the validity of TAP, .r Results from this experiment provide valuable implications for process-oriented studies in the future.

References

Asher, N., & Lasarides, A. (1998). Bridging. *Journal of Semantics, 15,* 83-113. http://dx.doi.org/10.1093/jos/15.1.83

Blakemore, D. (1992). *Understanding utterances.* Oxford: Blackwell.

Clark, H. H. (1977a). Bridging. In P. Wason & P. Johnson-Laird (Ed.), *Thinking: Readings in cognitive science* (pp. 411-420). Cambridge: Cambridge University Press.

Clark, H. H. (1977b). Inference in comprehension. In D. Laberge & S. Samuels (Ed.), *Basic Processes in Reading: Perception and Comprehension* (pp.243-263). Hillsdale, NJ: Erlbaum.

Clark, H. H. & Haviland, S. E. (1977). Comprehension and the given-new contract. In R. Freedle (Ed.), *Discourse comprehension and production* (pp.1-40). Norwood, NJ: Ablex.

Deng Lina. (2007). *On the think aloud protocol and its application to the internal translation process.* Unpublished master's dissertation, Central China Normal University.

Ericsson, K. A., & Simon, H. A. (1979). Thinking-aloud protocols as data: Effects of verbalization. CIP. *Working paper 397.*Carnegie-Mellon University.

Ericsson, K. A., & Simon, H. A. (1993). *Protocol analysis: Verbal reports as data* (revised edition). Cambridge, MA: MIT Press.

Ericsson, K. A. (2002). Protocol analysis and verbal reports on thinking. Retrieved Nov. 1, 2010, from http://www.psy.fsu.edu/faculty/ericsson/ericsson.proto.thnk.html

Haviland, S. E., & Clark, H. H. (1974). What's new? Acquiring new information as a process in comprehension. *Journal of Verbal Learning and Verbal Behavior, 13,* 512-521. http://dx.doi.org/10.1016/S0022-5371(74)80003-4

Holmes, J.S. (1988). *The name and nature of translation studies.* London and New York: Routledge.

Huang Xingguo. (2008). *Bridging reference in English and Chinese verbal communication: A cognitive study.* Unpublished master's dissertation, Guizhou Normal University.

Huo Jing. (2004). *The effects of first language thinking in EFL writing process on EFL composing: A case study based on think-aloud verbal protocol of 20 English majors in China.* Unpublished master's dissertation, Northwest Normal University.

Krings, H. P. (1986). Translation problems and translation strategies of advanced German learners of French (L2). In J. House, & S. Blum-Kulka (Ed.), *Interlingual and intercultural communication: discourse and cognition in translation and second language acquisition studies* (pp. 263-276).Tübingen: Gunter Narr Verlag.

Löscher, W. (1991). *Translation performance, translation process, and translation strategies: A psychological investigation.*Tübingen: Gunter Narr Verlag.

Matsui, T. (1993b). Assessing a scenario-based account of bridging reference assignment. *UCL working papers in linguistics, 5,* 211-247.

Matsui, T. (2000). *Bridging and relevance.* Amsterdam/Philadelphia: John Benjamin's Publishing Company.

McKoon, G., & Ratcliff, R. (1981). The comprehension process and memory structures involved in instrumental inference. *Journal of Verbal Learning and Verbal Behavi*or, 20, 671-682. http://dx.doi.org/10.1016/S0022-5371(81)90238-3

Meng Fanli. (2006). *Relevance-theoretic interpretation of bridging reference in Chinese discourse.* Unpublished master's dissertation, National University of Defense Technology.

Mo Aiping. (2003). *Bridging reference in Chinese discourse: A pragmatic approach.* Unpublished doctoral dissertation, Guangdong University of Foreign Studies.

Noveck, I. A., & Sperber, D. (2004). *Experimental pragmatics.* N.Y.: Palgrave Macmillan. http://dx.doi.org/10.1057/9780230524125

Ryohei Sasano, & Ryohei Sasano (2007). Improving Conference Resolution Using Bridging Reference Resolution and Automatically Acquired Synonyms. *Anaphora: Analysis, Algorithms and Applications, 6th Discourse Anaphora and Anaphor Resolution Colloquium, DAARC 2007, Lagos, Portugal, March 29-30, 2007. Selected Papers.* Springer Berlin Heidelberg. 125-136

Sanford, A. & Garrod, S. (1981). *Understanding written language: Exploration in comprehension beyond the sentence.* Chichester: John Wiley.

Sidner, C. L. (1983). Focusing and discourse. *Discourse processes,* (6), 107-130. http://dx.doi.org/10.1080/01638538309544558

Singer, M. (1994). Discourse inference processes. In Gernsbacher (Ed.), *Handbook of psycholinguistics* (pp.479-515). Academic Press.

Sperber, D. & Wilson, D. (1995). *Relevance: Communication and cognition.* Oxford: Blackwell.

van Someren, M. W., Barnard,Y. F. & Sandberg J. A.C. (1994). *The think aloud method: A practical guide to modeling cognitive processes.* London: Academic Press.

Wilson, D. & Matsui, T. (1998). Recent approaches to bridging: truth, coherence, relevance. *UCL working papers in linguistics,* 10.

Yang Xiaoli. (2009). *A study of translation process in handling lexical gaps with the application of TAPs method.* Unpublished master's dissertation, Chongqing University.

Yang Chang. (2008). *Bridging reference and discourse coherence.* Unpublished master's dissertation, Southwest University.

Ye Huijun. (2005). *Cognitive inference in bridging of English and Chinese: A contrastive study.* Unpublished master's dissertation, Hebei University.

Zhou Yali. (2006). *A tentative study on translation strategies in translation process: investigation based on think aloud protocols of twenty translation majors in China.* Unpublished master's dissertation, Northwest Normal University.

Table 1. Comparison of factors affecting BR with two candidate referents

Type / No.	Cause-effect relation (%)	Temporal sequence (%)	Syntactic position (%)	Encyclopedic information(%)
5	100	0	0	20
7	100	0	0	0
8	53	0	27	47
9	100	0	0	0
11	100	0	0	7
12	80	13	13	13
13	33	13	20	47
17	73	20	13	7
20	93	0	0	20

Table 2. Connective constraint on interpreting BR

Question / Answer	1 (%)	2 (%)	4 (%)	6 (%)	10 (%)	14 (%)	15 (%)	18 (%)	21 (%)
A	87	100	0	80	84	100	67	100	27
B	13	0	100	20	7	0	33	0	66
A or B	0	0	0	0	7	0	0	0	7