

The Application of Semantic Priming in Lexical Ambiguity and Bridging Reference

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The Application of Semantic Priming in Lexical Ambiguity and Bridging Reference

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Master of English Linguistics

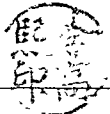
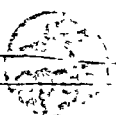

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ABSTRACT

The Application of Semantic Priming in Lexical Ambiguity and Bridging

Reference

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Semantic priming is a robust tool that can be useful in linguistics research. This paper will introduce the concept, usage, and theory behind the phenomenon known as semantic priming. What semantic priming is, how the current theories explain it, and how priming is used for research in Linguistics is explained. Two demonstrations are also presented showing application of semantic priming in research. The first demonstration, an association test for lexical ambiguity, applies the theory behind semantic priming. The results give support to only one of the three current theories of ambiguity resolution. The second demonstration uses the semantic priming paradigm as a model of how bridging reference is made. This model explains the flexibility people have in choosing antecedents for referents encountered in normal speech.

I. Introduction

Given a machine whose function is not understood, it is a simple thing to take it apart to understand its function. Machines are easy to reverse engineer. The cover plates are simply taken off and the movement of the parts can be observed. In linguistics, the processes of the mind that are responsible for language need to be discovered. In this field, one cannot simply get a hacksaw and take someone's head apart. Even if this were done, nothing vaguely resembling what is thought of as language would be found. Language is almost ethereal in its quality.

How are the mechanics behind the theories about language discovered? In the field of Mathematics, there are various tools one can use to generate proof-tools like the squeeze theorem, identity, and inference: A implies B, and B implies C, so A implies C. Even though Linguistics will use logic and deduction like this, it still seems to be lacking in the area of some hard-core tools for generating proof and instead relies on native speaker's intuition, modern usage, and statistics to promote their theories. A nice, simple hammer-like tool, which produces quantifiable results, is necessary. Fortunately, a tool like this does exist, and it can be used to open a person's skull and trace what they are thinking. This tool is semantic priming.

In this paper, what priming is and how it works will be explained. Two examples of its use in research will also be presented. The first research example is on determining the correct theory used in ambiguity resolution through a simple word association experiment. The second research example presents semantic priming as a model for what is happening in bridging reference.

What Is Priming?

Semantic priming is a common process of the mind and shows up whenever language is used. However, as it is so common, it tends to be overlooked. Mistakes in processing, on the other hand, tend to be noticed more readily. To introduce the concept of semantic priming, here is a mistake that arises because of it:

- (1) *What color is a cloud?* _____
 What color is ordinary paper? _____
 What is a fine expensive cloth from China? _____
 What does a cow drink? _____

Obviously, the answer to the last question is, cows drink *water*. However, many people will make the mistake of answering *milk* here. This error shows that some function of the mind is active here and that this function leads to the error. The answer also comes quickly without any thought. The function active here is subconscious, as those who make the mistake are not doing it intentionally and are not initially aware that they are making any mistake at all. The fact, that some people realize *milk* is wrong and choose *water*, shows us that this automatic function can be bypassed, turned off, or moderated in some way. This function is called semantic priming, and is defined as “the phenomenon where presentation of a word will reduce response time for a semantically related word” (Psybox, 2002). As the listener’s mind has been primed with information relating to the word *milk*, it is the first answer to come to mind. In example (1), there are three different types of priming operating between *milk* and *white*: semantic, phonetic, and associative.

Semantic Priming: To take an example, one attribute of *cloud* is *white*. This attribute is the same for *milk*. Here *milk* and *cloud* share the semantic feature *white*. *Cloud* semantically primes *milk* even though the concepts do not appear to be that similar. Semantically related words overlap in their semantic features. The words *dog* and *horse* are semantically related as they have many features in common. Both are: countable, alive, have four legs, run, and eat.

Phonetic Priming: The word *silk* is phonetically similar to *milk*. The phonemes [I], [l], and [k] are the same in each word. The two words also rhyme and there are not a lot of words other than *milk* that rhyme with *silk*.

Associative Priming: The word *cow* is associated with *milk* as milk comes from cows. These two words are learned together and occur together often. They are strongly collocated just like the words *milk* and *cookies*. Associatively related words tend to have very few semantic features in common. If words are strongly or weakly collocated, they may be associated. Another example of this is the pair of words *pearl* and *harbor* or *big* and *apple*.

Other candidates for associative priming may use purely personal knowledge. If a person named *John* happens to own a *yellow VW* and has had it for a while, then his friend *Bill* may associate the color *yellow* and *car* in association with *Bill*. Since everyone is an individual and has learned things differently, some concepts closely related in one's mind may show no association for other people. Someone who was burned with hot oil, while making popcorn, for example, may develop a strong associative relation between *popcorn* and *pain*.

Semantic and associative priming is usually exploited in cognitive science for research into how words are grouped together in the makeup and organization of the lexicon and as a tool to determine differences between normal healthy minds and those with certain neurological or psychological disorders like Parkinson's disease, Alzheimer's disease, and schizophrenia. Much current research has been done in this area of cognition. For example, Giffard, et al. (2002) uses semantic priming in a study on Alzheimer's to try to measure the semantic memory of patients.

The priming effect was first documented by Meyer and Schvaneveldt (1971). They asked participants in their study to decide if a given letter string (the target) was a word, when the target was preceded by another word (the prime). The decision task was made more quickly when the two words were related (doctor-nurse) than when they were unrelated (nurse-chair). This reduced processing time is the mark of semantic priming and is cited as evidence for the association between concepts in semantic memory.

The term *semantic priming* is usually used to loosely refer to two different things: one being associative priming and the other purely semantic priming.

A. What Is Going On to Give Rise to the Priming Effect

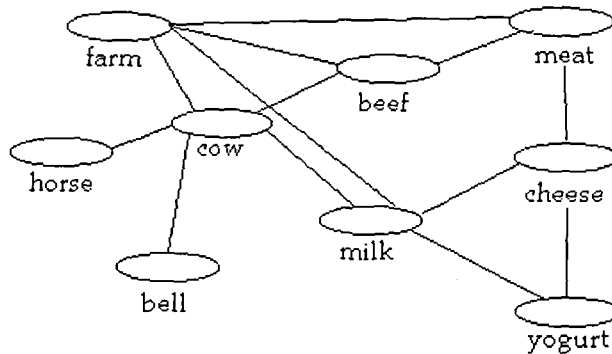
There are three current theories to explain semantic priming; they are the theories of **spreading activation**, **compound-cue**, and **distributed memory**.

1. Spreading Activation Theory

In the cognitive model of the mind, information is stored in nodes and the nodes are all connected to each other in the form of a network. How many individual

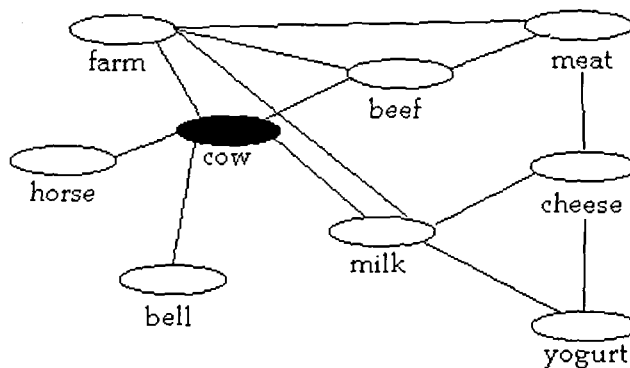
nodes are needed for each word is yet undetermined. For simplicity, this will be illustrated using only one node.

Diagram 1



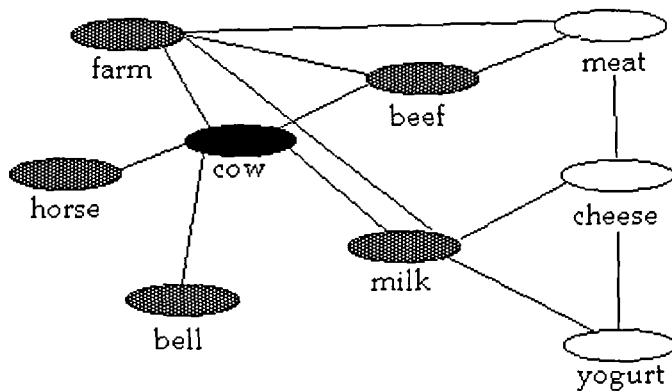
All the nodes here are connected but not necessarily to each other; some nodes may be more distant. Above in Diagram 1, the ideas *farm* and *cow* are more closely associated and therefore closer to each than *horse* and *yogurt* are.

Diagram 2



According to Collins and Loftus's (1975) spreading activation theory, when one node is activated, like *cow* is in Diagram 2 above and Diagram 3 below, other nearby nodes are also energized, reducing the time needed to access them for the next process. Whenever a new idea is introduced, certain neurons in the mind associated with the word are excited or activated. This activation then spreads to nearby neurons, partially activating them. Through this means, when one word is encountered, it partially activates many related concepts. When the target word is then encountered, it is already partially active and takes less energy and time to fully activate. This leads to faster times for further processing based on the target and the relationship between the prime and the target. Spreading activation is an automatic process that is done for every word we come across. Priming effects also can appear when pictures, sounds, smells, tastes, or even textures are encountered.

Diagram 3



A primed brain has an easier time understanding later communication. When the word *book* is heard, other properties related to it easily come to mind like *library*, *pen*, and *author*. Our activation levels are raised so that the related words in the following utterances are processed quicker, almost like those words were expected. When a related word is encountered, the relation between it and its prime is salient. Retrieval effort is normally believed to be time-consuming if long-term memory is accessed. However, in the case of an already partially active node, the retrieval effort is reduced as well as processing any question regarding those activated memories as shown by Anderson (1983), Collins and Loftus (1975), McNamara (1992a, 1992b, 1994).

2. Compound-Cue Theory

Dosher and Rosedale (1989), McKoon and Ratcliff (1992), and Ratcliff and McKoon (1988, 1994) propose that the prime and the target form a compound-cue made up of the combined features of both the prime and the target. When the prime and the target are related, this compound-cue produces a feeling of familiarity that in turn assists the person in making a lexical decision. Related words co-occur more frequently than do unrelated words, and so the compound cues for related words tend to have greater familiarity than do those for unrelated words. In the Gillund and Shiffrin (1984), Hintzman (1986), and Murdock (1982) models of memory retrieval, greater familiarity gives rise to faster and more accurate processing.

3. Distributed Memory Theory

Distributed connectionist networks were put forward by Kawamoto (1988); Masson (1991, 1995); McRae, de Sa, and Seidenberg (1993); and Sharkey and

Sharkey (1992). In connectionist networks, each concept is represented, not by a particular unit, but by a particular pattern of activation over a large number of interconnected units in semantic space. Smith and Medin (1981) noted that related concepts are represented by similar patterns of activity. Each unit can be thought of as encoding a particular semantic feature that participates in many concepts. Semantic priming occurs because the pattern of activation is similar for related primes. This similarity gives the processing a head start, as not all of the nodes need to be reset in order to change to the new pattern of activation.

These three theories on how priming works all describe the increase in processing speed as the result of a passive, automatic process that reflects the organization of semantic memory.

B. Example Application of Semantic Priming

The simplest form of test that makes use of priming theory is a free word association test normally used to obtain related words. Typically, these related words are then used as targets in subsequent trials. For free word association, a subject is given words (primes) as stimuli and then is asked to quickly respond by saying the first thing that comes to mind. The responses are then recorded, and how the two words are related can then be analyzed. The image of a psychologist asking for responses from a patient lying on a couch is a stereotype for this type of test. The words produced in this manner are, in theory, closely related to the prime word either semantically or associatively. One of the uses of this kind of test is to learn about the relationship between words, and then use this information in theories relating to the

structure and organization of the lexicon. Nelson (1986) and Sell (1992) showed that the free association test is simple enough to be used with small children.

The prototypical priming experiment has a setup similar to the following used by Meyer and Schvaneveldt (1975) and Neely (1991):

The single-word semantic priming paradigm:

- (a) Pairs of stimuli (prime and target) are sequentially presented visually or orally. Sometimes they are presented subliminally by reducing the exposure time to the visual prime;
- (b) The subject is required to respond to the pair, or to the target only, with a lexical decision as quickly as possible;
- (c) Priming effects emerge when the response to the target word is more accurate and/or the reaction time to it is shorter when a semantically related word, instead of an unrelated word, is presented prior to the target.

Consider the following examples of prime and target:

- First, a prime word is presented: cow
- Second, a target word is given: pen
- Third, the subject is then asked to respond to a question about the words:

E.g. Is the target word countable? Yes/No

Are these similar? Yes/No

As the prime and target are only slightly semantically related (both are countable) and not usually associated together, the processing for the question will take roughly the same time as if the prime were not presented.

- First, a prime word is presented: dog

- Second, a target word is given: cat
- Third, the subject is then asked to respond to a question about the words.

As the prime and target are associatively and semantically related the processing for the question will be done in less time than when no prime was presented. Diagram 4 shows the general flow of the test. The reduction in time shows up in the processing of the question.

Diagram 4

Prime word → Target word → Question asked → response given

C. Varieties of Priming

Tversky (1977) and Thompson-Schill, Kurtz, and Gabrieli (1998) show that associative priming is nonsymmetrical. For two semantically related words, the relation is symmetrical as their similarity is a function of their distance in representational space. The number of attributes that *dog* shares with *horse* is the same number that *horse* shares with *dog*. An associatively related target word may not call to mind the prime word as well as the prime calls the target. Normally pairs of words that are highly semantically related are on the same basic level as each other due to the fact that they share semantic attributes (i.e., lion – tiger). However, associatively related pairs may be on superordinate and subordinate levels, or simply occur together often. For the pair *big* and *apple*, *big* will call to mind the word *apple* sooner than the word *apple* will call to mind *big*. Similarly, *vehicle* will call to mind the word *car*, but *car* will more readily associate with words like *truck*.

Between semantic and associative we may now consider four categories of possible relations between words:

	Associative	Semantic
Not related	-	-
Asymmetrical	+	-
Semantically related	-	+
Asymmetrical and Semantically related	+	+

Back priming is something that only happens for asymmetrically related primes. In the above example, *big* will strongly associate with *apple*, but *apple* will only weakly associate with *big*.

big >>> apple

apple > big

Even though *apple* and *big* are presented in this order as prime and target in a priming test, according to Koriati (1981), an increase in processing speed will still occur in the lexical decision.

Repetition priming is the use of primes identical to the target. A repeated stimulus is processed better the second time than the first according to Scarborough, Cortese, & Scarborough (1977).

In a masked priming test, the prime is presented so briefly that the word does not become a conscious thought. The prime is presented subliminally. Even though the prime is only briefly presented, priming effects are encountered when the prime and the clearly visible target are semantically related. Balota (1983), Fowler, Wolford, Slade, and Tassinary (1981), and Marcel (1983), as cited in Deacon (2004), demonstrated that words shown only briefly, and which are consciously unrecognizable, still produce priming effects measurable in reaction time.

Information between the prime and its target can block the effect and cause errors in processing. Consider the following joke that also demonstrates another error that sometimes occurs in processing:

- (2) *You are driving a bus. The bus is 10 meters long; it has a six-speed transmission and a 300 hp diesel engine. It is a late summer night and the air conditioning is on. You are on the road, halfway to your destination, traveling at about 100 km/h. There is no one else on the road, so your high beam lights are on. A jackrabbit runs in front of the bus. What color are the bus driver's eyes?*

Usually upon hearing this question the listener is usually stumped and cannot come up with the correct answer. The listener is the bus driver, but this information is lost. Here is another error arising in the course of normal processing. All the intervening information is considered important and, as a result, the information necessary to answer the question is lost.

A study by Deacon et al. (2004) shows that intervening items between primes and targets disrupted priming of the target if the intervening item was not related. This disruption was still evident if the item intervening was masked.

D. What Kinds of Things Can Be Used to Prime With?

The phenomenon of semantic priming is basic and very common in life. Many different things can be used as primes and targets. Primes and targets can take many different forms. Any sense like sight, sound, smell, taste, and touch can be used to prime with. Under sight, pictures, colors, or words could be used. For the sense of hearing, speech can be used as well as second-language speech, music, voices, or

noises. The right-brain can even be separated from the left-brain by presenting the primes and targets to only the right or left ears or eyes as the right hand, eye, and ear are controlled by the left brain. In this way, smelling diesel fuel will remind people of bus trips they took, and the taste of beer may remind them of their university days.

In a test where the prime and the target are not presented in the same mode, i.e., if the prime is heard and the target is a picture, the priming is said to be cross-modal, as done by Swinney (1979).

E. Current Research in Priming Theory

There are two main ways priming can be used in linguistics. First, as semantic priming is a cognitive phenomenon, other mental processes can be compared to it to see if they are in any way similar. If they are similar, perhaps one can be subsumed in the other. The second possible use for this phenomenon is to plumb the depths of the mind to determine what proof or support for theories can be obtained by using it. Following are some of the uses of priming in the current literature.

1. Determining the Organization of General Word Knowledge

In a free word association test, a subject is presented with a concept in some mode and then asked to say or write down the first thing that comes to mind. This is similar to the well-known Rorschach or “ink blot” tests in psychology. These simple trials shed light on what words relate to one another. How the words relate to one another can shed light on how words are structured in the lexicon and the distance between the words.

2. Making Comparisons

Semantic priming is a cognitive phenomenon that has been extensively studied in normal adults. Its effects can be easily measured and for this reason it can be used to compare observed effects with the baseline of standard effects that it has on ordinary people. This baseline can be compared with anyone who falls outside these parameters.

Patients with Alzheimer's disease, Parkinson's disease, severe head trauma, or schizophrenia will all show some form of neurological disarray. A measure of effects can be made and directly related to the amount of neurological damage. Tests are easy to administer and non-invasive. The results are also easily quantifiable.

Giffard et al. (2002) uses semantic priming in a study on Alzheimer's to try to measure the semantic memory of patients. In their study, different types of related words are used. They compare the difference between coordinate (e.g., tiger–lion) or attribute (e.g., tiger–stripe) relationships. For coordinate relations between two words, the semantic priming performances increased abnormally (hyperpriming) before dropping down, whereas for attribute relations, the priming effects started off normal before decreasing (hypopriming). These results reflect a pattern of semantic memory degradation.

3. Measuring Language Development

As priming tests are easy to administer, they can be given to children (Nelson, 1986; Sell, 1992). The results can then be compared against normal adults and a measure of mental development can be obtained. This can also be applied to measuring progress and ability in students learning a second language. Woltz (1999) and Phillips, Segalowitz, O'Brien, and Yamasaki (2004) show that semantic priming

correlates significantly with reading ability, and therefore, semantic priming and reading comprehension are related in their processing.

4. Second Language Development

Differences in priming effects can be compared between a subject's first language (L1) and their second language (L2). Priming is an automatic process in comprehension (Neely, 1991) and a measure of development in a learner's L2 can be obtained through a priming exercise. Phillips et al. (2004) shows that priming is faster and more efficient in L1 than in L2, and that more highly proficient bilinguals were more efficient in priming than less proficient bilinguals.

They also show that the coefficient of variation in response time as a measure of automatic processing is significantly related to L2 proficiency.

5. Phonological Underspecification

In speech sometimes there are distortions of what is said due to noise in the environment or through weak articulation (e.g., talking with a mouth full of food). Connie, Blasko, and Titone (1993) used minimally mismatched primes to research phonological underspecification and found that pseudowords, such as **zervice*, reduced the response time to the target *tennis*. This demonstrates that the cognitive process of recognizing words is flexible and can compensate for errors.

6. Research into Grammar

Associative relations reflect word use and associations between words based on how they were learned. The likelihood of one word appearing with another has been used to model grammar. Temporal contiguity in verbal or written language was

studied by Plaut (1995) and co-occurrence within propositions was studied by McNamara (1992).

McRae, Hare, Ferreti, and Elman (2001) obtained robust priming when verbs were named aloud following typical agents (nun-praying), patients (dice-rolled), instruments (shovel-digging), and locations (arena-skating).

Chang and Maia (2001) described a model of grammar learning in which linguistic representatives are grounded both in the conceptual world of the learner and in the statistical properties of the input.

7. Research into Thematic Roles

Feretti, McRae, and Hatherell (2001) show that verbs immediately activate knowledge about typical agents, patients, and instruments. The thematic roles of a verb are formed through everyday uses and experiences. Fillmore (1968), Gentner (1981), and Jackendoff (1983) show that who plays what role in certain situations is associatively primed.

8. Researching Lexical Ambiguity Resolution and Homophones

In the case of lexical ambiguity, one word may refer to two separate concepts:

- (3) *I have a **change** of clothes.*
 *I need some **change** for this bill.*

Priming can be of use in determining where the ambiguity is resolved and if there are any preconceptions of the words when encountered.

9. Metaphor and Metonymy

Metaphor and metonymy refer to the figurative uses of words and concepts.

The following are examples of metonymy:

Part for whole (*All hands on deck.*)

Container for content (*I'll have a glass.*)

Controlled for controller (*Taxis are crazy.*)

Metaphor is based on the 'similarity' between the literal and the figurative meaning of an expression. Metaphorical uses also share certain semantic or associative properties with their literal use. The relationships here are more associative, which also implies they are not symmetrical. Tversky (1977) showed that people often prefer one direction to the other. A motorcycle is just like a bicycle rather than a bicycle is just like a motorcycle. In metaphors these asymmetries are more pronounced. *Life is like a journey* rather than *a journey is like life*.

III. Word Association Test for Ambiguous Words

A. Introduction

How is an ambiguity resolved in language? Many times during the course of any conversation, ambiguous words are encountered. The interpretation of each of these words can lead in two or more different directions. Currently, there are three theories on how this ambiguity is resolved. What evidence can semantic priming theory provide to support or undermine them? Are individuals all the same in how they deal with these words? These questions are explored in the following sections.

B. Lexical Ambiguity

Often a word has two or more separate meanings. Sometimes these words are homophones (hoarse-horse) and sometimes they are spelled the same and pronounced

differently (tear: to rip, tear: water from the eye) which may present problems when reading. Most of the time, they simply look and sound the same, but have different senses [bank (money), bank (river)]. In order to understand an utterance, a choice needs to be made to determine which sense applies in a particular instance. The choice made will be based on many factors. Are all senses of an ambiguous word accessed when a word is encountered, or is just one chosen initially? If just one sense is accessed, is it the dominant one or do different subjects sometimes access the less dominant one? Here a simple word association test is used to determine what related ideas subjects produce when presented with an ambiguous word in their L1 and their L2.

C. The Models

Laboratory studies using context have suggested three different models on how interpreters initially deal with ambiguity. In the **exhaustive access model**, the interpreter first accesses all possible senses and then selects one. In the **ordering access model**, the interpreter accesses the most common sense of the word and only changes to another meaning when the first one does not fit anymore. In the **selective access model** previous content directs interpreters to the relevant meaning of the word when it is encountered.

D. Pre-analysis

If the exhaustive access model is used, then it is expected that it would offer the best flexibility in choosing a meaning while at the same time requiring more memory to be accessible at the same time.

In the ordered access model, the most common sense of a word is assumed at first and only changes when the first sense does not fit anymore. This will lead to faster processing if the choice is made correctly at first. However, if the choice is the wrong one and another has to be accessed after some trial has been done with the first meaning, then the interpreter will be left with a sense of infelicity due to the wasted effort.

The selective access model uses previous content to direct interpreters. As a result, it is not a stand-alone theory and requires one of the two other theories above to help it if the ambiguous word appears in the initial place in a conversation.

(4) *Can he cancan on a can in the can?*

In (4), the first word is ambiguous, and there is no previous content to help us decide. Perhaps this account should be extended to cover word position in a sentence.

(5) *Where is he?*
 He is in the can.

In (5), the selective access model offers the least amount of processing. The previous dialog relating to the location of a man will call up an image of a bathroom. The exhaustive access model will waste effort by calling up other possible meanings including slang. The ordered access may waste effort by calling up the wrong meaning. However, the situation can change quickly:

(6) *Where is he?*

He is in the can. We sealed him in the drum and sank him in the ocean.

In this gangland example, the selective access model is at a disadvantage as the words necessary for disambiguation are found at the end of the second utterance. The ordered access model has one interpretation rejected in favor of another. The exhaustive access model may call upon more memory, but also offers the most flexibility.

Asher and Lascarides (1993) present this example:

- (7) a. *They put a plant there. It ruined the view.*
 b. *They put a plant there. It improved the view.*

Here, the word *plant* is ambiguous until the next sentence is seen. There is no previous dialog to work with here and, even after the end of the sentence, disambiguation is no closer. After the second sentence, the interpretation will more likely be ‘factory’ for (7a) and ‘vegetation’ for (7b), however, this interpretation is not set and can change based on later information.

Such later information could be like the following:

- (8) a. *They put a plant there. It ruined the view.*
 I can’t see into her window at night now.
 b. *They put a plant there. It improved the view.*
 There used to be a toxic waste dump there.

Now the interpretation will change to ‘vegetation’ for (8a) and ‘factory’ for (8b). Our expectancies at the end of the second sentence are now reversed. This goes against the

selective access model, as the earlier part of the utterance indicated the opposite meaning. Under the ordering access model, the interpretation will have changed, leading to wasted processing and infelicity. Final proof of one's interpretation is hard to obtain, and further utterances may change our interpretation. Intuitively, it seems that all meanings of an ambiguous word should be potentially accessible even after one has been 'selected', as shown in the following joke:

(9) A: *Tell me, is your refrigerator running?*

B: *Yes it is.*

A: *Well then you'd better go catch it.*

E. Ambiguous Word Association Experiment

In this experiment, we sought to discover what possible interpretations were initially available to subjects for a given ambiguous word.

1. Method

Subjects were given a simple word association test consisting of 20 prime words in written form. They were instructed to write down for each prime the first four words that came to mind. Of the 20 primes, half were in English and half were in Korean. If a subject did not know a prime in their L2, they were instructed to skip it and go on. For an English prime, subjects were instructed to write in English and for Korean primes, in Korean. Half of the primes were single ambiguous words. The other half were pairs of words consisting of an ambiguous word and another word associated with one of the senses of the ambiguous word.

2. Participants

There were 35 participants involved. Of the participants, Korean was the L1 for 21 of them, and English was the L1 for 14. Of the native Korean speakers, 10 were in an intermediate level and 11 were in advanced level English conversation classes at Chosun University. Of the native English speakers, all were teachers at Chosun University with at least a bachelor's degree from an English-speaking university.

3. Materials and Design

Almost all the primes for word association were ambiguous. Of the primes, half were paired with another word to activate one of the senses. The primes used were the following:

English Primes	Korean Primes
bank (river bank, money bank)	흰눈 (눈, eye or snow)
steel plant (plant, green plant or factory)	밤 (night or chestnut)
star (celebrity or celestial body)	배맛 (배, pear or boat)
go bowl (bowl, sport or dish)	길 (not ambiguous)
can (container or ability)	돌다리(다리, bridge or leg)
ring ring (sound or jewelry)	팔 (foot or eight)
right (direction, politics, or civil right)	은행나무 (은행, bank or tree name)
night bat (bat, animal or stick)	가지(branch or eggplant)
tear (cry or rip)	말하다 (말, talk or horse)
sea wave (wave, water or arm action)	일 (one , work or day)

4. Results and Discussion

Of the native English speakers, few were able to complete the Korean portion of the test. Subjects primed words related to all different word senses for the unpaired lexical items. As expected, words related to the dominant sense were triggered more often. However, unexpectedly, a number of subjects flipped between available senses in the association test, writing words related to one sense, then

writing another word from another sense, and then switching back to the first sense again. Of the words that were paired with one another to induce only one sense of the ambiguous word, two of the pairings did as expected and associated words only from the sense intended. *Go bowl* only primed words related to the sport sense of *bowl* and *sea wave* only primed meanings from the ocean sense of the meaning. However, for the other three, there were instances where the less dominant sense was primed. *Steel plant* led to one native English subject producing the word *tree* for the first blank in the test. *Night bat* primed baseball for others, and a number of subjects produced words like *round* or *gold* when primed with *ring ring*. For the English native speakers who knew enough Korean to write a few answers, the results were similar to their native language results. For one subject, the word 일 (il)(one, day, or work) triggered all senses of the word and even the North Korean leader's name, *Kim Jong-il*.

Of the native Korean speakers, most were able to complete both language sections of the test. Their results were similar to those by the native English speakers. For single words, more subjects produced both available senses, while for words that had been paired, usually only one sense of the ambiguity was triggered. Here, too, there were instances where ideas from the other senses of the ambiguous word were produced as well.

In all of the tests except one, there were instances of the subject producing different senses for at least one ambiguous word. Only one subject stuck to the same word sense for all four associations for each prime given.

5. Final Remarks

Our three models *all* work in different ways, and if any given model is followed, different results are predicted. Under the **ordering access model** only the most common word sense should be available, and there should be no switching *senses midstream*. In this study, a number of subjects produced words based on the less dominant sense first, most notably for *tear*, *ring ring* and *can*. For *tear*, most subjects produced the tears and crying sense at first but some subjects from the start produced only the ripping and cutting sense. Furthermore, many subjects flipped between ideas, producing first a word related to one sense of the ambiguity, with the following word related to another sense of the ambiguity. If the **selective access model** is followed, the words that were paired should have only produced words related to that sense. Even though the sense of some words had been pre-selected by being paired, the other sense was still primed, though not often. The fact that all except one of the subjects showed instances of producing words from different senses for an ambiguous word is a good indication that, for ambiguity resolution, most people think generally in the same way. The **exhaustive access model**, even though it accesses more memory and apparently requires more processing to work, seems to be the only one that has enough flexibility to explain what is happening in real life. This model best explains the initial priming of less frequent definitions and the switching between senses that occurs.

IV. The Influence of Associative Priming in Bridging Reference

A. Introduction

Matsui (1993), in her paper outlining the relevance theoretical account on bridging reference, states that the same bridging reference can seem felicitous to some

and infelicitous to others. Her claim is that the difference is due to the method of processing used and that various users process incoming information differently in their minds. She claims that some people will process incoming information in parallel while others will process it in sequence. It is proposed here that all people process information in basically the same way. A different explanation of why utterances are infelicitous to some and not to others will be presented.

Wilson and Matsui (1998) further reinforces Matsui's account. In this paper, the relevance-based approach is defended against approaches from the point of view of truth and coherence. We feel that semantic priming can help answer the question left from Matsui's first paper, namely: What determines the differences in accessibility of antecedents for different listeners?

Matsui ponders examples of bridging reference, which are viewed by some as being infelicitous, like the following examples from Erku and Gundel (1987):

- (10) *We stopped for drinks at the New York Hilton before going to the Thai restaurant. The waitress was from Bangkok.*
- (11) *We stopped for drinks at the Hilton before going to the zoo. The baby orangutan was really cute.*

In (10), *the waitress* could refer to *the Thai restaurant* or *the New York Hilton*. Most people intuitively match it up with *the Thai restaurant* and then make a bridging assumption like:

- (12) *There was a waitress at the Thai restaurant.*

There is nothing, though, to stop an individual from matching up *the waitress* with *the New York Hilton* and making a different bridging assumption:

(13) *There was a waitress at the Hilton.*

For (11), the listener will either match up *the orangutan* with *the zoo* or *the Hilton*.

Some other questions put forward by Matsui (1993) are:

- Why are these stylistically infelicitous for some people and not for others?
- Why are apparently similar-looking examples not infelicitous at all?

Anyone who has tried to learn a second language is amazed at how quickly people actually do speak. Comprehension and linguistic processing for a native speaker are quick, easy, and efficient. Marslen-Wilson (1975) notes that this implies that knowledge is organized so that many types of information can be computed and incorporated quickly. In order to understand clearly, the processing to form a bridging assumption must also be fast. It is fast. Sanford and Garrod (1981) explained this speed in terms of frame-based associations between the antecedent and the referent.

Finding the construction of bridging reference to be similar to the paradigm semantic priming test and knowing that, in bridging reference, the notion that efficient processing helps determine felicity it is believed that the gap in bridging reference is traversed through semantic and associative priming effects.

B. Bridging Reference and Bridging Implicature

Clark and Haviland (1977) coined the term 'bridging' to refer to the phenomenon that is occurring in the following sentences:

- (14) *I went downtown. **The police** were looking for someone.*
 (15) *Bob was eating an apple. **The worm** he saw made him sick.*

In (14), it is not openly said that *police were downtown*, or in (15) that *a worm was in the apple*, but intuitively each situation is interpreted by first matching up the antecedent with its referent, and then an assumption is created to introduce the referent. Interpreting these will call upon information from syntax, semantics, pragmatics, knowledge about the speaker, background knowledge about the situation, and encyclopedic information about what is being talked about.

Matsui (1993) defines a *bridging implicature* as “when a new contextual assumption is needed to introduce the intended referent” (p. 57).

This new contextual assumption is what is unique to bridging reference making it different from other types of reference. This bridging reference is done through a process that works similar to the following:

- (14') *I went downtown. The police were looking for someone.*
 In *The police*, *the* refers to something specific.
 What does *the police* refer to? Oh...*downtown*
 (Matching a referent with its antecedent)
Police were downtown.
 (Formation of the bridging assumption)
- (15') *Bob was eating an apple. The worm he saw made him sick.*
 In *The worm*, *the* refers to something specific.
 What does *the worm* refer to? Oh...*the apple*
 (Matching a referent with its antecedent)

A worm was in the apple.

(Formation of the bridging assumption)

Both *worm* and *police* use the definite article 'the'. Normally this is used on objects that have already been introduced in a dialog or text. Since this is not the case in our examples, this prompts the hearer to figure out what this definite article is meant to refer to and match up the referent with its antecedent. The hearer then assumes that *police were downtown* and *a worm was in the apple*, respectively. These assumptions are made, as this is the easiest way to fill in the missing information. This skipping of an introduction would not be done by the speaker if it were not beneficial in some way, such as reducing the total amount of work done in processing a dialog. In skipping the introduction, the second sentence seems to be less relevant than it could be in order for the dialog to more closely adhere to the Gricean sub-maxim of manner: be brief. If the cost and risk to understanding in making the bridging assumption were not offset by reduced energy in speaking, reduced processing of the interpretation, or some other advantage in communication, then it would not be used often. The benefits of use must outweigh the combined costs and risks.

Before considering about what is happening here, here are a number of examples to show what any theory on bridging needs to adequately explain. First, there are the basic level examples like (14) and (15) above where there is only one antecedent and one referent. There are also utterances with multiple antecedents and one referent. The referent only refers to one antecedent and the possible antecedents are different.

(16) *We saw the rose garden before leaving. The bus was at 5:00.*

Possible antecedents: *the rose garden* and *leaving*

First possible interpretation: *We left on the bus.*

(17) *I studied all night for the exam. I failed.*

(18) *I studied all night for the exam. The coffee kept me awake.*

Consider utterances with one antecedent and multiple referents:

(19) *Someone had broken into the cabin. The door was broken, the windows had been smashed, and the furniture was strewn about.*

Multiple referents to a single antecedent seem to be less infelicitous than multiple antecedents to a single referent.

Here are some utterances where the referent refers to one or both antecedents.

Note that the antecedents are similar and that some of these examples may be regarded as infelicitous.

(20) *We picked flowers before ordering pizza. The smell was wonderful.*

(21) *We stopped at the university before going to The Zoo. The monkey was cute.*

(22) *We stopped at the Hilton before going to the restaurant. The waitress was Mary.*

In some cases, the antecedent may be superordinate or subordinate to the referent, making bridging resolution more difficult.

(23) *We had a picnic by the pasture. The cows came for their supper.*

- (24) *The dog was in sight when we heard a yelp. We couldn't find the animal.*
(25) *Our car hit a tire on the road. The vehicle had broken down.*

Referents may refer to two antecedents at the same time:

- (26) *I studied before playing tennis. The strain was too much for me.*
(27) *I drank beer before going fishing. My wife was angry with me.*

Utterances can have two separate referent antecedent pairs. Matsui (1993) gave the following example of this:

- (28) *The train came into the station. The passengers ran for the taxis.*

Even three or four separate pairs:

- (29) *The train came into the station by the pond. The ducks started flying as the people ran for the taxis.*
(30) *The train came into the station by the pond at noon. The church bell ringing started the ducks flying as the people ran for the taxis.*

Notice that in all the above examples, there are two separate sentences and the end assumption forms a bridge between them. It is always possible in an utterance that the perceived referent has nothing to do with the perceived antecedent. The referent may refer to something else entirely. Or even if the antecedent is the one intended by the speaker, the listener may connect it with an entirely different one. A bridging reference may also be needed within a single sentence.

- (31) a. *I arrived at the farm. My father met me coming down the driveway.*
b. *When I arrived at the farm my father met me coming down the driveway.*

In this case, for (31a) the utterance is one continuous sentence instead of being split up into two, and hence, the listener is surer that *the driveway* relates to *farm*.

C. Concepts Similar to Bridging Reference

1. Pollution

In a given text or utterance, one utterance may pollute another with an unwanted meaning even though the two utterances are considered separate.

From Dean Derkson's (2004) book,¹ the following two questions are consecutive.

Notice how the first one pollutes the second.

- (32) 500. *How long does something have to be on the floor
before you won't eat it?*
501. *What is your favorite street food?*

Here, the idea of something being on the floor has changed the colloquial meaning of street food to something else. The interpretation of many utterances can change depending on what surrounds them.

- (33) *Our cat seemed fatter. The canary had disappeared.*

In this example, the implication is that the cat may have eaten the canary.

2. Ambiguity Resolution

¹ *Questions to Muse You*, a book of conversational questions for free talking ESL classes.

a. Lexical Ambiguity

Sometimes a word can have two or more separate meanings. Lexical ambiguity is similar to bridging reference when dealing with multiple antecedents in that a choice needs to be made in order to understand. For ambiguity, which meaning applies in a particular instance, needs to be determined. This is similar to bridging reference which must determine which antecedents belong with what referents. The choice will be made based on many factors. These factors will be similar to those for bridging reference.

b. Structural Ambiguity

A structurally ambiguous sentence could have a number of different interpretations. How those situations are interpreted will depend on surrounding information and on our own expectations.

(34) *He is at the house on the corner with a sign.*

Possible Interpretations:

- a. *There is a house on the corner, and that house has a sign.*
- b. *There is a corner with a sign, and a house is on that corner.*
- c. *He is holding a sign standing at the house on the corner.*

What is necessary for structural ambiguity is to figure out what the context is. We need to determine how the correct interpretation is chosen. Is the first accessible one chosen? How about the most probable? Possibly, the interpretation is ignored until further information is obtained. Regardless, this idea of figuring out what the context is is similar in bridging reference.

3. Coherence in a Text

Finding the connections implied in a pair of utterances is similar to finding the connections implied in a larger group of sentences.

Kibble and Power (2002) provide the following example:

- (35) *Dodge was robbed by an ex-convict the other night.
The ex-convict tied him up because he wasn't cooperating.
Then he took all the money and ran. He started screaming for help.*

Bridging reference is common and highly utilized in comprehension. A proper understanding of it will give insight into our understanding of comprehension and coherence. Even the second verse of the Bible has a bridging reference:

- (36) *In the beginning God created the heaven and the earth. And the earth was without form, and void; and darkness was upon the face of **the deep**.*
(Genesis 1: 2, KJV)

In (36), *the deep* refers to *the earth* and an assumption needs to be made: *water was on the earth*. Either the antecedent is connected with *the earth* or with something else previous.

4. Anaphora

Anaphora is very closely related to bridging reference, and they have many problems in common.

- (37) *I lived in New York before moving to Amsterdam. It is really nice there.*

Here *there* could refer to *New York* or *Amsterdam*. How this is resolved in the listener's mind will depend on similar factors relating to bridging resolution.

What separates these related ideas from bridging reference is the fact that, in bridging reference, an assumption needs to be made and the context needs to be extended.

D. Current Accounts

Currently there are three competing accounts for how bridging reference works: the **truth-based account**, the **coherence-based account**, and the **relevance-based account**.

1. Truth-Based Account

Is the overall interpretation factually possible? Sidner (1983) uses the term 'focus' to mean the element that is being referred to and suggests an algorithm for selecting a focus.

The expected focus algorithm:

(i) The subject of a sentence if the sentence is an 'is-a' or 'there'-insertion sentence.

(ii) The first member of the default expected focus list, computed from the thematic relations of the verb, as follows:

Order the set of phrases in the sentence using the following preference schema:

- theme, unless the theme is a verb complement in which case theme from the complement is used.
- all other thematic positions with the agent last.

- the verb phrase.

Under this account, there is an expected focus or a default referent in a given sentence for a following antecedent. If the expected focus has nothing to do with the antecedent, then the focus is rejected and alternative candidates are searched for. Sidner's account breaks down when two equally salient accessible items are found. Matsui (1993) gave the following examples:

- (38) *I moved from Earl's court to Ealing. The rent was less expensive.*
 I moved from Earl's court to Ealing. The rent was more expensive.

Intuitively, these sentences are generally used to express the same situation, but, according to the expected focus algorithm, different antecedents are chosen for each.

Erku and Gundel (1987) also use a topic-focus-based account. Under their system, an anaphoric expression will be interpreted as referring to the topic of the sentence since the topic for the following discourse is more likely to be introduced in the verb phrase of the main clause. The expectation is that the second sentence will go on to talk about the topic. Any other interpretation would then be considered stylistically infelicitous. Intuitively though, the following examples do not seem stylistically infelicitous in any way, yet the antecedent in each case has a different referent in the previous sentence.

- (39) a. *I went downtown. The police were looking for someone.*
 b. *I went downtown. The road was short.*
 c. *I went downtown. The headache came back.*

As already mentioned for (39a), the antecedent for *the police* is *downtown*. For (39b), the antecedent for the referent *the road* is the verb *went*. *The headache* in (39c) refers back to *I*. In these examples, the antecedent alternates between the subject of the sentence, the verb, and the object.

2. Coherence-Based Account

The coherent interpretation looks for interpretations that are coherent with prior discourse. Coherence-based approaches have been presented by Asher and Lascarides (1993), Grosz et al. (1995, 1998), Hobbs (1979), Lascarides and Asher (1993), Sanders et al. (1992, 1993), and Walker et al. (1994, 1998). Behind coherence-based approaches to bridging reference is the hearer's expectation that utterances are coherent with what was said previously. Under this account, if an utterance has two possible interpretations, the one that most satisfies coherence will be chosen. While this does add more flexibility in allowing us to choose different preceding antecedents, it also adds rigidity for the fact that the interpretation has to conform to the flow of what was being talked about. It does not make allowances for a statement that is an unrelated interjection. Intuitively, the speaker should be able to refer to any antecedent necessary, or possibly to something that is new to the dialog.

3. Relevance-Based Account

Most believe an account on bridging reference is lost without appealing to Relevance Theory in some way. This account relies on the Gricean assumption that hearers are looking for the most obvious interpretation of an utterance. Relevance Theory claims that attention and processing efforts go to information that seems

relevant. Only the most relevant information is accounted for. Less relevant material is ignored.

Wilson and Matsui (1998, p.16-18) use the following Cognitive Principle of Relevance:

Human cognition tends to be geared to the maximization of relevance.

Relevance is defined in terms of cognitive effects and processing effort:

Relevance

- a. The greater the cognitive effects, the greater the relevance;
- b. The smaller the effort needed to achieve those effects, the greater the relevance.

Cognitive effects are achieved when new information interacts with existing contextual assumptions in one of three ways:

Cognitive Effects

- a. Strengthening an existing assumption;
- b. Contradicting and eliminating an existing assumption;
- c. Combining with an existing assumption to yield contextual implications.

Optimal Relevance

An utterance is optimally relevant to an addressee iff:

- a. It is relevant enough to be worth the addressee's processing effort;
- b. It is the most relevant one compatible with the speaker's abilities and preferences.

This entitlement is spelled out in the Second, or Communicative, Principle of Relevance:

Communicative Principle of Relevance

Every utterance communicates a presumption of its own optimal relevance.

Relevance-theoretic comprehension procedure

- a. Consider cognitive effects in their order of accessibility (i.e., follow a path of least effort);
- b. Stop when the expected level of relevance is achieved.

To make a bridging relation, a listener will select an appropriate referent from the context. The context here should answer the following questions posted on SIL International (1999):

Who said it? Who was addressed?

What were the circumstances? What was the occasion?

When was this word or expression used? When was the text given?

Where was it spoken?

Why was it spoken?

How was it spoken?

How was it received?

The context is usually regarded as the one that is the most accessible. Assumptions derived from the previous utterance will be used to interpret the next, as that is what will be in the short-term memory. In a bridging reference, the immediate context is not sufficient. It needs to be extended. Going back to the basic examples:

- (14) *I went downtown. The police were looking for someone.*
 (context: downtown)
- (15) *Bob was eating an apple. The worm he saw made him sick.*
 (context: eating an apple)

The context needs to be extended by making a bridging assumption. The antecedent is introduced in the assumption. For these examples, the assumptions are *police were downtown* and *the apple had a worm*, respectively.

In cases where there are multiple antecedents for referents, as in examples (20-25), Matsui (1993) believes that the referents are tested in parallel by some people and sequentially by others leading to the situation where some hearers, if they use sequential processing, will test the wrong antecedent first, causing them extra processing. For our previous example (22), some hearers will try to match *Hilton* with *waitress* first before rejecting *Hilton* and finally matching it with *restaurant*.

- (22) *We stopped at the Hilton before going to the restaurant. The waitress was Mary.*

This extra processing will create the feeling that the form of the utterance is infelicitous.

E. The Similarity of Associative Priming to Bridging Reference

Semantic and associative priming is at work in bridging reference. This is deduced, first, because bridging reference is similar to the priming paradigm. In bridging reference, there is an antecedent and referent and a question as to what the referent refers to. In semantic priming, there is a prime, a target, and a lexical decision

task. Cases where the prime and the target are semantically or associatively related, processing is reduced for a following lexical decision.

The second reason we suggest this is that in associative priming when the prime and the target are related, there is an increase in the speed of the processing. Sanford and Garrod (1981) show a high rate of speed for basic examples of bridging reference. Wilson and Matsui (1998) explain this in terms of frame-based or scenario-based associations between the antecedent and the referent.

The third reason is that whenever two sentences are used together, information from one can be interpreted by our mind as being associated with the next sentence. This is shown by errors like those in examples (1), (2), and (32) above. These errors indicate that semantic priming is active in these situations.

Here there is a tradeoff. If perfection is desired, then the task needs to be done slowly. If speed is more necessary, then errors are bound to occur. How much accuracy is traded for speed in this? When semantic priming is active, the speed will be high and the likelihood of making an error is greater. When semantic priming is being bypassed, the processing will be slower.

F. How Associative Priming Works in Bridging Reference

In bridging reference, the antecedent works like a prime and the referent like a target. As the referent is definite and has not been introduced, it is automatic to ask what it refers to. In general, the antecedent and referent here are associatively related.

Note that the term 'prime' or 'target' may refer to a small group of words like *high chair*, *cold water*, or *low rent*. The relation between the prime and target that arises as a result of their encounter will be termed the 'background'. The more

significantly the target and the prime are related, the faster and more accurate the processing for any possible relation between them will be.

For a given target (referent) relating to a previous utterance the process is: Accept the prime (antecedent) with the strongest priming association. Let us check this with our initial examples.

(14) *I went downtown. The police were looking for someone.*

(15) *Bob was eating an apple. The worm he saw made him sick.*

How does a priming account work here? For example (14), the word *downtown* functions as a prime. This will partially activate associatively related ideas through spreading activation. *Downtown* will partially activate, among other ideas, the concepts *bus*, *one-way road* and *police station*. *The police* functions as the target. The target will also partially activate concepts like *handcuffs*, *gun*, and *downtown*. Here the concept *police* is already partially active and will take less energy and time to reach full activation. The concept will be retrieved from memory extremely fast. Since *the police* is not explicitly mentioned in the first sentence, it is automatic to ask where it came from. As there is a relation between *the police* and *downtown*, and the neurons relating them are already active, the processing for the question is fast, accurate, and efficient. The correct assumption in this case is the one that is the most active. The context is subconsciously extended and a bridging assumption is made to introduce the referent. *Police were downtown*. The process for (15) will be similar. The word *apple* will prime related concepts like *tree*, *fruit*, and *worm*. When *the worm* is encountered, the bridging reference with *apple* will be made. This need not

be the case for everyone. As everyone is idiosyncratic, what is related to concepts encountered differs widely between individuals. It is always possible for an individual to think of something entirely different from *apple*, which will then be associated with *the worm*.

Levinson (1983) gives the following as an example of the violation of the Gricean maxims of Quantity and Relevance. The statement is assumed to be co-operative though, and the suggestion that is arrived at is: *if Bill has a yellow VW, then he may be at Sue's house*.

(40) A: *Where is Bill?*

B: *There is a yellow VW outside Sue's house.*

In a priming account, *Bill* is the prime and *yellow VW* is the target. If *Bill* is familiar to the listener, then very likely, so is the fact that he owns a *yellow VW*. Hence, the background information and the extra information added through associative priming here will make salient the connection between *yellow VW* and *Bill*. The assumption in (41) will then easily follow.

(41) *Bill's yellow VW is outside Sue's house.*

A third party hearing the exchange in (40) may know little or nothing about *Bill*, yet the assumption in (41) can still be made based on associative priming, though the connection will be noticeably weaker. Even though *Bill* is not familiar, associative properties about *Bill* being a person will be active in the background. The activation

will spread to related ideas like: *job*, *personal property*, and *man*. In the response, *a yellow VW* (the target) is encountered. This concept will also partially activate others like *gasoline*, *tax*, and *personal property* though the associative distance is greater. The closest idea in the previous utterance is *Bill*. The assumption will then automatically form and the bridging assumption in (42) will be made for whom the VW belongs to.

(42) *Bill has a yellow VW and it is outside Sue's house.*

Even if the priming between the referent and the antecedent is very weak, if it is the most likely interpretation available for the third party hearing the exchange.

The following are some more examples where the referent and antecedent are distant.

- (43) a. *I went into the room. I heard **the door** lock behind me.*
b. *I went into the room. **The termites** were hard to see.*
c. *I went into the room. **The smell** was terrible.*
d. *I went into the room. **The monster** was eating.*

In (41a-d), there is little else for *the termites*, *the smell*, or *the monster* to associate with other than the notion of place related to *room*. However, the last two examples may also be interpreted as *the smell* or *the monster* being outside the room and the referent will then refer to something not even in the previous sentence.

1. Multiple Antecedents

Let us now take another look at example (15):

(15) *I went downtown. The police were looking for someone.*

Three separate ideas are actually entered into the background here: 1) that of the person speaking (*I*), 2) that of some kind of movement (*went*), and 3) that of location (*downtown*). All of these could serve as the antecedent to some referent in a following sentence such as in (44):

- (44) a. *I went downtown. The road was short.*
b. *I went downtown. The headache came back.*

Examples (43) and (44) show us that a given referent may refer back to anything in the previous sentence. Notably in the case of (43d) *the monster* can be interpreted as being *in the room*, which is mentioned in the previous sentence or it can be interpreted as being *outside the room*, or *in the building*, which is not mentioned in the previous sentence.

One of the main problems with bridging accounts is determining which antecedent is the correct one. A proper account of bridging reference should be able to select any antecedent as the correct one as all possible antecedents could be chosen as an antecedent to a referent. In this account, all possible antecedents need to be entered into the background and, therefore, all can serve as primes.

Most accounts of bridging reference state that it is reasonable for the hearer, who is expecting the utterance to be optimally relevant, to choose the most economical path to understanding context in an utterance. In a priming account,

something similar is happening. The information in the background becomes salient as the words are encountered and simply the strongest relation is chosen as the most likely one. Lewis (1983) suggested that hearers used the following pragmatic criterion in interpreting bridging cases.

Accept the first candidate that leads to an overall interpretation that is true, informative, and evidenced. (p. 242)

For Lewis, reference is assigned to the most salient candidate. Under his account, saliencies could be reordered at a future time.

Lewis's (1983) Rule of Accommodation for comparative salience states, "If at time *t* something is said that requires, if it is to be acceptable, that *x* be more salient than *y*, and if, just before *t*, *x* is no more salient than *y*, then *ceteris paribus* and within certain limits – at *t*, *x* becomes more salient than *y*" (p. 242).

In a priming account, the incorporation of additional information into the background can change what a particular referent refers to.

(45) *I went downtown. The police were looking for someone. Good thing I wasn't home.*

One worry for a priming account is that intervening primes between the prime and its intended target may interfere with forming a connection between them.

This will arise when there are multiple antecedents for a single referent as in the following examples:

(16) *We saw the rose garden before leaving. The bus was at 5:00.*

- (17) *I studied all night for the exam. I failed.*
(18) *I studied all night for the exam. The coffee kept me awake.*

Here is a joke from the movie *Airplane* (Abrahams, Zucker, & Zucker, 1980):

- (46) A: *I just heard some important news from the hospital!*
B: *The hospital, what is it?*
A: *It's a big building with doctors and patients.*

As (46) emphasizes by repetition, the intervening concept *the hospital* is selected instead of *some important news* for association with *it*. Of course, this is not a typical example. Intuitively, *some important news* needs to be chosen, not *the hospital* the last occurring prime.

When selecting an antecedent, a short list of possible ones is created and any nodes reasonably close to them are activated. The referent simply needs to be categorized with respect to these. Hughes and Wittlesea (2003) have demonstrated in instances where targets are categorized, that the priming effects can last for a long time, with many intervening potential primes between them and the target. Consider an example of this from my personal life: one morning I mentioned to my wife that she needed a hobby. Much later in the evening, we were walking home from downtown and saw a lady collecting cardboard with a cart. I said, "She has an interesting hobby." My wife immediately drew the connection and laughed. In this case, there was a whole day of extra information between the prime and the target. The activation of the primes will occur, and the referent will simply choose the best candidate (the one more closely associated) to form the background.

Many accounts on bridging reference discuss the accessibility of the bridging reference as well as the accessibility of the assumption that follows. There are many factors that affect accessibility. Wilson and Matsui (1998) mention the following:

order of mention	syntactic position	recency of mention
manner of mention	thematic role	main verb semantics
parallel function	choice of conjunction	overall salience

In a priming account, some of these can be negated, such as order and recency of mention. The other factors will simply be incorporated in the background as they are encountered along with the words. Some others may also be necessary, e.g., knowing who is speaking, some prior information on the subject of the utterance, and the location where the discourse is taking place. Without this information, general knowledge is all there is to rely on for the interpretation and the intended assumption for the bridging reference may not be arrived at. In the priming analysis for (16) above, the possible antecedents are *the rose garden* and *leaving*. *The bus*, a vehicle, is clearly associated with *leaving*. *The rose garden*, a place, is also slightly activated and associated with *the bus* but not nearly as much. So most people will associate *the bus* with *leaving*. For our other example:

(17) *I studied all night for the exam. The coffee kept me awake.*

Here the target is *the coffee* and the most salient primes are *I studied all night* and *the exam*. The resultant choice for the antecedent is the one most semantically and associatively related to *the coffee*, as that correlation will be the one activated. Obviously, it is *I studied all night* because people don't commonly drink coffee

during an exam. The assumption will then be produced introducing coffee: *I drank coffee all night*. Now given this, the sentence could be changed to:

- (18) *I studied all night for the exam. The coffee my teacher gave me kept me awake.*

Now compare the two primes with the target *The coffee my teacher gave me*. Since teachers are more closely semantically related to exams than studying all night with students, the background will reflect this and the assumption will change to: *My teacher gave me some coffee during the exam*.

2. Multiple Similar Antecedents

Taking another look at some previous examples. Some people will view these as being infelicitous, while others will view them as being felicitous.

- (20) *We picked flowers before ordering pizza. The smell was wonderful.*
(21) *We stopped at the university before going to The Zoo. The monkey was cute.*
(22) *We stopped at the Hilton before going to the restaurant. The waitress was Mary.*

In (20), for someone encountering these without a context, all there is to help with their interpretation is the semantics of the words. *Flowers* smell and so does *pizza*. Both will serve as primes. Perhaps the word *flowers* is more salient than *pizza*, but the listener is still on their own in choosing one as the antecedent of smell. Outside of a context, without any extra help in deciphering, this utterance may seem strange.

Stress and intonation could be appealed to to overcome this, but all we have here are words on paper. The conclusion then is that in order to understand which referent is the intended one, more information is needed. There is a lack of information. It is this lack of information that makes these sentences seem infelicitous. Associative priming effects could make either prime more salient for a given individual. In this situation, one needs to rely on other information, like whom the speaker is, to increase or decrease the strength of the competing associations available. Without this information, this bridging reference will be interpreted according to each individuals' personal view. The more salient one for that person will be chosen.

In (20), the primes are *flower* and *pizza*. The target is *smell wonderful*. Both of these antecedents can be activated. If the person making this utterance is known to be a large, old redneck, then a stronger relationship and hence a higher activation level is likely to exist between the concept *pizza* and *smell wonderful* because the typical large old redneck is more thought of as liking pizza than flowers. On the other hand, if it is known that the speaker is an anorexic vegan, the opposite conclusion, associating *flower* with *smell wonderful* will more likely be arrived at. In either case, the antecedent in closer proximity is more likely to be chosen.

For (21), it may be assumed that *the monkey* is at *The Zoo*, but still to be sure, some extra information to increase or decrease the activation needs to be known. *The Zoo* might be the name of a nightclub and *the university* may have a primate research laboratory. Then again, *the monkey* may also refer to the girl who dances in the cage at *The Zoo*. For (21), it is not necessary to know about the person making the utterance, but rather about the locations talked about. Simply stated, the things known

about the conditions and people surrounding utterances heard can have a drastic associative effect on the interpretation of events. In (20), (21), and (22), the pairs of sentences serve in creating the background. Each word in each utterance contributes to the overall understanding of the situation. As well, extraneous information from the listener's life may be incorporated in the background or the listener may have some strange associations in their own mind. The number of relations a pair of utterances can enter into is limited only by how well-connected the listener's mind is. The most salient one will be the first one to enter conscious thought and yet, if one ponders, other possible relations become available. This provides for great flexibility in interpretation. All bridging interpretations are available given enough time, and the addition of further information to the background could cause any of those possible relations to become more salient. The varying association between interpreters will determine the differences in the accessibility of antecedents.

G. A Bridging Reference Questionnaire

Following Wilson and Matsui (1998), an informal survey was prepared for this study in order to see how different people would respond to different bridging associations. The test had 16 pairs of sentences and, in all but one, the subjects had two competing antecedents to choose from. Instead of asking the subjects if the example was infelicitous, as Matsui did, the subjects were asked if they felt the example was strange. The subjects were all native English speakers with at least a bachelor's degree and over four years of experience in teaching English as a second language.

Some of the sentences were taken from Matsui's questionnaire, one was a standard example with one readily available antecedent and referent, and about half of the examples were new. The new sentences all had two antecedents to choose from. The test can be found in Appendix A along with the results. In the sentences with two possible antecedents, some of them were similar (*train, taxi*). Some of the antecedents were from different word-level categories (*doctor, wallet*), and some were of different word types (*jump, water* and *studied, exam*).

In the questionnaire, every sentence pair was marked as being strange by at least two of the subjects. Even (15), which was supposed to be the basic example of bridging reference, with one highly salient antecedent for the given referent, was marked as strange by 36% of the subjects.

(15) *Bob was eating an apple. The worm he saw made him sick.*

Only 86% of the subjects chose *apple* as the antecedent of *the worm*. Note that the subjects were allowed to mark the antecedent and mark the sentences strange at the same time. What was interesting was that for this example some subjects chose an antecedent that was not even part of the previous sentence. One of the subjects mentioned that they thought the worm was on the ground. This goes against the coherence-based account, where the interpretation depends on the prior discourse. In the following example, of the subjects who chose an antecedent, all chose *taxi*.

(47) *The train stopped the taxi. The driver died.*

However, even in this case, 50% of the subjects thought the example strange. In all of the other examples, either of the possible antecedents was chosen.

The examples that were taken from Matsui's questionnaire were roughly similar in their results with the exception of the following pair of sentences:

(48) *I prefer Italy to England. I hate the pasta there.*

In Matsui's study, 100% of the subjects chose *Italy* for reference with *there* while in this study 79% of subjects chose *England*. Perhaps this is a reflection of either the international thinking of the subjects in this study or the ordering of the sentences in the questionnaire.

For sentence pair (20), which we have already discussed, of the subjects, 86% chose flowers as the antecedent while 7% chose pizza.

(20) *We picked flowers before ordering pizza. The smell was wonderful.*

An associative priming account is compatible with this, as through this account, whatever the hearer thinks is important or salient can be factored into making the bridging reference. This implies that any possible thing the listener finds to relate best with the referent can be used, even to the extent that it replaces something that, to others, appears closer and is more accessible because it is in the previous sentence.

H. Comparing the Semantic Account with the Relevance-Based Approach

A relevance-based approach tries to balance effort and effect. Extra information is factored in through the use of encyclopedic knowledge.

Effort: The first interpretation is not always justified.

Effect: How fine does the interpretation need to be?

- a) Grice's Maxims of Quality and Quantity assume hearers expect utterances to be true.
- b) Grice's Maxim of Relation assumes hearers expect utterances to be relevant and coherent.

A priming-based account builds a background that automatically produces a connection between referent and antecedent. This happens because the processing is all done as the words are encountered. Other information is incorporated into the background through association with the words. Even word stress, the location the listener is in, and what the listener is concentrating on can contribute to the connection. If the listener is concentrating on something unrelated to the conversation, the wrong association could result. Hence, it may be possible to explain Freudian slips with this account.

Grice's Maxims of Quality and Quantity assume hearers expect utterances to be true. In a priming account, whether or not the speaker is telling the truth will be incorporated into the background. If someone often lies, then when they make an utterance, the belief that they may be lying is likely to be incorporated as part of the background. This extra association may change the interpretation of the utterance. Here is an example of this from a *Dilbert* comic strip modified to exemplify bridging reference:

(49) D: *Have you ordered the stuff I need?*

B: *The shipping takes two weeks.*

D: *I see you have cleverly avoided answering my question.*

Here Dilbert expects the person he is talking to to lie and interprets his utterance accordingly.

In Matsui's questionnaires people were asked to judge for themselves which antecedent was being referred to. She wanted to find out what people considered stylistically infelicitous and whether antecedents would be rejected due to encyclopedic knowledge about the referent. The questions all had two similar antecedents.

In Matsui's questionnaire, for the following sentences the subjects were all asked where the humidity bothered John. The percentages for responses are in brackets:

- (50) a. *John worked in England before moving to Hong Kong 5 years ago.*
The humidity didn't bother him. [England 40%, Hong Kong 60%]
- b. *John worked in Hong Kong before moving to England 5 years ago.*
The humidity didn't bother him. [Hong Kong 60%, England 40%]
- c. *John worked in England before moving to Hong Kong 5 years ago.*
The humidity really bothered him. [England 40%, Hong Kong 60%]
- d. *John worked in Hong Kong before moving to England 5 years ago.*
The humidity really bothered him. [Hong Kong 100%]

These examples are interesting because they show that no possible algorithm could be used to generate the results. In the questionnaire for this paper, (50a) and (50b) were included. The results were similar. For (50a) the results were: England 21%, Hong

incorporated into the background. Let us revisit our classic examples of infelicitous sentence pairs:

- (10) *We stopped for drinks at **the New York Hilton** before going to **the Thai restaurant**. **The waitress** was from Bangkok.*
- (11) *We stopped for drinks at **the Hilton** before going to **the zoo**. **The baby orangutan** was really cute.*

Matsui (1993) believes that these seem stylistically infelicitous because different people do the processing differently. Those who try to match the referent with the antecedents by matching in parallel (one referent to two antecedents at the same time) arrive at a choice for the match without any problem or feeling of infelicity. Those who match the referent to one antecedent and then the other in turn will encounter times when they will check the wrong candidate first and, as a result, experience some wasted effort which is expressed in their feeling of infelicity. Intuitively, all antecedent candidates need to be checked to see if they are acceptable. In a priming account, all are checked in an efficient manner, and the candidate most associated, in the interpreter's mind, is selected. How individuals select antecedents that are not even in the previous utterance can also be explained. Infelicity or 'strangeness' occurs when two or more candidate antecedents are available and a definite choice between them cannot be made. This inability to make a definite choice is directly related to the amount of information known about the candidate antecedents and uncertainty over which one to choose.

I. Justification for the Priming Framework in Bridging Reference

A semantic priming framework is necessary for bridging reference because it allows any antecedent to be chosen by any referent. This choice of antecedent is also not final, as the background information will linger for a short time. If a further utterance changes the background, another antecedent can become more salient. This account also does not depend on having a minimized amount of processing available. According to individual association, antecedents that seem, to most people, to be more accessible can be rejected in favor of other antecedents. Also, this account explains how different individuals can choose different antecedents for a given referent. Taking another look at example (15):

(15) *Bob was eating an apple. **The worm** he saw made him sick.*

If the individual is focusing on *the apple*, the individual will enter *the apple* into the background and interpret *the worm* as being in *the apple*. However, if the individual is focusing on where *Bob* is, they will enter that into the background and interpret *the worm* as being on *Bob* or on *the ground*.

J. Consequences for the Analysis of Other Pragmatic Processes

The semantic account has the potential to help explain other problems in pragmatics, such as deixis and ambiguity resolution. The semantic associative account is almost mechanical, showing that little conscious thought is required. It should be possible to develop it further to explain some aspects of humor, the Freudian slip, and why certain errors are introduced into utterances. It also ties together different levels

of processing like that done for pragmatics with some of the mechanics underlying the lexicon. An additional benefit of this account is that semantic priming uses a neural network model, and setting up a neural network model for computational processing is more straightforward than a relevance-based account. This could lead to improved accuracy in machine translation.

K. Final Remarks

A relevance theoretical account provides a basic means of looking at how bridging reference works without getting into a lot of detail. However, sometimes the detail allows us to see reasons why things work the way they do, and without the detail, some of the antecedents that are chosen in real life would not be accessible. A priming account provides a close up view of what is actually going on in the mind of the listener and gives an adequate explanation as to why an utterance can be infelicitous to some and felicitous to others at the same time as well as how the same utterance can be interpreted differently by different listeners. Without this capacity and without the possibility of interpreting utterances in the many different ways, any account of bridging reference will be incomplete. A bridging reference account needs to be able to choose any available antecedent. A priming account of bridging reference has this ability.

V. Conclusion

Semantic priming is a useful tool for doing research in linguistics. As shown in the first example “A word association test for ambiguous words”, semantic priming theory can be used to design and perform simple, easy-to-apply experiments to find support for theories. The theory can also give us insight into the interpretation

of results. As shown in the second example, “The influence of associative priming in bridging reference,” the model of semantic priming can also be applied to other linguistic phenomena to see if they are in any way similar, and hence it can be shown whether priming is active in those phenomena as well. Semantic priming is a useful tool for linguists to use in their research.

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Appendixes

Appendix A. Bridging Reference Test with the Results:

For the following sentences, what do the **bold faced** words refer to in the previous sentence. If the sentence seems strange, mark it as strange.

1. John worked in England before moving to Hong Kong five years ago. **The humidity** didn't bother him.

Results: England 21%, Hong Kong 71%, strange 14%

2. John worked in Hong Kong before moving to England five years ago. **The humidity** didn't bother him.

Results: Hong Kong 50%, England 36%, strange 50%

3. Kevin moved from New Zealand to England. He hates **the sheep**.

Results: New Zealand 64%, England 21%, strange 64%

4. Kevin moved from New Zealand to England. He loves **the sheep**.

Results: New Zealand 21%, England 50%, strange 71%

5. The dog was in sight when we heard a yelp. We couldn't find **the animal**.

Results: Dog 43%, Yelp 21%, strange 50%

6. The doctor found a wallet. A week before **the man** had lost it.

Results: Doctor 7%, Wallet 50%, strange 71%

7. The man jumped into the water. **It** was too cool.

Results: Jump 7%, Water 86%, strange 14%

8. Bob was eating an apple. **The worm** he saw made him sick.

Results: Apple 86%, Other 7%, strange 36%

9. I studied all night for the exam. **The coffee** kept me awake.

Results: Study all night 43%, Exam 0%, Other 7%, Strange 36%

10. We picked flowers before ordering pizza. **The smell** was wonderful.

Results: Flowers 86%, Pizza 7%, strange 57%

11. We stopped at the university before going to The Zoo. **The monkey** was cute.

Results: University 7%, The Zoo 71%, strange 57%

12. I ran from the classroom to the playground. **The children** were making too much noise.

Results: Classroom 50%, Playground 29%, strange 50%

13. I prefer Italy to England. I hate **the pasta** there.

Results: Italy 7%, England 79%, strange 21%

14. The train stopped the taxi. **The driver** died.

Results: Train 0%, Taxi 71%, strange 50%

15. The taxi stopped the train. **The driver** died.

Results: Taxi 29%, Train 36%, strange 79%

16. I prefer Italy to England. **The weather** is worse.

Results: Italy 14%, England 57%, strange 64%

Appendix B. Ambiguous Word Association Test

Name _____ Age _____

Directions: Read the given words, and then write down four more. If the word is Korean, write Korean. If the word is English, write English. If you don't know the word, then skip it.

bank				
steel plant				
star				
go bowl				
can				
ring ring				
right				
night bat				
tear				
sea wave				
흰눈				
밤				
배맛				
길				
돌다리				
팔				
은행나무				
가지				
말하다				
일				

어휘적 중의성과 교량지시의 의미 점화 적용

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본 논문은 언어 연구의 한 도구인 의미 점화(semantic priming)의 기존 이론들을 종합 분석 검토하여, 의미적 점화가 무엇이고, 여러 이론들이 의미 점화를 어떻게 설명하고 있는가를 밝히고, 의미 점화 이론이 언어 현상 설명에 어떻게 적용될 수 있는지를 두 가지 언어 현상을 예를 들어 논의 한다.

첫번째 예는 어휘적 중의성(ambiguity resolution)문제이다. 어휘적 중의성 해소(lexical ambiguity resolution) 및 어휘적 중의성에 대한 여러 현상들이 의미 점화 이론을 적용함으로써 더 명확히 설명될 수 있음을 보았다. 두번째 예는 교량 지시 (bridging reference) 문제이다. 사람들이 보통 담화나 연설에서 부딪히게 되는 지시 대상물의 선행사 선택 문제에 의미 점화 패러다임을 적용함으로써 보다 일관성있게 해결 될 수 있음을 밝혔다.

이 두 언어 현상을 각각 영어 본토인 화자와 한국인 학생을 대상으로 한 설문지 응답 자료를 바탕으로 설명함으로써 의미 점화 이론이 두 언어현상에

어떻게 적용되는가를 실험으로 증명했다. 의미 점화 이론이 다른 여러 언어 현상 설명에도 적용될 수 있다고 생각하며 더욱 활발한 연구가 이루어지기를 기대한다.