A Thesis

entitled

Hard Science Linguistics and Brain-based Teaching: The implications for Second Language Teaching

by

Muye Sun

Submitted to the Graduate Faculty as partial fulfillment of the requirements for the Master of Art and Education Degree in ESL

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An Abstract of

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Input is usually thought of as linguistic forms to which learners are exposed. How the brain works has a significant impact on what kinds of learning activities are most effective. Using differentiated PowerPoint presentations with materials in an artificial language designed for the study, this study investigates three types of language input to find the most effective input to help foreign language teaching in the classroom: translation-based input, picture-cued input and breadth-and limits-of-association input. Three PowerPoint presentations were created providing various types of input. The target language was an artificial language we designed. Subjects were 80 undergraduate students divided into 3 groups. The results of ANOVA and post hoc Scheffé performed on post-test scores for the 3 groups indicate that the breadth-and limits-of-association input showed a significant advantage over the other two, but the picture-cued input did not differ from the translation-based input (F=16.041, p=.000).
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Chapter 1

Linguistic & Brain-based Teaching

1.1 Motivation

English has developed into such a powerful language in the 21st century, and is often taught even beginning at kindergarten in many non-English speaking parts of the world. While there is generally great interest in how language is learned in the modern classroom, the question arises as to what type of language input is most effective. In my undergraduate English class, the English class was simply separated into three parts. First, we studied the translated meaning of the new vocabulary words. Second, we translated the text and explained its difficult grammar points. Third, we answered the questions or did the exercises in the textbook. That was also the model by which I learned English while in middle school. In many of the second language classes, teachers still use this kind of traditional translation-based, word-to-word teaching method, which simply follows the textbook, teaching the vocabulary and the text by offering its translated meaning. I used to work as private tutor for five middle school students several years ago; the textbook they used was a newer edition, and the content was more interesting than what I experienced as a middle school student. Instead of just having text, these newer
textbooks always included at least one picture illustration for some vocabulary or for some specific part of the text, I was encouraged to see such changes; however, although texts have changed somewhat over the years and while there is generally great interest in how language is learned in the modern classroom, the question remains as to what type of language input is most effective. This paper will investigate the most effective second language input in the classroom.

1.2 The role of second language (L2) input in the light of SLA theories

The importance of input has been widely recognized in the field of Second Language Acquisition (SLA) (Schmidt 1990; Krashen 1985). Input is one of the most important elements in the process of SLA because of it plays a fundamental role (Ellis 2007; Gass & Mackey 2007). As Gass (1997) has mentioned, without language input, L2 learning simply cannot take place. Niżegorodcew has noted that “L2 input should be first noticed and related to the existing knowledge” (Anna Niżegorodcew 2007, p.59). Chaudron (1985) regarded the input which was available to second language learners as “the raw data from which the learners derive both meaning and awareness of the rules and structures of the target language” (p.10). Sharwood Smith (1994) described input as the “language data which the learner is exposed to.”

Input is presented within the framework of the Language Acquisition Device (LAD) (Chomsky 1964) as “the primary linguistic data” (Chomsky 1964, p.26). Chomsky believed that there is an innate “language learning device,” through which the well-formed sentences (language input) transfer to generative grammar. Input also plays an essential role in Chomsky’s Universal Grammar, as it triggers knowledge of language
consisting of principles, parameters and lexical items (Cook 1996, p.154). Chomsky (1964) originally claims that a "mental device" for language learning takes well-formed sentences as input and somehow inductively constructed a generative grammar using the input as raw data. Gold's (1967) unlearn ability proof forced Chomsky to add Universal Grammar to the theory. Innate is something which is already there in our minds since birth.

A framework within which input also plays a dominant role is the Input Hypothesis (Krashen 1981; 1982; 1985). This hypothesis considers input as bits of language that are read or heard by the learner, and claims that the only way that a learner can acquire language is by receiving “comprehensible input.” Krashen continued Chomsky’s theory and view of input as the “primary linguistic data,” and claimed that learners acquire second language in only one way, which is by understanding messages or receiving comprehensible input that is at a level a bit higher than that of their current level of acquired competence. He says learners progress along the natural order by understanding input containing i+1, where i is their current level of competence and i+1 is the level immediately above it (Krashen, 1985).

1.3 The problem of traditional SLA theories

The central claim of Chomsky is that human syntactic ability derives from a specialized, genetically transmitted “organ” of the human brain (Chomsky 1986). He claims Universal Grammar is a set of innate “principles and parameters” that exist in all human brains. If Chomsky is correct, there is no explanation for where humans got their innate ability for language. From Liberman’s point of view, Chomsky’s theories of
human language tend to “mirror opposing views concerning the biological bases of human language” (2003, p. 24). Liberman claims that Chomsky’s view “does not correctly characterize the brain” and “the evolutionary mechanisms that yielded human language includes first natural selection acting on the genetic variation that is present in any population” (Liberman 2003, p 25).

Liberman demonstrated this with two arguments, which come from Darwin’s notion of natural selection. As he wrote, “the evolutionary mechanisms that yielded human language include first natural selection acting on the genetic variation that is present in any population.” In other words, in order to adapt to the environment and survival, some selectively reproducing changes may happen in a population’s genotype. For example, rabbits that can run faster than others may be more likely to escape from predators and manage to reproduce. But the “language organ” that Chomsky claims to exist would have provided no evolutionary advantage to the first person who had it. Therefore, there would have been no reason for the gene to spread. Second, the Darwinian mechanism of natural selection has shaped the biological capacity for human language as “an organ might be modified for some other and quite distinct propose” (Liberman 2003, p. 24). But according to Chomsky, in order to learn a grammar like human languages possess today, they need to have a “language learning device.” Therefore when one considers what evolutionary advantage the supposed mutation would provide, the answer is none.

Another problem is that most of these linguistic theories portray language as an object that the learner can obtain. However, language is only a “projection and externalization of the speakers’ properties onto the real world” (Yngve 1996). For example, for my grandma who has never learned English, the manuscript I am working
on is just a collection of sheets of paper which have weird marks on them. As the object of linguistics study, language does not exist in the physical domain, but belongs to the logical domain. For instance, the word “apple” does not exist in the physical world; it exists only in our subjective experience. Therefore language cannot be observed in the real world. The objects of language (words, sentences) cannot be data in a scientific approach to the study of human communication.

In other ways as well, the assumption that input consist “primarily linguistic data” has been shown to be false (Klein 1986, Yngve 1996). Klein (1986) created the Chinese Room thought experiment:

Suppose you were locked in a room and were continually exposed to the sound of Chinese coming from a loudspeaker; however long the experiment continued, you would not end up speaking Chinese…. What makes learning possible is the information received in parallel to the linguistic input in the narrower sense (the sound waves). (p.44)

This parallel input, in Klein’s view, consists of real world things that the learner can perceive from the context, such as who participate, when and where the interaction takes place, facial expression and gesture of both speaker and listener. But language does not exist in the real world, which cannot be input. If Chomsky’s theory of Universal Grammar were right, the Chinese room would allow the learners to receive the necessary input. Therefore, input does not consist of language objects, but consists of the full range of available sensory experience (Coleman 2005b, p.5).
1.4 Hard-Science Linguistics

Victor Yngve (1996) has developed a new theory that provides the basis for what should be taught in the second language classroom: Hard Science Linguistics (HSL). HSL lets linguists take a scientific approach to studying second language acquisition processes by focusing on people communicating instead of on language, and it mainly concerns the details of how people communicate rather than how sentences are parsed.

HSL divides areas the study into two categories, those in the “physical domain” and those in the “logical domain” (Sypniewski 2009). Traditional linguistics theory rests on the assumption that humans communicate through language and look at language as a real observable property of people’s communication. However, those that adhere to this view fail to recognize that language is not observable in the real world. Language exists only in the logical domain, whereas the speech and marks on the paper belong to the physical world. Focusing on the physical world not only allows us to study the speech and the marks, but also the people, their actions, their physical environment and relevant objects in their environment (Yngve 1996). Studying second language acquisition within Yngve’s HSL framework requires linguists to embrace modern standard science rather than the ancient semiotic-grammatical tradition. The objects of study when taking a HSL perspective are people, the sound waves of speech, other communicative energy flow, and relevant parts of the real physical environment (Yngve 2004).

Yngve defines communication in terms of a linkage which is a model consists of the participants, the props, the settings and the channels. (Fig. 1)
<table>
<thead>
<tr>
<th>Real Physical Objects</th>
<th>Theoretical Constructs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Person</td>
<td>Communicating individual</td>
</tr>
<tr>
<td>Assemblage</td>
<td>Linkage</td>
</tr>
<tr>
<td>Group member</td>
<td>Participant</td>
</tr>
<tr>
<td>Energy and means of energy</td>
<td>Channel</td>
</tr>
<tr>
<td>Physical object</td>
<td>Prop</td>
</tr>
<tr>
<td>Other parts of the surroundings</td>
<td>Setting</td>
</tr>
</tbody>
</table>

Fig. 1 Theoretical constructs of HSL. (Yngve, 1996, p.130)

As Figure 1 shows to us, Yngve’s HSL framework provides an objective way to study people’s communication. Yngve believes that these theoretical constructs are the key aspects of communication events that can be optimized in order to teach people how to communicate in second language more effectively. Through this way of analyzing and observing communication events, teachers may be able to know what to teach and how to teach people to communicate in a foreign setting better.

Second language input in the real world involves not only the speech and the marks on a page, but also the rest of what the learner observes or experiences. The input could come from “the influence of other aspects of the person, influence of what others do and the influence of the environment” (Yngve 1996, p.89). In other words, the input comes from all senses in the process of communicating or interacting with the surroundings. Perhaps then, having a full range of sensory experiences available to a learner during the learning process will generate the most effective second language acquisition input. Coleman has also shown that effective input must correlate perceptions across sensory
modalities (Coleman 2007). Therefore, second language teachers should use multi-sensory input as their main instructional method in the classroom. In this way the instruction can shift from having a focus on language to a focus on the observable properties of communication.

1.5 Brain-based Teaching/ Learning

Second language input in HSL or in a real-world sense is the full range of sensory experience combined with the learner’s internal state, which causes changes in a communicating individual’s properties. Hence, to explore an instructional method that may enhance input to promote acquisition in a new way requires us to look into how the sensory input is processed in the brain that results in learning new behaviors.

Brain-based learning (BBL) is a framework which takes account of how the brain gets, processes, and interprets the information, also makes connections and stores and retrieves those messages (Greenleaf, 2003). This theory offers us a brain-friendly way to teach. Hart (1983) is the first one who connected the brain functions with the traditional education practices. He called the brain “the organ of learning” (1983). Caine and Caine (1991) developed twelve principles to connect the brain functions and classroom teaching strategy. In the 1990s brain-based learning gained widespread acceptance.

This new brain-based learning theory requires that we now shift our focus to the learning process. Scientists have worked for over a century to understand how the brain learns, stores, and processes language. As evidenced from various studies, the human brain has some parts dealing with language processing.
From a neurobiological level of analysis, the process of learning involves the changes in the nervous system, leading to changes in the human’s behavior. To discover how the nervous system controls learning new behaviors, we need to, first of all, know the fundamental structure of the nervous system as well as the properties of its basic components. Generally speaking, the brain has two halves – the left and the right hemispheres. The brain's right hemisphere is adept at seeing the big picture and processes information intuitively. The left brain processes information more logically and analytically.

The brain looks like a web-knitted with neuron cells. Our brain consists of a huge number of mutually linked information units, which are known as neurons. The Nobel Prize winner Santiago Ramon Cajal (1894) discovered that neurons are connected to each other through their axons and dendrites that cover the large areas of human brain. Neurons are specialized to receive and transmit information.

The nervous system is the body’s communication network and control center; it coordinates our actions and transmits signals between different parts of our body. The neuron is the functional unit of the nervous system, which receives and integrates input and distributes the processed information to other neurons. As shown in Fig. 2, all neurons have three major parts: dendrites, cell body and axon. Dendrites receive input from another cell and transmit it to the cell body, then it transmitted by axon from cell body to the axon terminals which communicate with other cells and send the information to another neuron. Finally, the information is transmitted from cell to cell through a special junction known as synapse. The axon terminates at the synapse. At the synapse, the axon of one neuron usually is separated from the next cell by a tiny gap, known as
synaptic space (Rattoni & Escobar, 2000). Information traveling from neuron to neuron must cross the synaptic space in order for the signal to continue along its path, which is called neurotransmission. A single neuron may be capable of receiving messages simultaneously on its dendrites and cell body from several thousand different cells (Willis 2006). Learning occurs by altering the strengths of connections between neurons, and by adding or deleting connections between neurons. The more frequently these synaptic connections are made, the more they are strengthened in the brain.

![Structure of a Typical Neuron](image)

Fig. 2. Structure of a typical neuron (Wikipedia, 2011)

1.6 Information processing in the brain

As Fig. 3 shows, a neuron represents the basic element of a model of information processing in the human brain.

1.6.1 Sensory memory

When students are exposed to communicative behavior, the input will be perceived by one or more of the five senses. The neocortex has an area for each type of sensory
stimuli. The visual cortex processes visual information, the auditory cortex processes sounds, and the somatic cortex processes touch. Then these perceptions will be converted in the sensory register, which is also called sensory memory. Sensory memory is the ability to retain impressions of sensory information after the original stimuli have ended (Coltheart, 1980).

The brain receives language input through all senses simultaneously and separately. Psychologists have found that learning occurs most rapidly when it is associative, that is, information is received through more than one sense. Based on these instantaneous inputs, the brain immediately forms a rough sensory impression of the incoming information.

1.6.2 Short-term memory

Facing the overwhelming amount of input, the brain will scan quickly for the useful information and move it from the sensory register to the short-term memory (SMT) by focusing more specific attention on it (Gaddes & Edgell, 1994). Another name for the STM is working memory.

According to Levine (2000), working memory works as a storage area to compare and combine a new memory with old memories. As the learners are exposed to new input, their brains try to find some associations that are already established. If the learners have some previous knowledge or experience about this new learned input, it is much more likely to remember it. Active working memory performs different tasks that are very important for success in school.

For instance, the teacher holds up an apple in an ESL class, and says “This is an apple” while she pointing at it. Then she points at an orange and says “This is an orange.”
She points to a banana and says “This is a banana.” To non-English speakers the visual input and their previous experience could let them recognize the items the teacher is pointing at. The sound input offers them knowledge of the new language. When newly learned information makes a person remember past information, the connection is built. After the teacher repeats these actions several times, the students’ brains will strengthen various associations which are generated by the new connections among neurons. This association can be described as a great web or connected ways and tracks inside the brain among the neural events. The repetition of the visual input and audio input strengthens the neural web. If there is more sensory input offered in the process of learning, more association will be built in the brain.

1.6.3. Long-term memory

Just as the sensory and short-term memory systems are associated with the process of encoding or registering information in the brain, the long-term memory system is associated with the processes of storage and retrieval of information. This is where information is stored for future use. It should be noted that the long-term memory is a reconstruction, not a pure recall of information or events.
Fig. 3. A model of human information processing (Dynamic Flight, 2003).

In this style of teaching, any given exercise stimulates many of the above areas in order to involve as much of the brain as possible in the learning experience, thereby producing more effective results. Moreover, by using multiple senses to learn, a second language learner will find it easier to match new information to their existing knowledge thus promoting new language learning.

1.7 Translation based teaching method and the Natural Approach

The field of linguistics and teaching has developed several different foreign language teaching methods and approaches in the 20th century. The grammar-translation method is a methods based on traditional method of teaching Greek and Latin. The goal of this method is to make learners able to read and translate the new learned language, but not to speak. This method requires students to translate sentences word for word in
order to memorize the abstract grammatical rules. In the following experiment the translation based input (input 1) was created based on this teaching method.

The Natural Approach is designed to develop basic communication skills. The Natural Approach is an approach proposed by Krashen and Terrell (Terrell, 1982) to develop teaching principles which rejects the formal grammatical organization of language to teach and it emphasizes comprehensible and meaningful practice activities.

In the Natural Approach the teacher speaks only the target language and class time is committed to providing input for acquisition. Our picture-cued input in the following experiment is designed based on the Natural Approach teaching method.

1.8 The input with breadth- and limits- of- association

It is important to note the associations formed are slightly different. This is because people who speak different languages do not distinguish things in the same way. This has been described in terms of differences in scope of reference.

<table>
<thead>
<tr>
<th>A STRAIGHT CHAIR</th>
<th>AN EASY CHAIR</th>
<th>A SOFA</th>
</tr>
</thead>
<tbody>
<tr>
<td>English</td>
<td>chair</td>
<td>sofa</td>
</tr>
<tr>
<td>Polish</td>
<td>krzesło</td>
<td>kanapa</td>
</tr>
<tr>
<td>French</td>
<td>chaise</td>
<td>fauteuil</td>
</tr>
<tr>
<td>Chinese</td>
<td>yìzǐ</td>
<td>shàfa</td>
</tr>
</tbody>
</table>

Fig.4. A few simple cases of scope of reference compared (Adapted from Coleman, 2007:125)
As this figure shows, in China, we call a straight chair “yizi” and call an easy chair and a sofa “shafa.” In comparison, English speakers call a straight chair and an easy chair “chair.” For French, there are three different names for these three different items.

In this situation, a teaching method which contains two kinds of variability are needed, breadth-of-association and limits-of-association.

Breadth-of-association variability exists when inputs show how broadly a certain communicative behavior applies (Coleman, 2007). “For individuals to learn new ways to communicate, input must correlate perceptions across sensory modalities” (Coleman, 2007, p.120). This means that a teacher should introduce a broader range of objects in the communication environment through second language teaching process. For example, an English speaker points at a chair and says to a Chinese person who knows no English, “This is a chair.” Then he points at a sofa and says, “This is a sofa.” After performing several similar actions with several different objects, the Chinese person will understand that by saying “This is” you have performed an identification. He will also understand that by saying “chair” you are referring to the chair and that by saying “sofa” you are referring to the sofa. However, he cannot know that an easy chair is also a chair. In this situation, he needs breadth of association. He needs to know the range of items in the particular culture that can all be referred to by a certain communicative behavior, for example, by saying “chair.” Breadth-of-association is a broad requirement that applies to communicate learning. In order to offer the breadth-of-association input to learners, the teacher need to provide various sensory channels that accompany speech and text (Coleman, 2007).
On the other hand, we also need limits-of-association, which shows the limits of the range of objects in the particular culture. Suppose you point at an easy chair, which in Chinese people’s understanding is in the same category as a sofa, and say to a Chinese English learner, “This is not a sofa,” the Chinese person will surprised to learn the different word boundaries under English culture. The limits-of-association variability shows the learner where “potential referents of chair end and those of sofa begin” (Coleman, 2007). In the following experiment input 3 is created based on breadth- and limits-of-association.

1.9 Hypothesizes

\[ H_A \]: The students group which exposed to the breadth- and limits- association input can get higher score on the post-test than the students who were shown picture-cued input and the translation based input.

\[ H_0 \]: The students which were exposed to the breadth- and limits- of- association input can get equal or lower score on the post-test than students who were shown picture-cued input presentation and the translation based input presentation.
Chapter 2

Experiment

The current experiment utilizes quantitative research methods to explore the most effective second language input by comparing translation based input and picture-cued input versus breadth-and-limits-of-association input. The difference in performance among the students in the three groups in comparison to one another is expected to provide valuable insight into the ESL teaching method.

2.1 Participants and Setting

The participants in this study are ESL students in the University of Toledo. All of the participants were taking the same level of English class when they participated in the research. Six intact groups of Composition I classes were divided into three groups and each group were exposed to different type of input by showing PowerPoint slides. There were 18 students participated the translation based treatment, 28 students participated the picture-cued treatment and 38 students participated the breadth-and limit-of-association treatment.
2.2 Input design

We used an artificial language in the test which was designed by Douglas W. Coleman of the University of Toledo. The items showing in the PowerPoint are common items which can easily recognized by the students from different cultures. Three different types of input were separately presented by PowerPoints via projection screen at the front of the classroom.

2.2.1 Translation based input (input 1)

The translation based input PowerPoint contains 50 slides and last about 8.5 minutes. Each input slide last 10 second. Each slide in input 1 presented a target language sentence and its corresponding English translation, as well as the audio sound of the target language. For example, the target language sentence “Ko wost psaspa” was translated as “This is a chair” Input 1 also included negative illustration slides, which consisted of the negative form of the target language text and its translation sentence, as well as corresponding speech. For example, “Ko mwo wost psaspa” —-“This is not chair”.

After an introduction slide, one positive and one negative slide were shown for eleven items, the PowerPoint presentation recycled one time and then shown the first 5 non-negative-form slides for the remaining time. Figure 5 shows four example slides for translation based input.
2.2.2 Picture-cued input (input 2)

Picture-cued (one picture per sentence) input consists of target-language sentences and image to which the sentence applied, as well as the audio sound. The target language sentences were provided in text, but no translations were given. Each sentence matched with exactly one image. For example, the target language text “Ko wost psaspa” was shown at the top of the slide and a picture of chair was shown under it; simultaneously, a recording of “Ko wost psaspa” was played. Otherwise, it also included negative illustrations slides, which also consisted of one image illustration matching with the
negative-form of the target-language text and the corresponding speech. For example, “Ko mwo wost psaspa” means “This is not chair”, this sentence will be followed by one picture which is not a chair. The negative-form slides always followed the non-negative one, in order to make it easy to understand (Fig. 6). There are total 49 slides except an introduction slide. After one positive and one negative were shown for each item (22 items), the PowerPoint presentation recycled the slides that had already been shown for the remaining time. This PowerPoint presentation showing the images and playing the audio has run for about 8.5 minutes and each slide last 10 seconds also.

Fig. 6 slides example for picture-cued input
2.2.3 Input with pictures that provides breadth and limits of association (input 3)

PowerPoint of input with pictures that provides breadth and limits of association consists of pictures of objects and target-language speech playing at the same time, but instead of one images to one target language text, students have seen multiple different images for the object “chair”. The different chair that student seen have changes in style. Input 3 also offered negative-form slides. Two negative slides followed by one negative-form slide. For example, we gave a picture of chair with the target sentence “Ko wost psaspa” and its corresponding audio sound in the first slide. Then in the second slide showed the same combination, we just change the picture to a different kind of chair (Fig. 7). There are total 50 slides and the PowerPoint has been presented for about 8.5 minutes. Each slides also last 10 seconds.

---

![Chair images]

---

![Chair images]
Fig. 7 slides example for Input with pictures that provides breadth and limits of association

2.3 Procedure

One of the three PowerPoint presentations was shown in the class first, and then followed a PowerPoint presentation with the post-test. Before the PowerPoint presentation, the answer sheets were distributed to the students. The test used after each input presentationed the same one, which contained 18 questions. The questions were designed to test the kind of differences in scope of reference that occur naturally in real languages, such as the ones seen in Fig. 8. The students will choose between “Kap” (translated as “yes”) and “Mwo” (translated as “no”) on that sheet. For the test PowerPoint presentation, each exam slide contained a picture and a target language question sentence (Fig. 8). There were five introductory slides at the beginning of the exam PowerPoint to help the students understand how to answer each question (Fig. 9). Each exam slide ran for 10 seconds to ensure the students have enough time to choose an answer on the answer sheet.
Fig. 8 An example test slide in the exam PowerPoint

Fig. 9 An example of the introductory slides in the exam PowerPoint
Chapter 3

Discussing of the result

The data instrument was designed to determine which input is most effective in accordance with the different types of SLA instruction methods. After the input PowerPoint presentation there is a test with 18 questions. Because we need confirm the level of informativeness of the data, the data needed to be analyzed to determine if the skewness and kurtosis of the three groups are within -2 and +2, which would make it likely to be interval level. The result showed all the skewness and kurtosis were within bounds. Kolmogorov-Smirnov (K-S) test were also done to test for normality and the result indicated that the distribution of the data was normal.

Given that the appropriate assumptions were met, I used a one-way ANOVA test to compare results from the test used across the three treatments. The first table below has a summary of the relevant descriptive statistics (Fig. 10). We can see the mean of the breadth- and limits- of- association input (input 3) appears to be much higher than the means of the other two (translation based input =12.5, picture-cued input =11.86, breadth- and limits- of association input =15.29).
In the one-way ANOVA test results, $F$ measures the relative strength of the observed differences in the means. We can see that we have significant differences among the scores of the three groups ($F=16.041$, $p=.000$).

From the results so far we know that there were significant differences between the groups as a whole. The table in Figure.12 shows all possible two-way cross-comparisons.
The Scheffé test (Fig.12) shows that there is a significant difference between the means for translation based input (input 1) and breadth- and limits- of association input (input 3) ($p=0.001$), also between picture-cued input (input 2) and breadth- and limits- of-association input (input 3) ($p=0.000$). However, there is no significant difference between translation based input (input 1) and picture-cued input (input 2) ($p=0.700$).

<table>
<thead>
<tr>
<th>Test Score</th>
<th>Scheffe</th>
<th>Multiple Comparisons</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(0)</td>
<td>(1) Mean Difference</td>
</tr>
<tr>
<td></td>
<td>(J)</td>
<td>(J) Std. Error</td>
</tr>
<tr>
<td></td>
<td>Input Group 1</td>
<td>Input Group 2</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>0.643</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>-2.794</td>
</tr>
<tr>
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</tr>
<tr>
<td>3</td>
<td>1</td>
<td>-3.437</td>
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<tr>
<td>3</td>
<td>2</td>
<td>2.794</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>3.437</td>
</tr>
</tbody>
</table>

* The mean difference is significant at the 0.05 level.

Fig.12 SPSS for Windows Scheffé test based on ANOVA.

The results from the statistical analysis allow us to draw the following conclusions regarding the most effective second language input. The breadth- and limits- of-association input (input 3) group scored significantly higher than the other two groups on the test. Obviously, participants who were exposed to breadth- and limits- of-association input (input 3) learned and recalled words better. Students who were exposed to the translation based input which consists of target language, translation and the audio got the
worse academic performance in the test. It may be a surprise, but the picture-cued illustration input showed no advantage on the test over the translation based input, which is different from our expectation.
Chapter 4

Implication for teaching

As mentioned before, it is clear that the input for language learning consists merely of language, but the totality of a person’s sensory experience. The input for learning should consist of all the sensory experience available to the learner. Accepting the idea that input cannot consist of “primary language data” has a significant impact to second language learning and teaching. The previous theory of language learning is not a real-world theory. Learning occurs on the condition that the learner is being involved in a communicative event that allows association in memory across sensory modalities.

As mentioned before, Chinese and English speakers have different scopes of reference under their own culture. Translation based input and picture-cued input both fail to present such differences in scope.

As in the translation based input (input 1) that we designed for the experiment, we provided the target language and its translation, as well as the audio of the text read aloud. When we showed the translation based input (input 1) PowerPoint to the learners, the teacher and the learners could be considered the participants and the PowerPoint that we showed could be modeled as “props”. The sound waves coming from the computer and
the energy flow of the light waves reflecting of the screen could be modeled as “channels”. When the PowerPoint repeated similar slides, the learner’s brain will form various associations among neural events, based on the co-occurrence of various sensory perceptions. As these co-occurrences become more and more frequent, the relevant synaptic strengths will increase, facilitating these associations. However, in the translation based input the communicative behavior is new but the scope of reference is not presented. For example, the slides showed “Ko wost psaspa” and its translation “This is a chair”. Based on the learners own experience or culture background, they have their own scope of the word “chair.” When they learn “psaspa,” they must associate it with the same scope of reference that have for “chair.” Therefore, they did not really understand fully what “psaspa” is. The association is just created by a wrong connection between their own scope of “chair” and “psaspa.” Therefore, although translation based input has negative form slides, these were used only to teach “mwo,” not to provide limits-of-association to the learners.

In the Natural Approach, the perception of speech or writing does not occur in isolation from people communicating, but is linked to gestural and directed gaze behaviors of the teacher (and sometimes of the students) and to objects present in their environment (Coleman, 2009). When the same PowerPoint repeat, a correlated set of events has occurred involving speech, picture, and the target-language. In consequence, the learner’s brain will form various associations. Although picture-cued input provided one picture to the learners, the association formed here is the same as the one formed in the translation based input. It is just a picture replaced a sentence. The scope of new
learned “psaspa” is still the same as their own scope of “chair”, which is not the scope assigned to "psaspa" in the target language designed for the experiment.

Translation based input and picture-cued input are both fail in defining the correct scope of the new learned language and providing language accuracy. The scope of the new learned word under these two inputs depends on what your first language is.

That is probably why there was no significant difference between the scores resulting from the translation based input (input 1) and the picture-cued input. The slides of the breadth- and limits- of- association input (input 3), in comparison, only gave the learners a clear idea of the new scope of reference for the communicative behavior being learned.

In classroom teaching, the translation based method has more disadvantages. It neglects second language speaking, which plays an important role in communication. Therefore, students fail to express themselves adequately in daily communication.

The most effective teaching techniques for a second language teacher involve showing learners the correlation of parts of input across sensory modalities and providing more communicative interactions. Second language learners should be presented with breadth-of- and limits-of- association input in the form of props, a well-designed environment that facilitates learning by doing through the means of multiple types of media and meaningful real world activities.

In this style of teaching, any given exercise stimulates as many of the above areas of the brain as possible in the learning experience, thereby producing more effective results. Moreover, by using multiple senses to learn, second language learner will find it easier to
match new information to their existing knowledge so that to promote new language learning.
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