

## **Input Frequency and CALL Courseware**

Abstract: The resurgence of input as a consideration in second language is a result of technological advances in measurement and computational linguistics. New brain models allow realignment of consideration for what is best for learners, especially second language learners at a university setting Japan, and for practical curriculum considerations. CALL courseware is currently the leading method of increasing input in a variety of meaningful non-threatening situations and provides one of the best input mechanisms outside of class time. Integration of CALL into the curriculum leads to groundwork for future research.

Input Frequency in linguistics has seen a resurgence in importance with recent technological developments. Cognitive Science is using the Functional Magnetic Resonance Imaging (fMRI) to take “video” of brain activity during intellectual activities, among them using a second language (Gregg, 2006). New models of the language learning such as Emergentism (Gregg, 2003) and Connectionism (Medler, 1998) have developed and challenged the current models of language acquisition. This new model is seen as a result of advances in Computational Linguistics and Cognitive Science. (Hadley, 2002)

### **Input Frequency**

Input Frequency is a function of linguistic input (Long, 1985) which is the quality and quantity of the target language the learner is exposed to and the effects it has on the second language acquisition. Parameters often considered are setting (in class or not, in natural target linguistic environment or artificially created environment such as an intensive language program), quality and level of the input, be it phonological, semantic, syntactic or pragmatic. Other concerns to cognitive scientists are the power law of practice (how often one is exposed to the target language), cue competition (where subjects usually choose the simplest if more than one cue is presented simultaneously), constraint satisfaction (Kyle, 2006) and frequency of language tokens (Ellis, 2002a).

The Connectionist model purports that we develop rules and concepts as a result of repeated association of simultaneous experiences. The Emergent model takes this one step further to say that all intelligent activity is based on this process of emerging associations as a result of input. Both connectionist and emergent models are a result of technology. From Artificial Intelligence, a field of Neural Networks developed, where simple networks were developed with simple mathematical algorithms. These algorithms channeled information (usually a simple binary yes or no, on or off) in the direction it was experienced doing, reinforcing certain paths and not others. From this a primitive kind of changeable network was developed.

### **New Brain Model**

Jeff Hawkins (2004) has been researching intelligence for more than 20 years. Originally he studied Artificial Intelligence (AI) but became disillusioned and went on to neural networks for a short time before turning to creating a new model of the brain. (In the meantime he made millions developing the Palm Pilot and its handwriting recognition system.) Hawkins felt there were three criteria necessary for a complete model of intelligence. 1) Time: the brain processes information very quickly, 2) Feedback: The brain uses an incredible amount of its processing power to provide feedback in all steps of an operation. 3) Physical aspects of the brain: The model had to follow how the brain actually worked (this criterion was beyond AI or Neural Networks).

The brain (or at least the newest part, the neocortex) is about the size of a dinner napkin. It has six layers, each about the thickness of a business card. The dinner napkin is crumpled up inside the skull. There are specific areas of this fabric that do certain tasks (Broca's area encodes speech, for example). These areas are the same general location in everyone's neocortex, but blend into each other and are not rigid.

Vernon Mountcastle postulated in 1978 that even though these areas performed different functions, they were actually doing it with the same mechanism. He proposed that there was only one general computational tool for the entire

cortex. Hawkins goes on to give examples of this theory in his book *On Intelligence*. "Brains are pattern machines." (2005, p.62). The cortex creates invariant representations, similar to the Platonic Ideal, of everything you perceive. "The entire cortex is a memory system." (*ibid* p.68) From this ideal conception variations are added. At the center of this model are four attributes:

- The neocortex stores sequences of patterns.
- The neocortex recalls patterns auto-associatively.
- The neocortex stores patterns in an invariant form.
- The neocortex stores patterns in a hierarchy.

(*ibid*, p.70)

Auto-associative memory is a built-in feedback loop to the original input neuron. It is a checking mechanism that is regularly formed as a part of most electrical stimulations in the brain. In fact, most of the electrical activity in the brain is not stimulation, but feedback. *Hierarchy* is the specificity of the memory: "the brain remembers the important relationships in the world, independent of the details." (*ibid*. p.75) One more point. "Prediction is not just one of the things you brain does. It is the *primary function* of the neocortex, and the foundation of intelligence." (*ibid*. p.89, original author's emphasis)

Space does not permit us to elaborate on how the six layers of the brain work together to bring a hierarchy of patterns, and an inter-association of those patterns. Let us suffice it to say that prediction of patterns is the central process of the new brain, and language is no different, at the most fundamental level, than any other kind of pattern-matching done in the brain. To both create patterns and reinforce their use (memory and recall), repetition is the key. But it must be repetition in a meaningful way, so that the connections or associations of patterns are richer and therefore more memorable.

"The model proposes that the rules we observe in language are as the result of many thousands of interacting micro-constraints acquired as a result of linguistic experience. Harmony maximisation can be viewed as the process of disambiguating or parsing linguistic utterances, so that the final interpretation, closely obeys the statistical constraints that represent the listener's model

of language. In this description, language acquisition is viewed as a process of integrative learning, over visual, auditory, social, and linguistic input - a statistical learning process which parallels the learning mechanisms that occur in networks of neurons in the brain.”(Kyle, 2006, p1)

## **Practical Considerations**

This new model of the brain has coincided with the resurgence of importance of input and its frequency because of the connectionist and emergentist learning models. The question to applied linguistics that must be addressed is how to create the appropriate environment for this connectionist learning to take place. It is important that there be a large amount of practice input outside of the traditional classroom.

The field of Second Language Acquisition can use this new model to prescribe methodologies that are more in line with connectionist concepts. One must first consider the learner, then the material and finally the methodology. We turn here to a specific situation at a university English department in Tokyo, Japan and its efforts to bring connectionist learning to a small part of the English skills program, the Oral Communication classes.

## **Lousy Language Learners**

Why are Japanese learners of foreign languages (especially English) consistently ranked near the bottom of most international measures (i.e. TOEFL)? The amount of speculation leads us in many directions, but if we look at the situation through the lens of this new learning model (connectionist) and the way most learners function here in Japan, we can clearly see the causes.

Language is taught here as a content course, not a skills course. Even though things are improving the overarching methodology reduces motivation and promotes decay because of the scheduling of most classes, especially in the junior high and high school. Students study two or three hours a week and have

occasional homework, but this only lasts about 35 weeks a year. There are long stretches of time when there is no exposure to the foreign language in any form.

“The point is to treat the language from the start as a mode of operation of body and mind, not as intellectual knowledge. This way, learners begin to muster up a language as a coherent tool to be handled as a whole, and it becomes “language for use” (in the words of American linguistic anthropologist Dell Hymes in his influential 1972 paper, “On communicative competence”).” (Childs, 2006, p.14)

Language needs to be taught as a skill, with a huge amount of practice time to be effective. In the movie “Dance, Dance, Dance” the main character is advised to “practice five hours for each hour of lessons”. If we consider complex skills such as playing a musical instrument or dancing, ones that require automatic physical motion combined with high level processing. To develop the automaticity as well as building a framework of linguistic structure on all levels requires constant and repeated input. No one would imagine learning to play a piano with 2 or 3 hours a week in a piano class, a little outside homework, and only 30 weeks a year or less, as is common at the tertiary level. This recipe for failure can be counteracted with a few adjustments.

### **Three Steps Forward, Two Steps Back**

Learning a language is like climbing Mount Fuji. The volcanic ash on the sides of the mountain cause one to slip back for each step taken. In English the saying is “two steps forward, one step back,” but I find the Japanese version more cynical, pessimistic and accurate for language learning here in Japan. Students are trained to memorize chunks of language at sporadic intervals and allowed to forget most of these during vacation, going “three steps forward, two steps back.” Decay because of inconsistent and infrequent input is the primary problem of most Japanese learners. The student in the quote below is the exception.

“Decora had a friend who had spent time in the United States. One day she heard the friend conversing with an American teacher. Decora told me, “I was shocked. I was observing something I had never seen or imagined. I had studied English for about four years and didn't think it was useful for anything. But there they were, laughing and enjoying each other. After that I knew English was spoken naturally.”

Decora quickly began her own learning program. She became a “high input generator” (a term coined in 1977 by Herbert Seliger, now of Hofstra University in New York), a learner who deliberately placed herself where the language would hit her.” (Childs, 2006, p.14)

Research into Input Frequency shows that you cannot teach a language. Every learner has to create the framework and build on that framework, from scratch. The most benefit a learning environment can afford is one rich in input graded at the level of greatest need, providing information as soon as it is called for by the learner.

Input Frequency research shows us that every utterance in the target language is input that will potentially be assigned a pattern in the learner’s linguistic framework. Every utterance in the native language reduces that opportunity, indeed, it is clear motivation NOT to learn the language. As an 11-year-old science fiction fanatic I was transformed by a quote; “Either you are growing or dying.” I mulled that the rest of the summer and continue to measure my life by that phrase. The moment anyone stops learning, they are mentally dying.

Fortunately for us, the brain is a learning machine,

## **Five Steps Forward**

In an effort to eliminate the two steps back and make all five steps forward, the author is proposing a readjustment of attitude by both the students and faculty

of the English department to make input more consistent, appropriate, adequate and quantifiable. The five aspects would include:

- 1) Self-Access Center: A place for students to access additional input in a voluntary and non-threatening environment, or a place for remedial assigned work for students that need extra input.
- 2) Special Activities: Primary focus here is to increase motivation as well as authentic input with activities that are inherently interesting to students so they would be willing and curious. Special lecturers or media to increase extensive listening and reading. These activities could be required (homework), options (extra credit) or voluntary (games or contests).
- 3) Autonomous Learning: Promote and encourage autonomous learning through a series of rewards for conspicuous students (i.e. Top Ten Percent list, Contest winners, profiles of learning and studying). Study Skills (Kiso Zemi) class would have an integral role here.
- 4) English Only Environment: Students tend to follow example over instruction. We need to make the lingua franca English with important information conveyed in English, and only offered in Japanese after repeated requests. For every word spoken in English a step forward is taken, every word in Japanese is a step backward.
- 5) CALL (Computer Assisted Language Learning): Courseware and other programs to give students access to spoken and written input outside school hours and semester. This is the most important of the 5 aspects because the potential for additional work is the most open (students are often overworked during the week during the semester, but do little outside that time period.) CALL has the additional advantage of being easily monitored for help and support.

## **Enter CALL**

Another Artificial Intelligence (AI) expert turned learning specialist Roger Schank (2002) has opined that the traditional classroom is the worst place in the world for learning. If you consider that most classrooms have the minimal input in the way of information, with blank walls, standard chairs and desks, and a blank blackboard. The only input is created by the teacher. There problem is

that there is only one teacher for 30 students. Schank advocates that the proportion should be the exact opposite, that there should be 30 teachers for each student. These teachers should be available to advise the student at the exact moment that the expert information is needed by the student.

Economically, this is not feasible, unless we bring computers into the mix. If we can create a program that will expose the students to a realistic situation with authentic problems to be solved using the target language, and then provide explicit information about the language needed to solve the problem at the moment it is needed, students can use the computer to increase input with a variety of meaningful situations.

The strengths of CALL can be leveraged to improve classroom input and interaction. Giving time over to CALL will increase input and automaticity in a non-threatening environment. The teacher is then freed to apply that knowledge and skill in face-to-face (f2f) interactions in the classroom, challenging to the student apply what was learned in the CALL sessions and be able to adapt.

The ubiquitous computing environment also allows study of CALL outside the laboratory. Entire courses, lectures, and materials are being made available for increased audio and video input to the student through syndicated subscription (RSS) to a series of computer files downloaded from the Internet and loaded onto portable players for consumption any time or place. This is usually called "podcasting."

Courseware (a complete course in a software application, covering all 4 skills and a variety of levels) offers a wide range of practice activities that reinforce classroom input with a variety of situations and constant input at a much higher rate than a normal classroom. Moreover, the computer program can be adapted to the level of the student depending on the answers learners submit. Up until this point in time, these courseware products have required so many hardware resources that they are usually only available on a desktop machine in a laboratory.

DynEd (Knowles, 2004) is a company that provides leading courseware for language learning. Showa Women's University has been using one of these

programs, New Dynamic English (NDE) for approximately four years as part of various different courses and programs. This author has been using DynEd software for more than a decade. Approximately 6 years ago a major upgrade in the software led to a richer environment with more multimedia aspects along with speech recognition (SR) to focus on speaking, listening and reading with a smaller component for writing.

Another major upgrade in the software will change how the software is used. The new licensing agreement allows students (for a small monthly fee) to load the software on their home computer or laptop. Students can then study whenever and wherever they like, and at the end of each session (or a series of sessions) a small amount of data to our main site for record keeping.

This will open up a plethora of possibilities, with weekend, evening and vacation study the first obvious benefit. Beginning April 2006 students will be able to study from home if they choose. Research will focus on who and why chooses this supplementary program, and how their progress compares to those who only study in the language laboratory on campus.

The miniscule granularity of information provided by the record-keeping facility built into all DynEd software will allow us to look at input frequency quality and quantity in literally hundreds of different ways. We propose to look at the power law of practice and other issues treated by Ellis (2002b) for input frequency in further research during the year 2006 and report here next year.

## **Bibliography**

Childs, M. R., (2006). The Practical Linguist: Designing effective classes. *Daily Yomiuri*, February 3, 2006, p. 14.

Ellis, N. C. (1998). Emergentism, connectionism and language learning. *Language Learning*, 48, 4, 631-664.

Ellis, N. C., (2002a). Frequency effect in language processing. *Studies in*

*Second Language Acquisition*, 24, 143-188.

Ellis (2002b) Reflections on frequency effect in language processing. *Studies in Second Language Acquisition*, 24, 297-339.

Gregg, K., (2003). The state of emergentism in second language acquisition. *Second Language Research*, 92, 2. 95-128.

Gregg, T., (2006). Use of functional magnetic resonance imaging to investigate brain function. Retrieved Feb. 2006, from <http://www.neuroguide.com/gregg.html>.

Hadley, H., (2002). Reviewing first and second language acquisition: A comparison between young and adult learners. *Niigata Studies in Foreign Languages and Cultures*, 8, 37-48.

Hawkins, J., & Blakeslee, S., (2004). *On Intelligence*. New York, NY.: Holt.

Knowles, L., (2004). The evolution of CALL. *Language Magazine*, 3, 12, 20-24.

Kyle, R., (2006). The emergence of linguistic rules in connectionist networks. Retrieved February 8, 2006 from <http://www.inf.ed.ac.uk/events/jamboree/2005/posters/RobKyle.pdf>

Long, M., (1985). Input and second language acquisition theory. In Gass & Madden (Eds.), *Input in second language acquisition*. Rowley, Mass.: Newbury House.

Medler, D., (2006) A brief history of connectionism. Retrieved Feb 2006 from [http://neuron-ai.tuke.sk/NCS/VOL1/P3\\_html/vol1\\_3.html](http://neuron-ai.tuke.sk/NCS/VOL1/P3_html/vol1_3.html).

Schank, R. C., (2002) *Designing world-class e-learning: How IBM, GE, Harvard Business School, & Columbia University are succeeding at e-learning*. New York: McGraw Hill.

Wikipedia (2006) Connectionism. Retrieved Feb 2006 from

<http://en.wikipedia.org/wiki/Connectionism>