How can teachers access the brain's learning processes in second language acquisition and use the information effectively and practically?

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Questions plague humans, and in their quest for answering them, growth is attainable.

WHO?

The English language learners' brain is of great interest to ESL teachers as it holds the secrets to best practice for second language acquisition.

WHERE?

Ontario's multicultural schools are the epicentre of equity. To foster its dissemination teachers must work as efficiently and effectively as possible.

WHEN?

Cognitive linguistics is not new, but since the brain is extremely complex its research is ongoing and often controversial. As Canada's immigrant population increases so does the urgency for teachers to plan better so that learners are able to learn faster.

WHAT?

The way parts of the brain are related to learning a second (third, fourth etc.) language.

HOW?

Applying the theoretical knowledge of how the brain functions in second language learning to teaching and practical learning applications, strategies, methods etc.

WHY?

To improve our English as a second language teaching practices, substantiate existing good practice, and equip the minds of English language learners with the necessary scaffolding for learning English quickly and successfully.

"Cognition, consciousness, experience, embodiment, brain, self and human interaction, society, culture and history are all inextricably intertwined in rich, complex and dynamic ways in language. Yet despite this complexity, there are patterns everywhere."[1]

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[1] Robinson, Peter, and Nick C. Ellis. *Handbook of Cognitive Linguistics and Second Language Acquisition*. New York: Routledge, 2008. Page 3.

The Brain

Teachers are the personal trainers of the brain, but how often is this essential organ explicitly considered in schools? The brain is a 3-pound mass of nerve tissue composed of up to one trillion nerve cells. There are four main sections of the human brain: the brain stem, the diencephalon, the cerebrum and the cerebellum.[2]

The Brain Stem	The Diencephalon	**The Cerebrum**	The Cerebellum
- Contains medulla oblongata - Nerves on the right side cross to the left side of the brain - Nerves on the left side cross to the right - **each side of the brain controls the opposite side of the body**	-includes thalamus and hypothalamus **-thalamus: relay station for sensory information and is concerned with some emotions and memory.** autonomic nervous system, - hypothalamus controls endocrine system and controls body temperature	-80% of brain's weight -cerebral cortex performs higher brain functions: **receives and interprets sensory information and remembers, analyzes, interprets, makes decisions. -meaning is extracted from spoken and written language -speaking** -association areas control emotions and intellectual processes by connecting sensory and motor functions **-memory**	-controls movements of muscular system needed for balance and posture

This paper will focus on the **cerebrum.** Memory and learning occur within this area, but are independent of one another. Learning is defined as 'a process that will modify a subsequent behaviour' Whereas memory is defined as 'the ability to remember past experiences.' To understand this in terms of language: "You learn a new language by studying it, but you then speak it by using your memory to retrieve the words that you have learned."[3] Therefore **memory is the record left by learning**. Memory depends on learning: learning depends on memory. Memory allows the linkage of knowledge which is integral to learning. You can more easily remember something you learned by linking it to something you already know.

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[2] "Brain." UXL Encyclopedia of Science. 2002. *Encyclopedia.com.* 21 Jul. 2011 <http://www.encyclopedia.com>.

[3] Dubuc, Bruno. "THE BRAIN FROM TOP TO BOTTOM." *LE CERVEAU À TOUS LES NIVEAUX!* Canadian Institutes of Health Research: Institute of Neurosciences, Mental Health and Addiction, Jan. 2002. Web. 21 July 2011. <http://thebrain.mcgill.ca/flash/d/d_07/d_07_p/d_07_p_tra/d_07_p_tra.html>.

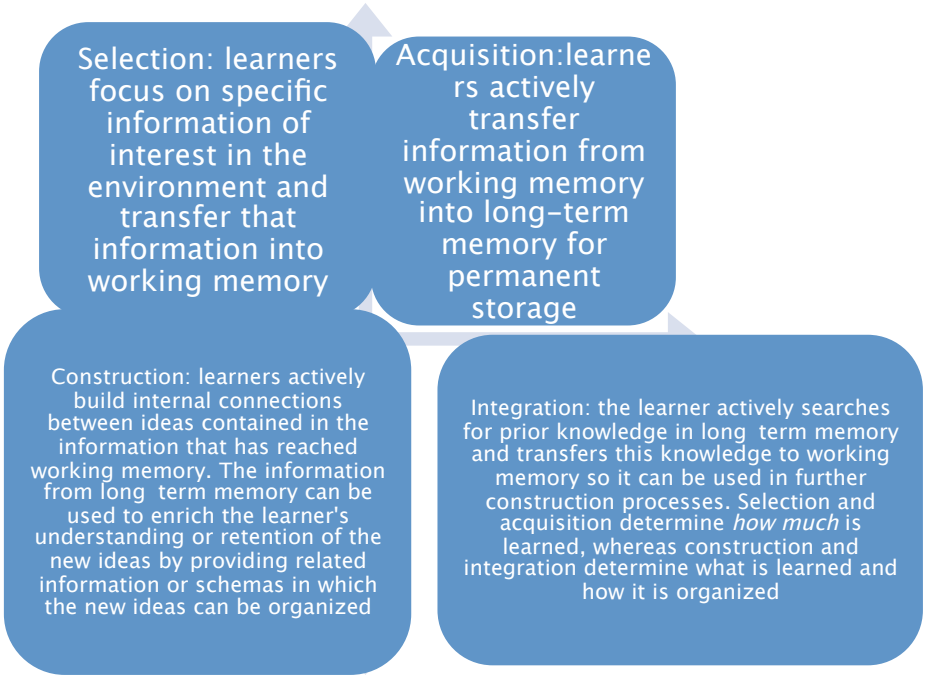
Teacher translation: If students already know one language they can make connections to more easily learn another. In addition, using word families, making content connections to material the students are familiar with and reviewing are excellent methods to access the memory-learning relationship.

Memory

The two main types of memory that teachers are concerned with are short and long term memory (refer to appendix 3 for diagram). Short term memory disappears unless a conscious effort is made to retain the information processed so that it can be transferred to long term memory. Long term memory stores significant events, retains meanings of words and physical skills we have learned. Not all information stored there is equal because there are two types of long-term memory (refer to appendix 3 for diagram). Implicit memory is associated with physical things and explicit with language. [4] A lot of research has been done to study the association of **memory and how information is stored there**.

One paradigm that outlines this process is four-tiered: **selection, acquisition, construction and integration.**

[4] Dubuc, Bruno. "THE BRAIN FROM TOP TO BOTTOM." *LE CERVEAU À TOUS LES NIVEAUX!* Canadian Institutes of Health Research: Institute of Neurosciences, Mental Health and Addiction, Jan. 2002. Web. 21 July 2011. <http://thebrain.mcgill.ca/flash/d/d_07/d_07_p/d_07_p_tra/d_07_p_tra.html>.



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The above information about brain function is composed of indisputable facts however research about **processing second language is quite controversial** as researchers themselves cannot agree on many fundamentals.

The Amygdala too, is an important part of learning as it's a part of regulating memory consolidation. In itself it does not hold long-term memory however it serves as a filter. It works better and stores information longer when transferring and storing emotionally stimulating material. (See image Appendix 2). According to professor of psychology, Michael Gabriel, "Our data show that a disabled amygdala leads to a breakdown of learning-related changes in other parts of the brain.....Specifically, disabling the amygdala blocks learning-related changes…"[6]

Teacher Translation: Make lessons meaningful, and select topics which generate emotions from the students. Ensure that the students feel comfortable and safe in your classroom by creating a welcoming environment so that they are able to access this passion which helps them remember better. Be sure to integrate new and previous lessons, words, and grammar principles together. Always review frequently.

How the Brain Learns

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[5] O'Malley, Michael J., Anna Uhl Chamot, and Carol Walker. "SOME APPLICATIONS OF COGNITIVE THEORY TO SECOND LANGUAGE ACQUISITION." *CourseStar2*. Georgetown University InterAmerica Research Associates Catholic University of America, 1983. Web. 21 July 2011. <http://coursestar.org/ku/markham/TL817/docs/O_Malley.htm>.

[6] Gabriel, Michael. "Amygdala and Memory." *TBI RESOURCE GUIDE*. Centre for Neuroskills, 2001. Web. July 2011. <http://www.neuroskills.com/tbi/pr-amygdala.shtml>.

Children generally learn language in an order of skills that coincides with the ESL strands *(Listening and Speaking, Reading, Writing, Scio-cultural and Media Literacy)* in order as follows: listening, speaking, reading and writing. The strategies children use to learn these skills in a second language are similar to those used in acquiring their first language. "This suggests that there is a unity of process that characterizes all language acquisition, whether of a first of second language, at all ages. "[7] This further emphasizes the distinction between the Ministry of Ontario's distinction between ESL and ELD.

Researchers are constantly making reference to the value of L1 for acquisition of L2. In 'The Handbook of Cognitive Linguistics and Second Language Acquisition' research reinforces this argument by stating: "Furthermore, the fact that L2 learning is so heavily influenced by transfer from L1 means that it would be impossible to construct a model of L2 learning that did not take into account the structure of the first language."[8]

In terms of learning new vocabulary in L2, direct translation from L1 to L2 may not always be possible. That's why with vocabulary meaningful relationships between words is how learners access their brain's dictionary. In practice this looks like word games that contain related pairs as they are the best way to learn words according to the experts.[9]

Teacher Translation: You can transfer skills from L1 to L2 simply with language support. But that same method will not be successful for ELD learners as they must explicitly learn how to acquire literacy, even in L1. This is also a reminder that teachers should encourage students to attend weekend language schools in L1 as it is beneficial to learning English also.

Semantic networks, such as 'word webs' and other brainstorming activities activate prior knowledge and helps store words long-term. Word games are both fun and useful for memory.

Parts of the Brain- Making Connections

The Brain is very complex and has different areas that are responsible for comprehending different parts of language. Typically language is processed in the left hemisphere of the brain. Within the left hemisphere a section called the 'Broca' is believed to be responsible for

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[7] Ambert, Alba N., and Sarah E. Melendez. "P 51." *Bilingual Education A Sourcebook*. New York: Garland In., 1985. 51.
[8] Robinson, Peter, and Nick C. Ellis. *Handbook of Cognitive Linguistics and Second Language Acquisition*. New York: Routledge, 2008. Page 342.

[9] Sousa, David A. *How the ELL Brain Learns*. Thousand Oaks : Calif.: Corwin, 2011. Print.

processing vocabulary, syntax and rules of grammar. Another section in the left hemisphere the 'Wernicke' processes the sense of meaning of language. Therefore it's important to create functional networks to link the two areas to create a greater understanding. "When preparing to produce a spoken sentence, the brain uses not only Broca's and Wernicke's areas (refer to appendix 1: for image of the brain) but also calls on several other neural networks scattered throughout the left hemisphere. Nouns are processed through one set of patterns; verbs are processed by separate neural networks. The more complex a sentence structure is, the more areas in the brain that are activated, including some in the right hemisphere."[10] Researchers found that the Broca's and Wernicke's areas work together to determine whether changes in syntax or semantics result in changes in meaning.

In addition scientists emphasize the role of the mirror neuron system that is, basically learning language through imitation. It is not limited to children's first words being imitated from their parents but continues into second language acquisition. In one study brain imaging technology showed that certain neurons in the brain which occurred when someone planned movement are the same that launch when someone else performs the same movement. [11] Therefore how we speak and the models we produce are more than just providing examples rather they are providing a pathway for learning.

Teacher Translation: It's vital that we model appropriate grammatical structures in our every day speech. We must also make connections between structure and function of language so that we stimulate more than one area of the brain. For example simply stating the definition of a word isn't sufficient in itself, it's better to be defined and used in context.

Learning within Context

Jeannette Littlemore, a professor of applied linguistics, argues that the same processes one uses to make sense of their surroundings are also used when learning languages. An important part of the language learning process is that it is 'usage based', meaning that language is used in interactive settings and contextual cues are employed to decipher meaning. The main cognitive processes involved in this are: comparison, categorization, pattern finding and blending. She elaborates this idea by emphasizing 'centrality of meaning' which is the understanding of vocabulary for its pure meaning and its function in the language. Maintaining that words cannot fully be learned through strict memorization as the meaning that will be learnt will not be comprehensive therefore teachers need to focus on deconstruction of language to

[10] Sousa, David A. *How the ELL Brain Learns*. Thousand Oaks : Calif.: Corwin, 2011. Page 9.

[11] Sousa, David A. *How the ELL Brain Learns*. Thousand Oaks : Calif.: Corwin, 2011. Print.

activate the brain. [12] Teachers are notorious for spelling tests, but according to the experts the words chosen should be those from stories read in class or classroom activities not just arbitrarily selected. This is important because academic vocabulary is seen as integral for standardized testing, and teaching it cannot as a separate entity but rather needs to become embedded in lesson plans.

Teacher Translation: Word lists are good for simple meaning and spelling but are not comprehensive and words are more meaningful when learned 'in context'. There are many series of ESL books (for example Cambridge Connect) that have reading comprehension that coincides with vocabulary lists, which are complimentary to grammar activities etc. These 'sets' are integrated with technology and are on familiar topics to the students and have proven to be effective.

In addition some curriculum expectations, like the one in ESL EO 'writing for academic purposes' suggests "write a report comparing the environments of two regions of Canada." [13]This would be using what we know about the brain to make meaning of our surroundings through the avenue of writing. For example: Concept Maps[14]

Feedback

Susana Sotillo, a professor of Education Management focuses her studies on corrective feedback's role in learner uptake of language. She argues that it's vital for ELLs to interact with native speakers to negotiate meaning and modify their English output. Correction is important because ELLs are able to see their errors and modify appropriately. Her studies show that indirect (ie. asking for clarification) negative feedback (negative feedback is corrective feedback) is more effective than explicit (ie. definition of terms) negative feedback because the latter is only short term whereas the former requires the brain to consider linguistic forms.

Sotillo takes her idea one step further and reasons that computer mediated communication are an important tool in strengthening students' second language acquisition abilities.[15]

Teacher Translation: When giving feedback we should ask probing questions like, "Why do we use 'too' instead of 'to' in this sentence?" rather than restate grammar rules "Too is like also". Assignments such as interviews and extra-curricular activities where ELLs

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[12] Littlemore, Jeannette. *Applying Cognitive Linguistics to Second Language Learning and Teaching*. Basingstoke, Hampshire: Palgrave Macmillan, 2009. Print.

[13] English as a Second Language and English Literacy Development. The Ontario Curriculum Grades 9-12. Page 112.

[14] Many Roots: Many Voices- Supporting English Language Learners in Every Classroom. P25

[15] Pu tz, Martin, and Laura Sicola. *Cognitive Processing in Second Language Acquisition: inside the Learner's Mind*. Amsterdam: John Benjamins Pub., 2010. Print.

interact with native speakers are beneficial to their auto-correction process. In all areas of the ESL/ELD curriculum there are 'Listening and Speaking' strands which have the common specific expectation of 'Listening/Speaking to interact.' Therefore emphasis must be put on this to ensure that students are aware of the value it has on their progress. The curriculum says we must give constructive, systemic feedback[16] but it doesn't say who should give it. Perhaps peer evaluations and group work are also part of this interactive auto-corrective learning.

Another important factor mentioned in the above research is the use of technology to communicate in English, so maybe 'Twitter', 'Facebook' and 'MSN' shouldn't be blocked from our classrooms after all.

Gender

There are differences in the ways males and females learn and are motivated, therefore it's no surprise that they process language differently too. Male brains process language in the left hemisphere of the brain whereas female brains process language in both hemispheres. (See appendix 4) Also the amount and size of communication neurons is larger in females than males.[17] This means that **when learning a second language females communicate sooner than males do**. This has implications for classroom activities based on speaking and communication.

Introvert/Extrovert

Research shows that introversion, perhaps not so in other subjects, in language learning aptitude is less effective because extroverts usually prefer to interact and therefore learn faster and practice more. [18] Although no practical methods have been discussed to effectively change this behaviour, it can explain some of the correlations between low marks in ESL and introversion. To predict which students are at risk for introversion teachers can do multiple intelligence testing and be proactive once they know the student has a predisposition to intrapersonal tendencies.

Teacher Translation: Should we expect different things from boys than we do girls? We cannot change the curriculum but we can differentiate. What can we do to help introverts?

Meta-cognition and Repetition

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[16] Many Roots: Many Voices- Supporting English Language Learners in Every Classroom. P30-31
[17] Hinkel, Eli. *Handbook of Research in Second Language Teaching and Learning*. Mahwah, NJ: L. Erlbaum Associates, 2005. Print.

[18] Hinkel, Eli. *Handbook of Research in Second Language Teaching and Learning*. Mahwah, NJ: L. Erlbaum Associates, 2005. Print.

Thinking about thinking is more effective than memorization. Meta-cognitive activities such as pre-reading, prewriting, word analysis, and post-reading are effective for teaching literacy. [19] Journal reflections and writing essays can also be meta-cognitive if structured appropriately.

Repetition

Some may argue that repetition is similar to memorization, however parallel they may be repetition is more effective than memorization. It is vital that the learners' initial exposure to vocabulary or grammar be followed by additional repetitions. These repetitions must be timed to provide correct retrieval before forgetting prevents the connections to occur in order for the information to be stored long-term.

Teacher Translation: Before starting a new lesson or unit, review the previous one. Make a web of each unit and connect them together before a test or exam. Keep it posted prominently in the classroom and encourage students to make a personal web too.

Give students opportunities to question, infer and be active participants in their learning. Daily journals are a great way to practice, reflect and monitor growth.

Some Additional Questions Raised During Research:

?➠What factors describe "a good language learner" and what characteristics do "good learners" share with them? Is there cross referencing in the brain for these two?

?➠What is the role of aptitude in L2 learning and what role does motivation play in aptitude?[20]

Teaching to activate the brain:

- introduce classroom reading materials that are culturally relevant to the ELLs
- read aloud frequently to allow students to become familiar with and appreciate the sounds and structures of the English language.
- direct students' attention to the spellings of words and grammar encountered while reading
- point out common spelling patters and ask students to think of other words that follow the pattern

[19] Sousa, David A. *How the ELL Brain Learns*. Thousand Oaks : Calif.: Corwin, 2011. Print.

[20] Hinkel, Eli. *Handbook of Research in Second Language Teaching and Learning*. Mahwah, NJ: L. Erlbaum Associates, 2005. Print.

- reference grammar rules as you model writing (I am going to write about parties, how to do you spell party? what's the plural of party? Why did I change the letter 'y'?)

Conclusion

The Ontario curriculum echoes many of the theories of cognitive linguistics therefore it goes without saying that it's vital for teachers to abide by and enrich it. In the early 1950's and 1960's the dominant psychological theory was that of the 'behaviourist learning theory' which focused on memorization.[21] However in 2011 we know that's no longer the most effective method because humans have the ability to continue to ask questions and therefore understanding evolves. It should be noted that all of the brain research considered, science cannot agree on many things and new theories are always surfacing. Additionally the readiness of the child in terms of their stage of culture shock and current living situation must be taken into consideration for the brain to be receptive. Teaching grammar and vocabulary within context, making connections to familiar topics or L1 among other techniques we already know and employ have been reinforced by cognitive neuroscience. I enjoyed learning how the brain processes second language and ways teachers can effectively and practically utilize this information. Nothing entirely new was discovered in this research, but I am now able to substantiate the aforementioned methods and truly know they're 'best practice'.

Teacher Translation: Connect material to students, connect learning to L1. How? By using differentiated instruction, L1, and materials that relate to the learners we can apply what we know about the brain to our daily practices.

[21]Ellis, Rod. *Second Language Acquisition*. Oxford: Oxford UP, 1997. Print.