COGNITIVE LOAD THEORY AND TEACHING ENGLISH AS A SECOND LANGUAGE TO ADULT LEARNERS

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Most second language teaching recommendations place a considerable emphasis on "naturalistic" procedures such as immersion within a second language environment. Immersion means exposing learners to the second language in many of their daily activities, including other educational activities ostensibly unrelated to learning the second language. While immersion may assist in learning a second language, anyone who has lived in an immigrant society cannot fail to have noticed the many adults who learn almost nothing of the second language despite years or even decades of immersion. Furthermore, within an academic environment, even if immersion assists in learning the second language, it is likely to be associated with a considerable decline in learning the associated academic subjects. Simple immersion is unlikely to be effective.

While not always explicitly stated, the argument for immersion seems to be: "Look how easy it is for people to learn their native language. Despite little explicit vocabulary or grammar instruction, they pick it up easily and effortlessly within a few years simply by immersion in their native language environment. If we use the same procedures for a second language, it too will be learned easily, effortlessly, and largely unconsciously."

For young children, this argument probably is valid. For adults beginning to learn a second language, the argument is almost certainly invalid. Adults do not learn a second language in the same way as young children learn a native language. The suggestion that learning a second language should mimic the learning of a first language ignores much of what we know of human cognitive architecture and its consequences for instructional procedures. Cognitive load theory (Sweller, 2015, 2016; Sweller, Ayres, & Kalyuga, 2011) uses our knowledge of human cognition to devise instructional procedures. That theory will be used to structure the remainder of this article, beginning with our knowledge of human cognition.

Human Cognitive Architecture

Categories of Knowledge

For current purposes, there are two categories of knowledge (Geary, 2012; Geary & Berch, 2016): Biologically (or evolutionary) primary and biologically secondary knowledge. Primary knowledge is knowledge we have evolved to acquire over countless generations.

It is acquired easily and without conscious effort. It is modular in the sense that we may have evolved to acquire different types of knowledge during different evolutionary epochs and so the cognitive procedures associated with the acquisition of different types of primary knowledge are likely to differ. Learning a native language provides an example of a category of biologically primary knowledge. We have evolved to acquire listening and speaking skills in a native language and so can acquire the skills without conscious effort or explicit instruction.

Biologically secondary knowledge is required for cultural reasons. We have evolved to acquire secondary knowledge in general but we have not specifically evolved to acquire a particular category of secondary knowledge. The manner in which secondary knowledge is acquired tends to be similar irrespective of its category but vastly different to the acquisition of primary knowledge. All categories of secondary knowledge are acquired with conscious effort and unlike primary knowledge, are best acquired with explicit instruction (Kirschner, Sweller, & Clark, 2006; Sweller, Kirschner, & Clark, 2007). Learning a second language as an adult provides an example of secondary knowledge acquisition as do most of the topics covered in educational institutions. We invented education to deal with biologically secondary information. Learning to listen to and speak a second language as an adult requires conscious effort on the part of the learner and explicit instruction on the part of instructors. Little will be learned solely by immersion. Furthermore, since learning to read and write are biologically secondary because we have not evolved to acquire these skills, they also require conscious effort by learners and explicit teaching by instructors, irrespective of whether we are dealing with a native or second language.

Human Cognitive Architecture Associated with Biologically Secondary Knowledge

Learning a second language as an adult conforms to the structures and processes associated with acquiring any other category of biologically secondary knowledge (Sweller & Sweller, 2006). In this section I will briefly outline those structures and processes.

Information-store principle. In order to function, we must store immeasurably large amounts of information in long-term memory. The difference between people who are more as opposed to less competent in any area including competence in a second language is heavily determined by the amount of knowledge held in long-term memory (Ericsson & Charness, 1994; Nandagopal & Ericsson, 2012).

Borrowing and reorganising principle. How do we acquire the huge amounts of biologically secondary information that constitute substantive areas such as learning a second language? Such knowledge is mainly obtained from other people by reading what they write and listening to what they say. For example, anyone who deliberately studies information produced by others, either written (e.g. in a textbook) or spoken, is using this principle. Once knowledge is obtained, it is usually reorganised by combining it with previously stored information. Based on this principle, learning a second language requires copious, explicit, written or spoken instruction.

Randomness-as-genesis principle. While most of the biologically secondary information we process is obtained from other people, that information must first be generated. Usually, the process of generation occurs during problem solving by a random generation and test process. If we are unable to obtain information from others, we must attempt to generate it. While there is no alternative to generate and test when we are unable to obtain accurate information, this process tends to be inaccurate and clumsy. One merely needs to observe a second language learner attempting to generate spoken or written text from an inadequate knowledge base to realise the deficiencies of the process. It needs to be emphasised that pure random generation rarely, if ever, occurs because we rarely take any action in the complete absence of knowledge. The major point is that in the absence of complete knowledge, action is determined by a combination of knowledge and random generation. The more knowledge available, the less random generation is needed.

Narrow limits of change principle. When dealing with novel information, in order to avoid having to test an impossibly large number of possibilities thrown up by the randomness-as-genesis principle, only a few elements of information can be dealt with at a time. As a cognitive structure, working memory is extremely limited in capacity and duration when dealing with novel information from the environment. Working memory only can hold about seven items (Miller, 1956) and process about three to four items (Cowan, 2001) of information simultaneously. Furthermore, it can only hold information without rehearsal for about 15–20 seconds. Students learning a second language are constantly dealing with novel information. A sentence that may be easily parsed in a native language (see the next principle) may impose an impossibly high working memory load in a second language. All instructional procedures need to account for the fact that students are constantly under a high cognitive load.

Environmental organising and linking principle. While working-memory is severely limited when processing novel information, it has no known limits when processing familiar information transferred from long-term memory. Triggered by environmental signals, appropriate information can be transferred from long-term to working memory in order to allow us to generate action relevant to our environment. In this way, information stored in long-term memory under the information-store principle transforms us. We can carry out activities that otherwise would be beyond us. The more information pertaining to a second language that is stored in long-term memory, the better we are able to use that language.

Based on this cognitive architecture, the purpose of instruction is to facilitate the storage of relevant information in long-term memory. Learning means storing information in long-term memory. That process of storage needs to take into account the characteristics of the human cognitive system and in particular, the limitations of working memory that are directly relevant to instructional design issues.

Instructional Implications

Learning biologically secondary information, such as a second language, requires close consideration of the above cognitive architecture. Instructors need to keep in mind that novice adult learners first must process this category of information in a limited-capacity, limited-duration working memory before transferring that information to an unlimited-capacity, unlimited-duration long-term memory. There are general rules of instruction that apply to all categories of biologically secondary information and some that apply specifically to second language learning by adults.

One general rule is that instruction needs to be organised in a manner that reduces unnecessary working memory load. It should be explicit in line with the borrowing and reorganising principle. Learners should not be asked to induce relevant information by using the randomness-as-genesis principle. In second language learning, this means teachers should explicitly present the grammar and vocabulary of the second language rather than expecting learners to induce the information themselves (see Kirschner et al., 2006, for alternative formulations that emphasise implicit learning) as occurs when dealing with a biologically primary task such as learning a native language as a child. We are good at assimilating information from others. It is a biologically primary skill that reduces cognitive load compared to inducing the information ourselves.

Another general rule is that the amount of biologically secondary information that is provided at a given time should not exceed working memory limits. For example, expecting adult learners to simultaneously learn a second language, particularly at the beginning levels, while also acquiring information concerning other curriculum areas such as science or history is likely to be counter-productive (for a counter view, see European Union, n.d.). We can learn a native language at the same time as we learn other things because we have evolved to do so. We have not evolved to learn a second language in the same way. Learning a second language and learning other curriculum areas should be kept separate whenever possible.

Instruction should be specifically devised to reduce working memory load. There are many examples but three will be emphasised here. First, avoid split-attention which occurs when multiple sources of information must be mentally integrated. For example, when learners need to have vocabulary translations provided, as they frequently do, provide translations close to the original, connecting them with arrows or, if using electronic instruction, allowing the translation to appear by clicking on the relevant word. Requiring learners to go to a separate dictionary imposes an additional cognitive load. Learners should not be required to search for needed information.

Another recommendation is to avoid redundancy. Unnecessary information frequently is processed with learners only finding after the event that they did not need to process the additional information in order to learn. I discussed split-attention above by suggesting that learners should not be required to split their attention between novel vocabulary and its translation. Instead, the translation should be provided in a manner that eliminated the need to search for it. If, however, the translation is not required because it is already known, rather than physically integrating it with the original material, it should be eliminated. Providing a translation is likely to increase unnecessary cognitive load, if only slightly, due to redundancy.

The redundancy effect leads to the expertise-reversal effect. As indicated above, information such as translations that are essential for novice learners should be physically integrated but as expertise increases, rather than integrating the translation, it should be eliminated entirely once it becomes redundant. In other words, an instructional design that is suitable for novices, gradually loses its effectiveness with increasing expertise and may become dysfunctional for more expert learners.

The expertise-reversal effect has implications for immersion in a second language environment. While attempting to teach a second language by immersion is counterproductive for novice adult learners, with increasing expertise, immersion is likely to become increasingly effective. Once they need the practice associated with immersion, it should be introduced and is likely to be effective. The fact that immersion can be effective for more experienced second language learners, not to mention native language learners, is no excuse to introduce it for adult beginners.

These instructional recommendations flow directly from cognitive load theory. They contradict many current instructional practices that routinely ignore most of what we know of evolutionary educational psychology and human cognitive architecture. It needs to be emphasised that instructional recommendations based on cognitive load theory have been extensively tested using randomised, controlled trials and have been demonstrated to be effective. Details, along with many other instructional effects may be found in Sweller et al. (2011).

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Professor John Sweller, Ph.D. is an Australian educational psychologist who is best known for formulating an influential theory of cognitive load. He has authored over 80 academic publications, mainly reporting research on cognitive factors in instructional design, with specific emphasis on the instructional implications of working memory limitations (e.g., Sweller, Merrienboer & Paas, 1998) and their consequences for instructional procedures. Sweller is a Fellow of the ASSA (Academy of the Social Sciences in Australia), and is currently Professor Emeritus at the University of New South Wales.