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Unveiling the Overlooked Negative Effects that are Spawned by Cognitive Ability on L2 Learning: Bridging the Research Gap

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Abstract

Although cognitive ability is essential to second language acquisition (SLA), there can be major obstacles associated with it. This study looks into how cognitive ability affects Chinese adults preparing for the IELTS exam by having them learn English. We discovered via a number of experiments (62 Chinese students took part in) that adult learners frequently rely on well-known language systems, which can result in inefficiency and lower-quality language output. These results point to a possible detrimental relationship between cognitive ability and SLA, especially in adults who have passed the critical age. By examining these effects from linguistic, neurological, and psychological angles, the study provides insights into the ways in which cognitive factors can facilitate or impede language acquisition.

Keywords

The acquisition of a second language (L2), cognitive ability and constraints, American Sign Language (ASL), neurolinguistics, age effects in SLA, adult language learner motivation, second language acquisition challenges

1. Background

There have been numerous findings in academic research on second language acquisition, including neurological perspectives on the process of second language acquisition, elucidating the pathways by which linguistic information is transformed in the brain (Lenneberg, 1967; Greenough & Black, 1992; Perani et al., 1998; Ellis, 1997;); corpus and information-driven learning styles have been explored (Crosthwaite 2015; 2017; 2019; 2024); phonological acquisition and articulatory processes (Munro &

Derwing, 1995; Major, 2008; Escudero, 2005), and Flege's (1995) research on the phenomenon of phonological transfer reveals the formation of pronunciation rules in new language in terms of grammar and syntax acquisition, studies have also explored various acquisition pathways (Ellis, 2002; Dekeyser, 2003; Gass & Marckey, 2014), such as natural language input, which emphasizes the importance of spontaneous acquisition of grammatical rules (Krashen, 1985). Studies in pragmatics theory have also explored the influence of the context and context of speech acts on actual second language acquisition and communication (Brown & Levinson, 1987; Kasper & Rose, 2002).

These studies have generally discussed how to make second language acquisition more efficient and explored the factors that positively influence L2 learners in the acquisition process. However, little has been explored about the original positive factors that may have a negative impact on the second language acquisition process, such as cognitive ability for learners, especially for some who have gone through critical period, but which may render the many positive influences and methods ineffective and trap L2 learners in a vicious cycle of not receiving positive feedback. It is crucial to understand the impact of cognitive ability on L2 learners, not only positive, but also negative, because it is also the essence of human consciousness.

Cognitive ability refers to the capacity to perform various mental activities associated with learning and problem-solving. This encompasses a range of mental processes, including memory, reasoning, attention, and language comprehension. In fact, many scholars believe that cognitive ability is a crucial weapon for language expression. For example, when you are asked to “describe an unforgettable place where you visited”, first of all, your brain accesses long-term memory to recall details about places you have visited that left a strong impression, which involves the hippocampus and other parts of the brain associated with memory. Then, you create a mental image of the place, the visualization process of which consists of the brain's visual cortex, as well as areas responsible for spatial and episodic memory. To describe the place, your brain simultaneously engages language centers such as Broca's area, which is involved in producing speech, and Wernicke's area, which is involved in understanding spoken language. Executive Function includes planning and organizing your thoughts to make your description coherent and engaging, and the prefrontal cortex plays a key role in these higher-order cognitive processes. Finally, "unforgettable" is tied to emotional memories. The amygdala and other limbic system structures play a vital role in processing your emotions, influencing how memories are recalled and described. All these components reflect different aspects of cognitive ability, showcasing how complex and integrated our mental processes are when responding to seemingly simple questions.

However, cognitive ability may, to some extent, be a barrier to second language (L2) acquisition for adults who have passed the critical period. This article explores the pros and cons of cognitive abilities through experiments on adult English learners and theories from three fields: neurology, psychology, and linguistics.

2. The Evidences of Cognitive Ability Benefit Second Language Acquisition

It is generally believed that second language acquisition relies on cognitive ability. In the context of cognitive ability in children, when language enters a learner's brain as information, high neural plasticity is exhibited (Greenough & Black, 1992). This plasticity enables children to flexibly reorganize their neural structures and functions, thereby adapting to and learning new languages more effectively. Particularly when exposed to a new linguistic environment, this cognitive plasticity helps them quickly establish new neural connections and language processing pathways. Concurrently, Broca's and Wernicke's areas, which are responsible for language processing, show heightened activity, enhancing their language comprehension and expression capabilities, as well as overall brain development (Perani et al., 1998). In this scenario, children naturally acquire language rules, structures, and a rich vocabulary through natural interaction and comprehensive language input, including intonation, vocabulary, and grammatical structures (Ellis et al., 1994).

Regarding adult cognitive ability, Johansen-Berg and Duzel (2016) argue that although adults exhibit relatively lower neural plasticity compared to children, the enhancement of language connections and immersion in a language learning environment can still promote brain reorganization and the formation of new neural connections, thereby improving second language learning outcomes. Furthermore, new language information can stimulate the Broca's and Wernicke's areas. Although the level of activity is not as high as in children, adults compensate for deficiencies in language processing by engaging other brain regions responsible for perceptual experiences (Abutalebi & Green, 2007). After receiving new information, adults can also engage in systematic language input and structured language learning methods (such as classroom teaching and language training software) to improve their grasp of second language elements. Crosthwaite (2019) study, for instance, found that L2 learners' second language acquisition efficiency is dramatically improved when they acquire the target language in a data-driven way through a corpus consisting of a large number of various types of texts (e.g., news, essays), and spoken speech. The real language data in the corpus enables adult learners with certain cognitive abilities to enter a natural and complete language interaction environment when learning a second language, better acquire language rules and rich vocabulary, and thus improve the efficiency of second language acquisition. Meanwhile, formulating detailed study plans and goals and having clearer learning motivations are also a reflection of adults' more complete cognitive abilities, and such behavior can often improve learning efficiency, reduce anxiety, and enhance self-confidence (Dornyei, 2001; MacIntyre & Gardner, 1994).

However, Lenneberg (1967), who proposed the Critical Period Hypothesis, suggests that there is a window during early childhood when language acquisition occurs more naturally and effectively, and after this period, the ability to learn a new language declines, and mother tongue(L1) influence becomes more pronounced. Does this imply that language learners' cognitive abilities in various parts of their habitual (L1) language processing hinder L2 acquisition? To verify this hypothesis, as a researcher in Linguistics, Education, and Business, and the founder of TopG, I with my colleagus

conducted an experiment in English classes.

3. The Experiment During the English Class

According to research by Liu et al. (2023), the field's theoretical and practical advancements depend heavily on the discovery of scientific empirical uniformity. By using an English classroom as an empirical setting, researchers can find common facts that serve as the cornerstones of their scientific investigations. Meanwhile, Bollinger et al. (2021) state that because an experimental approach allows for real-time data collection and offers a controlled environment to test hypotheses and observe sincere responses, it is particularly suitable for studying the detrimental effects of cognitive ability on language acquisition.

The experiment involved 62 Chinese students, ages 18 to 22, who all had B1 level English proficiency. The participants were split up into three groups and enrolled in IELTS preparation courses from February to June of 2024. To test the impact of cognitive ability on SLA, distinct topics were assigned to each group for vocabulary acquisition and language expression tasks. Both qualitative and quantitative techniques were used to analyze the data that were gathered through follow-up interviews, organized presentations, and direct observations.

In the first study, all the participants were told to make a presentation with two minutes for one of the Speaking part2 tasks:

“Describe an unforgettable place you visited:
You should say:
Where was the place,
Who were you traveling with,
What was the place like
And explain why you feel unforgettable.”

During the study, I found that the vast majority of students at this language level were unable to organize coherent and fluent sentences to accurately answer this simple question; and some who were able to answer relatively fluently also had obvious “off-topic” answers. When asked, "What do you think of when you hear the question?" some students answered, “The Palace Museum and West Lake in Hangzhou and other tourist attractions I have visited”, while others answered “The answers to similar questions I have prepared”. Meanwhile, students who “answered fluently but were off-topic” were the latter. This type of students, because they were prepared in advance for the test-oriented education model, did not take the experimental results into consideration. Therefore, I asked the second question to the first group of students, “When the actual scenic spots appear in your mind, what is your thought process for organizing the language to answer?” All the students' answers were almost the same. They believed that "the first thing that appears in my mind is the picture, then the corresponding Chinese, and then I will consider how to express this word in English and whether there are alternative words. Unless it is a word I am very familiar with, such as “great” and other basic and commonly used words."

The last question in the experiment was about the students' language acquisition routines after class. "According to your thinking process, when you encounter unfamiliar words, you need to look them up in English-Chinese dictionaries to complete your writing or oral exam preparation tasks. In this case, can those unfamiliar words, such as 'thatched', be successfully learned? That is, can they be used in listening, speaking, reading, and writing?" The students' answers were all "not sure or no".

In another experiment, in order to eliminate the possibility of students preparing in advance, a less familiar topic was replaced, but at the same time, the difficulty was ensured to follow the i+1 theory:

"Have you learned about outer space and stars? Do you want to travel in outer space? Do you think if outer space exploration is important? Why? "

Although the situation of "going off-topic" still occurred, this was more considered to be an "instinct reaction under the test-oriented education" - they habitually used irrelevant information to enrich their answers so that they could say as much as possible, thinking that this could get higher scores. Of course, this part of the experimental results was irrelevant to the purpose of the experiment, so it is still excluded. The effective results obtained are the same as the first experimental group.

The third group of students was given topics that were closer to their common language. The purpose was to verify how familiar the topic (or vocabulary) was for the students to be able to fluently complete a two-minute speech:

"Describe an interest or hobby that you enjoy.

You should say:

How you become interested in it

How long have you been doing it

Why you enjoy it

And explain what benefits you get from this interest or hobby."

For this question, which is closer to daily life, the participants' answers were significantly easier than those of the previous two groups (although there were still grammatical errors and overly simple or inaccurate words). The participants said that the reason for their "fluent answers" was that words such as "swimming, football, and good for health" did not need to be "referred" from their native language. However, in the expressions, such as "aerobic exercise and sedentary lifestyle", unfamiliar words still prioritized the native language system.

In summary, when using language to express information or related feelings, under the influence of cognitive ability, people will give priority to calling up relevant information stored in the brain. This information is more often presented in the form of pictures. In order to express accurately, people will then use the language system they are familiar with to organize words, and the grammar also follows the language system they are familiar with. This language system is more of a native language system unless the L2 user has reached a near-native level (C1 or above) in the language (whether words or grammar). At the same time, there is no evidence that the L2 learners' learning habits of "conversion between native and second language" are helpful for L2 acquisition, for example, helping learners

accumulate more unfamiliar vocabulary. Therefore, in this circumstance, cognitive ability plays a negative role in L2 acquisition.

4. The Evidences of Cognitive Ability Distract the Efficiency from Second Language Acquisition

Baddeley's thesis (1992) given in the Working Memory Model is in line with my findings. He believed that familiar visual information in the brain is prioritized during expression because this processing method is more efficient for cognitive ability. This pattern causes adult L2 learners to search for circumstances in their native language before expressing themselves in the target language, thereby reducing output efficiency (Baddely, 2003). For example, the learners may recall experiences from their native language environment (such as West Lake) before constructing an image. While this retrieval and "processing" of familiar information can enhance the interaction between visual and verbal encoding systems (Paivio, 1990), this beneficial interaction is based on the premise that adult L2 learners can directly respond in the target language after constructing the image and the situation that stored information in the brain may become a preconceived signal.

After the brain presents the image, to achieve a more accurate interaction between visual and language information, the experimental results showed that, unlike children with high brain plasticity, the learners tended to organize their expression using their familiar language system, including vocabulary, grammatical structures, and intonation, before converting to the second language for output under the influence of cognitive ability. This phenomenon is consistent with Kroll and Stewart's (1994) idea, indicating that bilinguals experience a transition phase from the native language to the target language during language switching, with the native language system dominating. The research of Crosthwaite (2019) in corpus linguistics also shows that L2 learners will habitually organize language interaction through the framework of their mother tongue when they initially "train" in a data-driven corpus. They are also influenced by their mother tongue in the process of dealing with referential expressions and bridging descriptions (Ryan & Crosthwaite, 2020). In addition, Gass and Selinker (2008) also discuss transfer errors extensively, noting that adult language learners often rely on L1 syntax, morphology, and phonology to construct L2 sentences and this reliance can impede the correct usage of L2 grammatical rules and vocabulary. Only when L2 learners' proficiency in the second language is close to their native language level, such as the C1 level, can they exhibit proper language processing in cognitive ability (Birdsong, 2006; Bialystok, 2009).

Moreover, the tendency of adult L2 learners' cognitive ability to use familiar language systems can hinder second language expression, and over time, this hindrance will become more significant and difficult to correct. Different from children who expand vocabulary and acquire grammar unintentionally, if a native language dominates during output and learners who have passed the Critical Period overly rely on translation, it will hinder their direct understanding of the target language, affecting language acquisition (Ellis, 1994; Flege, 2019). Habitual reliance on the native language during the bilingual transition phase can affect L2 learners' degree of language automatization, thereby

hindering improvements in language fluency and accuracy (Cook, 2001). Once fossilization occurs, certain erroneous forms stabilize in a learner's interlanguage and persist despite further exposure and instruction (Selinker, 1972).

5. Negative Effects in other Perspectives

From a memory perspective, cognitive ability has been proven to potentially have negative impacts on S2 acquisition. Short-term memory, which involves the immediate processing and temporary storage of linguistic information, has capacity constraints, especially when adult L2 learners are required to process multiple sources of information at the same time. It is proved that it may result in cognitive overload for them, leading to information processing errors (Gathercole & Baddeley, 1993). Sweller (1988), in addition, found that if the cognitive demands of L2 learners exceed their learning capacity (Including memory), it leads to cognitive overload and hinders acquisition efficiency. In other words, during the short-term memory process of learning the target language, they may be spontaneously told to handle multiple tasks through the ability, such as vocabulary, grammar, phonology, and possibly work-related cognitive demands, all of which make their brains struggle to manage these concurrent demands by exceeding the upper limit of short-term memory capacity. This multitasking mode disperses the learner's attention, and they are also required to continuously switch focus between different tasks, and the pressure on cognitive resources is accumulated, and the process of acquiring the target language is sure to slow down (Skehan, 1998). Additionally, unlike children's implicit learning (acquired unconsciously), adult L2 learners mainly engage in explicit learning, meaning that they are required to be conscious learning of language rules and forms. It would result in cognitive overload of short-term memory and therefore hinder second language acquisition (Horwitz & Cope, 1986).

What is more, long-term memory is essential for learning a second language as an adult because it stores vocabulary and grammar rules along with the experiences that come with using them. However, cognitive skills, such as the ability to encode, store, and retrieve information, are essential for long-term memory to function effectively. Adult learners often exhibit notable deficiencies in working memory capacity and cognitive processing speed when compared to children (Craik & Bialystok, 2006). These cognitive constraints affect the effectiveness of encoding in long-term memory, which causes vocabulary and linguistic rules to be retained more slowly and more difficultly. It can be particularly challenging for adult learners to process multiple language inputs at once due to their limited capacity for attentional allocation; this is particularly evident in the early stages of learning a new language (Hummel, 2010). Adults also exhibit less neural plasticity, which impacts how language knowledge is transferred from short-term to long-term memory (Ullman, 2001). Therefore, adult learners may have trouble transferring language features from short-term memory to long-term memory without frequent repetition and reinforcement training which could impair their ability to use the language automatically and fluently (Schneider & Shiffrin, 1977). In the end, these cognitive constraints reduce the effectiveness and success rate of learning a second language.

6. Summary

Any theory is generally derived from the summary of practice. In my working experience, there are a great number of practical cases in Chinese English class to verify the above theories. For example, most of students are usually so busy translating that they forget to understand the real meaning of the questions and the articles when reading; Students are afraid of being laughed at by the "language police" for their pronunciation, which leads to more ingrained errors such as spelling and also affects listening ability; The vast majority of Chinese students who take the IELTS for the purpose of studying abroad mistakenly believe that they can use exam-oriented education or cramming education to improve their scores on language tests such as IELTS or TOEFL in a short period of time (e.g. one month), but, the actual language learning cycle conflicts greatly with their expectations, leading to negative emotions and thus affecting the results of L2 acquisition; Chinese culture believes that using academic and complex sentences is "advanced", but students ignore the fact that the essence of language is "communication", and this cultural gap causes learners to use the language unfluently and use incomprehensible expressions, make grammatical errors and improper use of words.

There are two sides to everything. In the past, most scholars or teachers embraced the advantages brought by cognitive abilities to L2 learning. This article discusses its obstacles to language acquisition from its opposite, providing language researchers with new horizons and basic theories for studying new educational programs.

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