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The Multidimensional Connection between Second Language Acquisition and Neuroscience

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Introduction

Second language acquisition during adolescence through adulthood is significantly impacted by structures in both the right and left hemispheres that process language. An individual’s degree of proficiency in a second language (L2) and their ability to acquire the language ultimately impacts proficiency in the second language (L2). Neurological, medical imaging studies such as functional structural magnetic resonance imaging (fMRI) and electroencephalography provide essential information about language processing in the brain regarding the language processing regions. Educators can use the information provided in this research study to enhance their practice when teaching adolescent and adult English learners. Understanding bilateral hemispheric involvement serves an integral role in second language acquisition in adolescents and adults. Educators can use the research explaining acquisition of L2 vocabulary when teaching English and the connection to the right hemisphere.

To present and analyze literature that addresses second language acquisition among adolescent and adult English learners. This review is intended to provide educators with important understanding how neuroscience explains the inner-working of second language acquisition, provides key information knowledge about academic involvement, and educational implications allows for development and implementation of strategies in the classroom to best meet the needs of adolescent and adult English learners.

GOAL AND RATIONALE

GOAL

To present and analyze literature that addresses second language acquisition among adolescent and adult English learners that explores the question, what does the current body of research say about the impact of neuroscience on second language acquisition for adolescent and adult learners during 2000–2017.

RATIONALE

The biological and psychological basis of second language acquisition has long been the focus of research in the field of linguistics. The study of the brain’s grey matter impacts both the left and right hemispheres of the brain. Grey matter in the left hemisphere processes language and speech, while the right hemisphere is involved in spatial cognition, such as facial recognition, music, and emotional processing. This research study explores the impact of bilateral hemispheric involvement on second language acquisition in adolescents and adults. The role of the right and left hemispheres in L2 language development, therefore, second language acquisition is a complex, multifaceted process that impacts adolescent and adult English learners in regards to academic involvement, and educational implications are integral to second language acquisition.

METHODOLOGY

TOPIC 1: NEUROLOGICAL IMAGING USED TO DETERMINE HEMISPHERIC INVOlVEMENT Diagnostic Neurological Imaging Studies

- Functional magnetic resonance imaging (fMRI)
- Structural magnetic resonance imaging (MRI)
- Electroencephalography (EEG)
- Functional Near-Infrared Spectroscopy (fNIRS)
- Magnetic resonance imaging (MRI)
- Functional Near-Infrared Spectroscopy (fNIRS)
- Electromyography (EMG)
- Electrophysiology

TOPIC 2: THE ROLE OF THE RIGHT AND LEFT HEMISPHERES IN L2 LANGUAGE DEVELOPMENT

- Bilateral Superior Temporal Gyrus, Bilateral Rolandic Operculum, Bilateral Middle Frontal Gyrus, Bilateral Inferior Parietal Lobule

TOPIC 3: EDUCATIONAL IMPLICATIONS

- Utilization of clinical neuroscience research in teaching and learning
- Reading, writing, speaking

RESULTS

Figure 1: Age of Acquisition x L2 Proficiency

This fMRI study illustrates the relationship between an individual’s age of second language acquisition and second language proficiency.

Figure 2A: Age of Acquisition and Socioeconomic Status

Bilateral Superior Temporal Gyrus and Bilateral Rolandic Operculum

This fMRI study illustrates the relationship between an individual’s age of second language acquisition and socioeconomic status.

Figure 2B: Age of Acquisition and Socioeconomic Status

Bilateral Middle Frontal Gyrus and Bilateral Inferior Parietal Lobule

This fMRI study illustrates the relationship between an individual’s age of second language acquisition and socioeconomic status.

DISCUSSION

Relationship between Neuroimaging and Educational Implications

- Educators can better individualize ESL students’ instruction and provide targeted language instruction when provided clinical neurological information regarding age of acquisition, socioeconomic status, and second language proficiency.
- Educators can refer the research discussing pitch discrimination, semantics, prosody, and discrimination and inflection to assist their bilingual students in learning these language features as they pertains to English.
- Educators can use the research explaining acquisition of L2 vocabulary when teaching English and the connection to the right hemisphere.

Relationship between Hemispheric Involvement and Educational Implications

- Language learning: bilateral involvement
- Reading and Vocabulary: increased L2 vocabulary affords greater gains in word learning

Integration between Clinical Neuroimaging, Hemispheric Involvement, and Educational Implications

- Defined relationship between the age of second language acquisition, socioeconomic status, and proficiency in L1 when striving to learn L2
- Integral relationship between language processing regions and L2 during adolescence-adolescence

Bilateral lateralization of the brain

- Right hemisphere: acquired
- Left hemisphere: acquired

KEY REFERENCES