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A Neuroscientific Approach to Understanding Listening Comprehension in EFL Contexts

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Abstract

The potential relevance of neuroscience to education has been gaining attention from scholars and educators in recent years. As stated by Tokuhama-Espinosa (2021), the professionalization of great teachers involves not only the content and pedagogical knowledge but also the ability to leverage technology based on the understanding of brain efficiency. In this sense, the current paper attempts to bring five applicable principles emerging from neuroscientific findings into the context of language learning and teaching, particularly the development of listening skills. The paper begins by presenting some nuggets of neuroscientific knowledge related to language learning, which opens a novel perspective of conceptualizing the process of listening comprehension. It will then go on to a proposal of a brain-based listening technique as an alternative to teach listening.

Keywords: neuroscience, language learning, listening comprehension, brain-based listening

1. Introduction

Neuroscience is referred to as the science of the nervous system (Churches et al., 2017). Neuroscience can be considered another source of evidence that can contribute to evidence-based practice and policy in education. According to Dubinsky et al. (2019), knowing neuroscience is essential to understand better how students' brains work and how teachers can contribute to its functionality to facilitate language learning and improve the effectiveness of their teaching techniques. Knowledge of neuroscience can be a powerful way to inform teachers of the theoretical bases for established or new classroom practice because it can affect teachers' views of learning. Besides, it also provides a mental framework for teachers to understand nuanced psychological factors that influence classroom practice.

Numerous scholars have suggested integrating the latest neuroscience findings into education practice from different perspectives in recent years. For instance, the Brain-Targeted Teaching Model of Hardiman (2012) gives teachers an instructional framework based on neuro and cognitive sciences research about how the brain and mind work. The six brain targets, representing six stages of the teaching and learning process, highlight the emotional and

physical learning environments, designing instructions to enable students to demonstrate mastery of content and apply knowledge in creative problem-solving. Meanwhile, Zadina (2014) develops a multiple pathways model to raise teachers' awareness of the many pathways involved in learning. His core assumption is that understanding how the brain learns and what is required before introducing new information is essential to orchestrate optimal learning. Similarly, Taylor and Marienau (2016) introduce the notion of Theatre of Knowing as a visual metaphor and storyboard for how learning occurs. The concept describes the interwoven relationships between two factors: the external and internal environment. They argue that educators can figure out how the brain engages in learning and how teachers engage in facilitation by comprehensively viewing this multifaceted relationship.

Likewise, Posey (2019) put an emphasis on brain-based teaching strategies and a demand for attending to the social-emotional needs of learners by proposing a Universal Design for Learning. This design portrays a systematic and proactive way to design learning experiences based on three identified brain networks involved in learning: recognition network (perception, language, comprehension); strategic networks (how we physically act, express and integrate executive function skills); affective networks (interest, effort, self-regulation). Later on, Jensen and McConchie (2020) posit that how the brain operates can offer solutions for finding the best condition to maximize learning. They put forward an approach that stresses the Engagement of Strategies based on Principles of how the brain learns (ESP approach). The most up-to-date argument may come from Tokuhama-Espinosa (2021), who promotes six evidence-support fundamental concepts about the brain and learning. On this premise, she builds 21 learning tenets covering several topics across a range of human variance, which underscores the learners' differences. She uses these principles to create 40 evidence-informed pedagogies for online and face-to-face teaching, believing that these can serve certain purposes of teaching and learning needs in different contexts.

All things considered; the abovementioned authors have acknowledged the enormous contributions of neuroscientific findings in terms of understanding learning mechanisms in the brain. Their attention may be drawn to different facets of the learning brain. Still, they all underlie the notion that creating an optimal learning environment requires the awareness of how the brain works to make learning happen. On the one hand, this knowledge offers a transformational viewpoint on teachers' professional practice. Teachers can gain more insights into the learning mechanism and then develop the appropriate approach to make it happen. On the other hand, this knowledge also gives learners a good reason to be persuaded by the teachers' methods or strategies to maximize students' learning.

Given the emergence of this interdisciplinary approach in education, the author attempts to present five fundamental principles concerning the human brain's nature associated with language learning. These principles are distilled from an extensive review of secondary resources from both educational and neuroscientific disciplines. To avoid misinterpretations of these results, the author examines different perspectives from various neuroscientists to detect the most common evidence. Subsequently, the data is also triangulated by revising numerous

educators' translations of these findings and their application. In this way, the content of the five principles is validated. The author also seeks to describe the L2 listening comprehension regarding the underlying concept of these principles. As a result, a brain-based listening technique is proposed as an alternative to the teaching of listening comprehension.

2. Neuroscience-based principles for language learning

The first and foremost principle about the human brain is that each brain is unique in terms of genetic makeup and neural pathways shaped by individual life experiences (Medina, 2009; Tokuhama-Espinosa, 2021). These two factors contribute to the variation in how the human brain operates or learns something (Barrett, 2017). In other words, each brain has followed "a unique trajectory based on its history, goals and practice" (Eagleman, 2020, p. 150). Therefore, the way learners approach a particular language tends to be coloured by how their brains have been wired based on their exposure to that language.

The second principle showcases the significance of prior experiences in the process of learning (Tokuhama-Espinosa, 2021). Its essence is underlined by David Eagleman, who claims that "early experience becomes foundational. It develops into the architecture upon which everything subsequent is built. Everything new is understood through the filter of the old" (2020, p. 140). Simply put, all new learning passes through the filter of previous experiences or "operational histories" of a particular learner (Lian & Sussex, 2018, p. 7). Learning is an act of meaning-making; the meaning of something to you is a web of associations based on your whole history of experiences. During the collision of old and new meanings, old meanings need to be challenged, refined, or even replaced so that learning can occur.

The third principle concerns the ability of the brain to structurally change in relation to input from the environment, which is described as neuroplasticity (Merzenich, 2013). Indeed, the human brain is malleable. This capacity declines with age but exists throughout the lifespan. Moreover, the adult brain remains plastic for both L1 and L2 (Steinhauer & Kasparian, 2020). This means that the more a person practices a new activity or a skill, the more proficient they can become at it. With extensive exposure or repetition, specific neural pathways are strengthened. Therefore, in the case of language learning, extensive, deliberate practice can lead to the achievement of fluency or the mastery of any language skill.

The fourth principle introduces the notion that our body and speech are synchronized during interactions (Tsuchiya et al., 2020). This harmonious organization of change between body motion and speech occurs in both intra-individual and inter-personal manners. People tend to coordinate and imitate in communication, which accounts for interactional synchrony (Dumas et al., 2010; Orsucci et al., 2013). In communicative settings, brain synchronization is discovered between interlocutors (Alejandro & Andoni, 2018). This phenomenon benefits social interactions in facilitating prediction, reducing cognitive load for smoother information flow and building up affective bonds (Hoehl et al., 2021).

The last principle is related to hemispheric asymmetries or the differences between the two regions of the human brain in terms of their specializations: the right hemisphere (RH) and the left hemisphere (LH). McGilchrist (2019) argues that regarding the nature of attention and processing input, the primacy of the RH should be highlighted. Specifically, according to McGilchrist (2019), the RH is responsible for attention globally while the LH dominance is for local attention. In other words, whatever we experience comes first in the RH. This idea also explains the priority of the RH, whose tendency is to deal with new experiences or learn new information that often causes apprehension. That is to say, new and unfamiliar input must first be present in the RH before it shifts to being the concern of the LH, once it becomes familiar (McGilchrist, 2019). This asymmetry or lateralization is also portraited in the operation of language. Though both hemispheres are involved in most tasks, these contributions from each may not be equal. Specifically, there is a dominance in the LH for most language processes, whereas the RH is more active in processing prosody and metaphor comprehension (Haegen & Cai, 2019). Despite this asymmetrical specialization between the two hemispheres, it should be borne in mind that this lateralization in all functions is not absolute. Still, both regions are involved in almost all mental processes; both constantly convey and transmit information in either direction several times a second (Haegen & Cai, 2019).

3.Understanding L2 listening through a neuroscience lens

According to Worthington and Bodie (2018), "although listening research has seen a resurgence in recent years, our understanding of key aspects of the listening process is woefully lacking" (p.11). Another reason is that the listening process is quite complex because it is individual and personal, involving cognitive activities, affective and behavioral components (Worthington & Bodie, 2018). Historically, listeners were viewed as passive processors or tape recorders; yet, later, there comes a realization that listeners are active searchers for meaning or even active model builders (Anderson & Lynch, 2003; Brown, 1997). As the latter view underlies the activeness of the listeners, it seems to have numerous advocators. For instance, Byrnes (1984) argues that during listening, learners are often inclined to focus on the word to construct meaning due to negative repercussions arising from having mastered their native language. On the contrary, Brown (1997) draws more attention to the impact of learners' background knowledge and their unique life experience. Likewise, Buck (2001) describes listening as an on-going process of constructing and modifying an interpretation of the incoming signal based on relevant information available at that time and emerging from their knowledge repertoires. Similarly, for Anderson and Lynch (2003), during listening, learners actively build their mental models to make sense of the signals. They postulate that listening is a process of building representations of auditory input as a result of combining new information with previous knowledge and experience in both linguistic and non-linguistic forms. Meanwhile, Rost (2016) highlights the integration of various types of processing: neurological, linguistic, semantic and pragmatic processing. He states that listening is an overlapping of these processes in a complementary manner.

It can be seen that these scholars all are on the same ground saying that listening is a process of constructing meaning. However, they differ in explaining how this meaning-making mechanism works. Most of them identify the presence of meaning, the contribution of prior knowledge and previous experience, the occurrence of an interaction between these mentioned factors. Only Rost (2016) presents a combination of processing types covering all facets, including a neurological perspective. However, he remains in the quest for identifying factors and putting them into categories. What makes the listening process through a neuroscience lens in the current paper distinguishable from these arguments is an acknowledgement of the existence of the unknown factors regardless of internal or external ones. The underlying reason is that if a history of an individual lifetime plays a crucial role in that person's learning process, as discussed in the first two principles, their meaning-making mechanism should be respected to maximize their learning. Therefore, when the unique characteristics are taken into account, an endeavour to seek certainty by diagnosing all factors seems not to be correct. Probably it may be helpful within the wall of classrooms, but in the long run, it may be ineffective in natural communicative settings, which are often filled with uncertain and unpredictable circumstances (Marton, 2015). In this case, the notion of operational histories showcases this dynamic feature (Lian & Sussex, 2018). Instead of listing the contributing external and internal factors in the listening process such as linguistic knowledge, background knowledge, prior knowledge, and experience, etc., the term operational histories highlight the activated elements that are supposed to be relevant online according to each learner's personal choice during the process of making sense of auditory input. Taken together, the author argues that listening comprehension is the process of constructing meaning as a result of the interaction between the auditory input and internal representations through the listener's perceptual filter or operational histories in a particular context. The three variables, namely internal representations, operational histories and context, are characterized as personalized, varied, inconstant, volatile and unknowable.

4. A brain-based technique for listening practice

In light of the alternative definition of listening comprehension above and the underlying assumption of principles 3, 4 and 5, the author proposes a listening technique that combines listening to filtered speech and normal speech in synchrony with body movements. This technique was created on the premise that it is possible to create optimal input as an awareness-raising activity to defeat the processing habits of L2 learners' brains (Cai et al., 2021). This can challenge these learners' reliance on the neural of their native language to learn and process L2 (Xie, 2018). Moreover, this input can trigger the right hemisphere before it is processed by the left hemisphere (Eagleman, 2020). In principle, learners have to listen to the filtered speech prior to the normal speech. A certain number of repetitions can be applied to each type of input depending on learners' proficiency level and the listening sources. They have to feel the melody with body movements. In the end, transcripts of normal speech are shown for self-check.

The filtered speech refers to the low-pass filtered utterance at a cutoff frequency of about 320

Hz. At this frequency, the prosodic features (stress, rhythm and intonation) are preserved, but the segmental elements (phonemic, semantic, and syntactic) are degraded (Luu et al., 2021). Studies in brain imaging have found that low-pass filtered speech can activate a number of areas in the right hemisphere strongly than normal speech (Fonseca et al., 2009; Ischebeck et al., 2008). This is because the unintelligibility of filtered speech effectively prevents learners from attempting to decipher the signal's original speech content. In this way, it bypasses learners' mechanism of processing information, which is dominated by the LH, in turn stimulating the RH effortlessly. In other words, when learners listen to filtered audio, this interferes with their well-established L1 listening habit, which tends to identify linguistic features. Under this circumstance, the prosodic features become more salient and more accessible during the listening process.

While listening, learners have to hum along with the melody (for filtered speech) or repeat the utterance (for normal speech) in coordination with their body movements. The underlying reason for this synchrony is explained by the link between body and speech in interactions discussed in principle 4. Learners can choose to move any part of their body (hand, fingers, legs, head, etc.) or even the whole body to feel the rhythm. By producing this kind of spontaneous beat movement, learners can sensitize and internalize the prosodic features maximally.

The technique can be implemented in both traditional and virtual classrooms or even beyond. With the capacity to filter the audio, teachers can build a data bank of listening resources in a particular teaching course. They can choose to play the recordings during the lesson as usual or to design an online platform embedded with filtered and normal speech for learners to practice listening by themselves. In view of the individualized nature of listening comprehension, a self-access listening course is recommended because it can offer learners a personalized, self-paced listening environment and promote their learning autonomy.

5. Conclusion

Overall, the paper set out to describe five principles concerning the human brain based on an extensive review of related findings in neuroscience and education. Accordingly, an alternative interpretation of listening comprehension and a listening technique are developed on the core assumption of the five principles. The paper has argued that understanding how the brain operates and how it processes input is essential for teachers to create an optimal learning environment that maximizes learners' listening performance. Specifically, considering the uniqueness of the human brain, the significance of prior experiences in constructing meanings, the brain's capacity to remold structurally, the synchrony between speech and body, and the functional differences between two brain hemispheres, the paper suggests implementing optimal input or filtered speech in coordination with normal speech and body movements in listening pedagogy. A description of a protocol for listening practice is also discussed in traditional or virtual classrooms as well as in online learning platforms.

This paper has gone some way towards enhancing our understanding of the human brain in the listening process and in language learning in general. It also provides some significant implications for educators and researchers. Specifically, given the enormous benefits of neuroscience knowledge, more workshop or training opportunities regarding this interdisciplinary view for undergraduates, graduates and teachers should be encouraged. By acknowledging the challenges and concerns in connecting two fields, educators need to make considerable attempts to translate the neuroscientific findings into the domain of education, specifically language teaching and learning. In this way, the information can be understood in the right way, and teachers can avoid misleading interpretations. Besides, teachers are advised not to make use of basic neuroscience findings and claim an educational application. Instead, investigation and experimentation are strongly recommended.

With the recent prevalence of online learning and teaching mode, there have been some attempts to find the appropriate approaches to teaching listening in the Vietnamese contexts (Ha & Ngo, 2021; Nguyen, 2021). Future research can be carried out to investigate the implementation of this brain-based listening technique in improving learners' listening comprehension in these virtual classrooms. This would be a fruitful area for further work.

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Biodata

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