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CONTENTS

From the Editor

Hello, everybody and welcome to our Spring issue of the ICC Journal. Congratulations to all attending the annual ICC Languages conference in Larnaka, Cyprus and we look forward to publishing some summaries of talks in our next issue.

We have a large number of excellent keynote articles contributed by experts in various fields but focusing strongly on the influence of technology on our language teaching materials and teaching approaches and so I have decided to put back coverage of webinars and book reviews to our next issue.

So, down to business. Geoff Tranter has published his latest highly entertaining and incisive Testing Times feature, this time imagining the possibility of US English, possibly replacing British English. Given the developments in the USA ,Geoff presents the case for MAEGA, standing for Make American English Great Again, complementing MAGA, Making America Great Again.

In our first of four Keynote articles, Professor Georgios Alexandropoulos of the University of Thessaly examines how the study of literature in the classroom can help develop literacy in the language they are learning. Using examples from Greek literature (but could be any language), he presents hour by hour lesson plans so that the class can progress working in groups to decipher the work and discuss its implications for culture and society.

Our second Keynote article by Heiner Boettger and Bianca Hoeppner, explains the role of the study of neuroscience in learning languages. They introduce a new concept, LEN (Language Educational Neurosciences) and explain how it can support successful language learning, especially for young children..

Minjie Zing of Manchester University and Amiliy Guenier of Lancaster University look at how the use of ChatGPT is being applied to students' academic essays. A fascinating and highly relevant discussion with examples from students in China presenting both the positive and negative sides of using ChatGPT which Minjie is presenting in the Larnaka conference.

Continuing the debate on the role of technology in language teaching Ines Farhadi of Carthage University in Tunisia and Janet Wolf of the University of Hradec Kralové in Czechia examine the influence of technology skills on teaching Englishas a Foreign Language (EFL)

Lastly, but definitely not least, are two more really useful and entertaining classroom teaching tips by Nick Mickelioudakis.

Enjoy the issue!

Eurolta Update

EUROLTA, the European Certificate in Language Teaching to Adults, remains a popular and inclusive qualification, welcoming educators of all languages—not just English.

At the ICC Languages Larnaka Conference, EUROLTA is represented by Myriam Fischer-Callus and leading course trainer Tatjana Kovac, who are also the joint chairs of ICC Languages.

Looking Ahead: Enhancements in 2025

In 2025, the ICC will continue to enhance the quality of the EUROLTA program by integrating valuable feedback from past participants. A key focus of the New EUROLTA is improved flexibility and accessibility. The updated course structure will feature shorter, more manageable modules, including asynchronous components that allow trainees to engage in learning at their own pace and from the comfort of their homes.

New content will also reflect current trends in language education, such as the integration of AI into teaching practices. These updates aim to create a more convenient, effective, and forward-looking training experience.

We believe these improvements will make the EUROLTA program more attractive to aspiring and current language educators, reinforcing its position as a leading certification in the field.

The first iteration of the updated program is set to launch in autumn 2025, marking a significant milestone in our ongoing commitment to delivering high-quality, adaptable professional development.

EUROLTA continues to be recognized as an excellent entry point into the field of language teaching, as well as a valuable opportunity for experienced educators to refine their skills and advance their careers.

KEYNOTE ARTICLE 2

Transferring language educational neurosciences (LEN) to primary contexts: Evincing a new perspective on language teaching and learning

Heiner Böttger & Bianca Höppner, Katholische Universität Eichstätt-Ingolstadt, Germany

INTRODUCTION

This paper introduces evidence-based concepts and methodological approaches to primary foreign language learning substantiated by language educational neurosciences (LEN). The aim is to illustrate the potential that educational neuroscientific research holds to complement insights from psychology, FL didactics and applied linguistics. Firstly, the importance of having an early start to (foreign) language learning is proven. Findings reveal that the years between 3 and 12 are essential to the successful learning of languages. Secondly, insights from LEN that substantiate the immense capacities of the implicit long-term memory (e.g. Schacter, 1995) are connected and transferred to the primary language learning context, before introducing two suitable classroom activities (storytelling, gamification) to foster it. For both main concepts (early start, implicit learning) and the latter's implementation activities (storytelling, gamification), implications for the learning process are further derived. Together, this allows a first glimpse of the potential that LEN holds for primary language teaching and learning.

1 The untapped potential of LEN

In the primary context, neuroscientific findings are key to changing the way foreign languages are taught and learned. This is because they provide a deeper understanding of the neurological processes of learning and can – or should – be used to adapt teaching processes and learning approaches accordingly. It is therefore not surprising that the application of neuroscientific insights to educational practices, particularly in the context of foreign language teaching and learning, is gaining ground in educational sectors worldwide.

In particular, the evidence highlights the increased plasticity of the brain during the primary school years, making it a neurobiologically perfect predisposition for foreign language (FL) acquisition. However, policymakers (e.g. ministries of education in Germany) have repeatedly been reluctant to embrace this evidence and the changes it implies for education (Eurydice Report, 2023). More generally, there seems to be a gap between scientific progress and policy, which delays the implementation of findings and their practical implications in the education system. Similarly, didactics – the science of teaching and learning practices – and applied linguistics – the application of findings of linguistic research to practical areas such as language teaching – often leave educational neuroscientific findings unconsidered, while at the same time, research is increasingly focusing on early language learning. Pioneering research in didactics and applied linguistics, which has become much more detailed over the last decade, has instead focused mainly on language input and output (Böttger et al., 2016). This focus has been, and continues to be, extremely valuable, revealing the impressive and previously underestimated language learning potential of young learners. However, this emphasis also seems to have led to a point where more and more detailed findings do not add much in the way of new insights. At least

not unless the focus is broadened to include language processing – or what happens in children's brains.

That is, research in this field seems to focus mainly on *sensory input*, e.g. looking at different facets of content, materials and media, and *output*, for example, oral or written communication in the foreign language, which seems not to bring about major new insights. This is not to say that earlier findings have not been revealing and essential for educational change. For example, a number of studies support the understanding that multisensory attention and motivation are essential for facilitating the long-term retention of linguistic material in the brain (Krashen, 1982; Willis & Willis, 2007). This has supported the inclusion of divergent input stimuli in classrooms, such as video material. In addition, the effects of visible and audible foreign language usage, or *performative output*, are also well documented, because they are easily accessible through observation, recording and temporal analysis of the data. Evidence from numerous research initiatives also provides a comprehensive understanding of the language skills of school children aged 6–10. Accordingly, we have accurate knowledge of their ability to acquire foreign languages and also understand the areas where further development is required (Gass & Mackey, 2015; Swain, 1995).

Yet, there remains the less explored domain in this field – the intricate process of language processing in the brain itself – *the intake*. The mechanisms that determine when, how, and to what extent foreign language is absorbed and retrieved, as well as the duration of such retention and the circumstances that influence it, remain largely elusive. Existing research has addressed this topic, outlining the role of cognitive load, working memory, and attention in language processing (Baddeley, 2003; VanPatten, 1996). However, the precise intricacies of these processes have

yet to be fully elucidated, providing a rich opportunity for future investigation. Thus, despite the continued growth of knowledge about language input and output, it requires new theoretical and methodological innovations to continue its progression and to answer new questions about early (foreign) language learning. The authors of this paper propose to change the way forward towards including language educational neuroscience (LEN).

Thereby, LEN is a brand-new term coined by this article's authors that is to extend the field of educational neuroscience and shall refer to the multidisciplinary field that combines insights from language education, neuroscience, and psychology. It focuses on understanding how the human brain processes, learns, and uses language, and how this knowledge can be applied to improve language teaching and learning methods. In connecting these reference sciences that are associated with (early) language education, it offers a new perspective on language acquisition that builds on the existing empirical evidence from foreign language didactics and linguistics. This paper aims to substantiate this line of reasoning by elaborating on four exemplary fruits that LEN has already yielded. First, the theoretical background and a short display of the reviewed research field follow.

2 Theoretical background

The theoretical background aims to understand the different fields of study that, when combined, can enhance our understanding of foreign language learning. It outlines the interconnected elements of these fields and explains the research methods used in (educational) neuroscience. It serves as background for the literature review conducted and the delineation of the selected research-based concepts and methodological approaches considered central and easily

implementable. These are outlined in section 4 and aligned with more detailed didactic considerations.

To begin with the interrelated fields of research, developmental psychology contributes critical perspectives on the stage-wise growth of children's cognitive, emotional, and social capacities, providing a fundamental understanding of the child's ability to acquire and use foreign languages (Siegler et al., 2011). At the same time, educational psychology provides pedagogical insights into the optimal ways to teach and motivate children, and shapes the environmental context in which foreign language learning takes place (Woolfolk, 2013). Neuropsychology links both with the study of the brain; specifically, neuropsychology is the study of behaviour and cognition in relation to the central nervous system. In addition, the burgeoning field of educational neuroscience sheds light on the neural mechanisms that underpin language acquisition, showing how the brain changes in response to foreign language learning and exposure (Kuhl, 2010). It provides us with the biological basis of how children absorb, process, and recall foreign languages, bridging the gap between observable behaviour and its underlying neural activity. Taking the outlined areas of interest into account, it is clear that there is a great deal of overlap with regard to foreign language learning. Collectively, they allow us to deepen our understanding of the complexities involved in early foreign language learning and guide us towards more effective instructional practices and educational policies.

In addition, the multifaceted dynamics of early foreign language acquisition encompass several intertwined elements. The most important ones, which are explored in this paper, are listed below. First, the processes of language acquisition are closely linked to the age of the learner. Research suggests that the ability to learn a language, particularly in terms of auditory comprehension, changes as a

function of age (Singleton & Ryan, 2004). For example, narrative or story-listening approaches can be beneficial in promoting language acquisition among young learners due to their ability to captivate attention and stimulate the imagination. Secondly, the mechanisms of memory, which encompass the processes of encoding (remembering), storage (recalling), and retrieval, are central to language learning. Much of language acquisition is implicit, where learning occurs unconsciously through exposure and interaction in the target language (Reber, 1993). Thirdly, and finally, it is crucial to challenge and dispel prevalent myths associated with foreign language acquisition (cf. e.g. Howard-Jones, 2014; Willingham et al., 2015). Based on empirical evidence, the principles of didactics and pedagogy of early foreign language instruction serve to debunk possible teachers` misconceptions and provide a scientifically sound framework for effective language teaching and learning (Lightbown & Spada, 2013). By consolidating the evidence from these three areas, a more comprehensive understanding of early foreign language acquisition can be developed, informing better teaching strategies and educational policies. The ultimate goal would be the architecture of a more natural, albeit institutionalised, language acquisition environment.

In order to develop appropriate research tools to support this proposed new approach, neuroscientific investigations are needed alongside those from the fields of psychology (e.g. experimental designs), didactics (e.g. contrastive analysis of teaching methods) and applied linguistics (e.g. corpus analysis). Neuroscientific research designs thereby intersect with the disciplines of medicine, psychology, and biology, and increasingly use state-of-the-art, non-invasive neuroimaging techniques to probe the intricacies of the human brain. Techniques at the forefront of this cutting-edge research include functional magnetic resonance imaging (fMRI),

magnetoencephalography (MEG), and electroencephalography (EEG) (Buzsáki, 2006; Hämäläinen et al., 1993; Poldrack et al., 2011). Functional magnetic resonance imaging (fMRI) uses the magnetic properties of hydrogen atoms to produce high-resolution images of brain structure and to measure human cognitive functions, which are essential for research into language acquisition (Huettel et al., 2009). The technique capitalizes on changes in blood flow and oxygen concentration – collectively referred to as the blood-oxygen-level dependent (BOLD) contrast – to map regions of the brain that are engaged during specific tasks or at rest (Ogawa et al., 1990).

In contrast, magnetoencephalography (MEG) and electroencephalography (EEG) provide insight into the electrical and magnetic activity of the brain over time. Used in tandem, these techniques provide a comprehensive picture of brain dynamics, with EEG providing excellent temporal resolution and MEG contributing enhanced spatial resolution (Cohen, 1968; Hämäläinen et al., 1993). EE measures electrical activity within cortical areas generated by the synchronised activity of thousands of neurons (in volts).

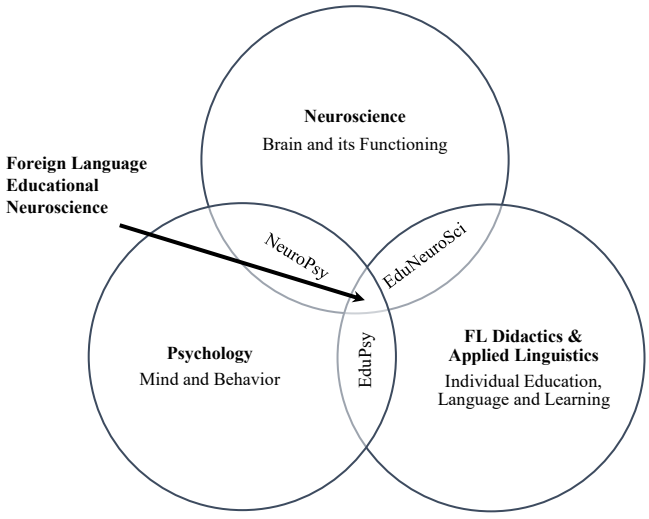
Together, these imaging techniques have transformed our understanding of the brain, providing an unprecedented glimpse into the neural underpinnings of cognitive functions such as language acquisition. They translate changes in cerebral blood flow, oxygen concentration, and electrical activity into computer-generated images, elucidating the complex workings of the brain. This allows for statements to be made as to how strongly, in which way and at what point in the brain language is used.

3 Aim and interlinked disciplines reviewed

The overarching objective of the literature review conducted is to delineate the two evidence-based concepts and the two methodological approaches for foreign language learning selected, with the aim of elucidating their significance and validating the need for an innovative trajectory in research. To achieve this, a rigorous review and synthesis of the relevant literature has been undertaken. The results are to be presented in a highly condensed form in section 4.

The literature reviewed is primarily rooted in three broad domains (cf. Figure 1): neuroscience, psychology, and language didactics as well as applied linguistics. Each of these disciplines contributes unique perspectives and methodologies to the study of language learning, and their integration provides a comprehensive framework for approaching this complex process (cf. Theoretical Background). Therefore, they also form the bedrock of the subsequent section on the two selected main concepts (early start, implicit learning) and the latter's two chosen methodological approaches (storytelling, gamification), which evinces the importance of (educational) neuroscientific findings.

Figure 1. The interlinked disciplines of foreign language education.



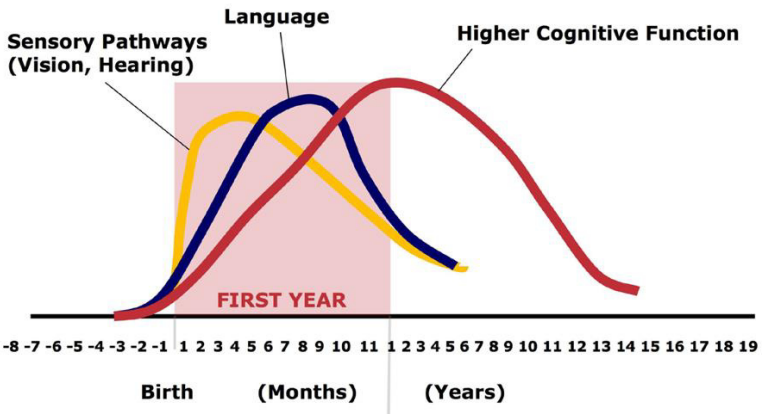
Note. From *Current Issues in Primary Foreign Language Teaching: Part Two: Change Is the Only Constant (Heraclitus)*, by H. Böttger, 2022, September 22, Advances in Teaching Foreign Languages to Young Learners (ATFLY), online.

4 Illustrating the potential of LEN

4.1 Early start

We initiate our examination by exploring the early years preceding a child's inaugural day at school. To begin, the likely most essential component for children to learn foreign languages fluently is to have an early start learning them. This is rooted in the fact that young children's brain is extremely neuroplastic, which implies that its structure is flexible and open to all sensory inputs. In contrast, adult brains no longer have the same plasticity, which reasons differences in learning. Emerging evidence underscores the profound impact of early experiences on the trajectory of brain development. From the prenatal period extending through the initial years of life, the brain undergoes its most dramatic phase of growth, and these early experiences are instrumental in determining the robustness or vulnerability of its architectural design (Knudsen, 2004). A singular and informative graph from Harvard University's Center on the Developing Child, formulated in 2000, provides a comprehensive overview of the challenges associated with our current language education system (Figure 2).

Figure 2. Development of synaptic formation over time.



Note. Adapted from *InBrief: The Science of Early Childhood Development*, by Center on the Developing Child, 2007, retrieved from *https://developingchild.harvard.edu/resources/inbrief-the-science-of-early-childhood-development/.*

The graph delineates the child's brain development corresponding to specific regions. These comprise:

1. The higher cognitive functions associated with the prefrontal cortex (represented by the red curve). These functions encompass decision-making, planning, structuring, and executing.
2. The receptive and productive language skills mainly linked to the Broca's area (indicated by the dark blue curve), which governs (amongst others) listening, speaking, and eventually reading and writing.
3. Vision and hearing associated with the visual/auditory cortex (indicated by the yellow curve).
4. The horizontal axis illustrates the initial months of life and thereafter transitions to years post the first 12 months. The vertical axis, albeit imaginary, signifies the quantity of synaptic connections in the brain. More precisely, a synaptic connection refers to the bond between two neurons. When these neurons interconnect and exchange experiences, it embodies a fundamental form of learning. Hence, the vertical ascent on the graph represents an increase in these connections, which corresponds to the amplifying experiences and learning processes of a child.

Each curve in the graph commences before birth, which represents an under-researched phase in terms of scientific evidence. Despite this, it is well-established that auditory and visual functions, as well as conscious perception, for instance, the discernment of parental languages, are considerably developed before birth. Following a gestation period of nine months, both infant and adult brains exhibit

approximately 100 billion neurons. Despite this numerical parity, the infant brain remains in a rudimentary and immature state. From this point, the brain's development is contingent on the child's natural, social, and cultural environment. In a stimulating environment, a child experiences rapid and significant learning during these "*sensitive phases*" or "*developmental windows*". These phases occur much earlier than considered in our existing educational framework. The curves demonstrate a downward trend as initial, low-level networks and circuits develop, paving the way for more complex, higher-level conscious experiences. Consequently, auditory and visual functions evolve prior to language skills and overall brain maturation. The construction of these initial networks lays the groundwork for subsequent ones (Lerner et al., 2023; Nelson et al., 2019).

A crucial observation is that any deficit in learning during these periods or weakened developmental processes will invariably influence future outcomes. It is during these "*sensitive"* phases that early stimulation by parents, guardians, or daycare providers is paramount to realize the child's full potential in the future (cf. Summer & Böttger, 2023). These windows of opportunity, of heightened neuroplasticity occur during early development when the brain's circuitry is particularly receptive to the influence of external experiences (Hensch, 2004). As Figure 2 also highlights, developmental peaks are achieved much earlier than in elementary school, with the child's brain architecture complete by the age of three, when conscious perception becomes apparent. From this juncture, even before starting school, the rate at which synaptic connections form decelerates, resulting in slower learning. By the end of the first decade (around the 4th grade), unused neural connections begin to decay further. The brain tends to discard weaker connections while significantly fortifying stronger ones, leading to early specialization (Böttger, 2023).

The initial five years of a child's life are correspondingly pivotal for their subsequent development, learning, career trajectory, and overall life path. Furthermore, all children intrinsically possess the ability to learn any language in the world – a capability encoded within our genes. This potential can be activated via everyday, interactive conversations with parents, educators, and caregivers – an implicit, unstructured form of learning. Correspondingly, formal language instruction in school is not an absolute necessity; instead, communication serves as the key (Bruner, 1983; Tomasello, 2003; Vygotskij, 1962). As cognitive development progresses, additional components of language learning can be elucidated, demonstrated, and taught. Unfortunately, we often deny our children their innate potentials and opportunities.

4.2 ***Implicit learning***

Children have been demonstrated to have the extraordinary capacity to extract rules from linguistic input, provided they are nurtured in an environment rich in natural language (Colmar & Wheldall, 1985). Acquiring their mother tongue essentially involves the implicit learning of language structure and specifics, without the need for detailed explanations. Instead, children learn by listening, exploring, formulating hypotheses, and testing them out in a trial-and-error fashion, and either succeed or self-correct accordingly (Kuhl, 2004).

Formal schooling for a child typically commences around the age of six. By this time, a child has usually mastered the phonetic and grammatical intricacies of their first language (Böttger, 2023). Thus, by the time formal education begins, children already have considerable experience in language acquisition, often more than they

are credited for. This fact highlights the vast potential of the young brain for further language learning, making it unwise to underestimate this capacity.

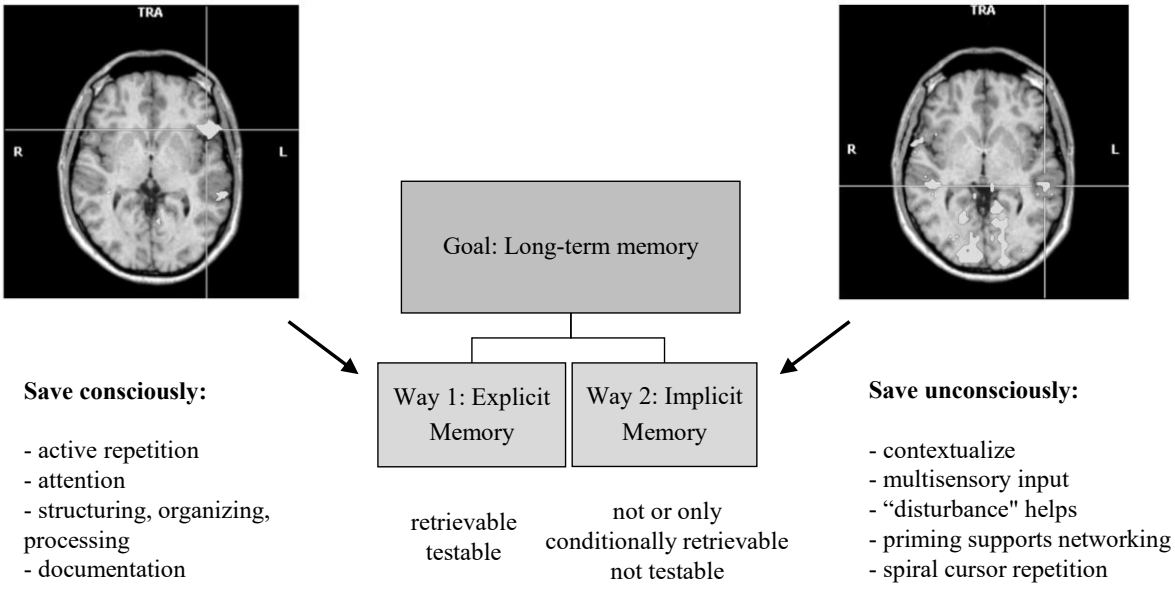
Rather than excessive explanations, descriptions, exercises, and repetitions, children require a set of preconditions for effective language acquisition. These include:

1. **Context**: Children require connected speech material, not isolated vocabulary.
2. **Exploration**: Children need adequate time to explore, create, and exhibit courage.
3. **Relevance**: Topics, texts, and conversations must hold meaning and interest for children. Otherwise, they may disengage or require substantial extrinsic motivation.
4. **Emotion**: Emotion acts as a potent memory catalyst, with multisensory input reinforcing learning (Immordino-Yang & Damasio, 2007).
5. **Feedback**: This promotes cognitive development, with children utilizing feedback to improve, demonstrating an early learning strategy.
6. **Autonomy**: Children need control over their learning process, with independent structuring of learning materials favouring open learning scenarios (Hannafin et al., 2014).

When these prerequisites are met, the language material that has been acquired can be consolidated into long-term memory. The outcome of implicit language learning is neurobiologically represented in long-term memory. There are two pathways leading to this – the explicit memory and the implicit memory (Figure 3):

Figure 3. The two pathways into the long-term memory: the explicit and the implicit memory.

Note. Adapted from "*Neural foundations of creativity in foreign language acquisition*," by H. Böttger, and D. Költzsch, 2019, *Training, Language and Culture*, *3*(2), 8–21. p. 15 (https://doi.org/10.29366/2019tlc.3.2.1).



The explicit memory encompasses memories that can be intentionally recalled. Explicit learning, which is at the root of explicit memory, is the main learning concept employed in our current school system – it has the great benefit of being easily testable. However, it is not without its limitations. For instance, trying to learn a language like English in its entirety through explicit methods would exceed a typical human lifespan (Long, 2014), suggesting that we should enhance our learning approaches.

The implicit memory, in contrast, represents an elementary form of memory that operates unconsciously and uncontrollably, and therefore is difficult to test. Various actions, such as riding a bicycle, swimming, playing an instrument, or using linguistic clause elements or idiomatic expressions, once learned, are performed automatically or intuitively. Such actions require individual skills like knowledge of musical notes, motor functions, and semantic-syntactic language skills, all retained in memory. Despite their complexity, these actions are almost exclusively performed without cognitive control, demonstrating that conscious access to or conscious retrieval of implicit knowledge is not directly possible (R. Ellis, 2002).

Two primary implicit modes are priming and habituation. In priming, language stimuli are processed by the brain even when they remain beneath the threshold of conscious perception, such as during sleep. Priming unconsciously leads to the development of mental networks, connecting semantically related words, thereby justifying the use of word webs in language learning. Habituation, following repetitions and exercises, leads to automatic and unconscious language competencies, underscoring the benefits of implicit learning. An example would be kids naturally greeting (in a foreign language) without consciously thinking about it (N. Ellis, 2005).

The two brain images depicted in Figure 3 highlight that there exist differences between explicit and implicit learners. Explicit learners primarily activate speech-related areas in the left hemisphere (Figure 3), such as Broca's area, which processes language information. Implicit learners, in contrast, utilize both brain hemispheres, activating more corresponding brain regions, which is deemed more efficient (Ullman, 2001). Hence, implicit learning should also be central to primary foreign language education in schools.

Shown as a contrastive comparison, here (Figure 4) are the most important aspects of explicit and implicit language learning in a nutshell:

Figure 4. Important aspects of explicit and implicit language learning

Note. Adapted from "*Neural foundations of creativity in foreign language acquisition*," by H. Böttger, and D. Költzsch, 2019, *Training, Language and Culture*, *3*(2), 8–21. p. 17 (https://doi.org/10.29366/2019tlc.3.2.1).

explicit	**implicit**
conscious	unconscious
declarative	procedural
controlled	automatic
deliberate	habitual
voluntary	involuntary
perceptual	pre-perceptual
attentive	pre-attentive
remembered	Non-registered
formal	informal
intentional	**incidental**

All these observations and interpretations underscore the need for a reassessment of language instruction methods in educational systems, as well as the development of appropriate testing formats for measuring success in language acquisition. Here there is plenty of room to take this into future consideration, e.g. developing implicit task formats through research.

The culmination of this discourse brings us to a few key points that educators should consider in their didactical approach to language learning.

1. **Balancing Learning Processes**: Research indicates that a blend of explicit and implicit learning strategies, which changes as the child grows older, is beneficial. In younger stages, and in the context of our project, an emphasis on implicit learning is recommended. Implicit memory plays a significant role in language performance, and students can quickly reacquaint themselves with constructing their own hypotheses (Hulstijn, 2005).

2. Constructing Context: Gamification, scaffolding such as robust visualization through images, storytelling, gestures, and speech redundancy can all help create a rich, contextual learning environment (Gee, 2007).

3. Vocabulary Teaching: Educators should strive to teach word meanings at the point of need, thus making the learning relevant and timely for children. Only in desperate situations should a few words be pre-taught (Kötter, 2017).

4. **Diverse Texts and Topics**: A variety of text types and topics should be used, with the inclusion of repeated readings of old favourites. These read-aloud experiences could include direct explanations of words along with dialogic interactions, akin to storytelling. Following reading, it could be beneficial to engage students in discussions around words to build word consciousness (Beck & McKeown, 2007).

5. Avoid Caretaker Speech: Educators should aspire to be language role models, avoiding overly simplified *'caretaker speech'*, and instead using appropriate, fully formed language structures (Hoff, 2006).

6. **Positive Feedback**: As a catalysing factor, positive feedback, including implicit feedback, should be utilized to motivate and guide students in their language acquisition journey (Hattie & Timperley, 2007).

Through the application of these strategies, educators can better support their students in language acquisition, thereby enabling them to harness their full linguistic potential. In order to foster implicit learning, they can further use stories or gamified learning approaches.

4.2.1 Storytelling

Storytelling offers the first of two outlined methodological approaches suitable to foster implicit learning in primary foreign language contexts. Aligned with the six didactic approaches outlined in the above, storytelling shows great benefits to

foreign language learning. The following subsection’s introduction delves into the enjoyment of stories and their specific features from a neuroscientific perspective:

a. Engagement with Stories: Children and adolescents of various age groups derive pleasure from listening to or reading stories. These narratives provide a sense of stability, security, and continuity. This notion can be substantiated by the fact that children often express discomfort when familiar stories are altered (Nikolajeva, 2013).

b. Neurological Reactions to Stories: Stories incite similar responses in the brain as real-life experiences (Landrum et al., 2019). This resemblance explains the robust memorization associated with stories. Additionally, the vivid language, inclusive of descriptive adjectives, employed within stories stimulate images and emotions in the brain. Narrative gaps are not viewed as hindrances; instead, they are intuitively filled with imaginative pictorial and content-related matter. However, in a legal context, the imaginative potential of narratives could pose challenges when testimonies are given as they are essentially stories.

We can identify three primary aspects of stories from a neuroscience standpoint:

1. Stories as Connectors of Experiences

Stories serve as memorable contexts, bridging the old and new. The Default Mode Network (DMN), a cooperative network of brain cells, is engaged half the time we are awake, and is particularly active when we indulge in stories, enabling our thoughts to wander (Buckner et al., 2008). With the DMN's assistance, language is deeply processed on an emotional level. The DMN also helps anticipate linguistic patterns and retain them sustainably, preparing them for individual language production.

Storylines incorporate unknown language, such as new technical terms, into familiar contexts.

Fundamental learning entails blending the known with the unknown. This is mirrored in our brain function, wherein new neural connections are forged and pre-existing neurons form new synaptic connections. This allows for the emergence of new experiences from old ones, thereby enhancing memory and facilitating the quick integration of new sensory impressions and content, especially when transmitted through multiple sensory channels (multisensory) (Mason et al., 2019). Stories are ideally suited for this purpose as they provide extensive context for new linguistic and content-related input.

2. The Holistic Impact of Stories

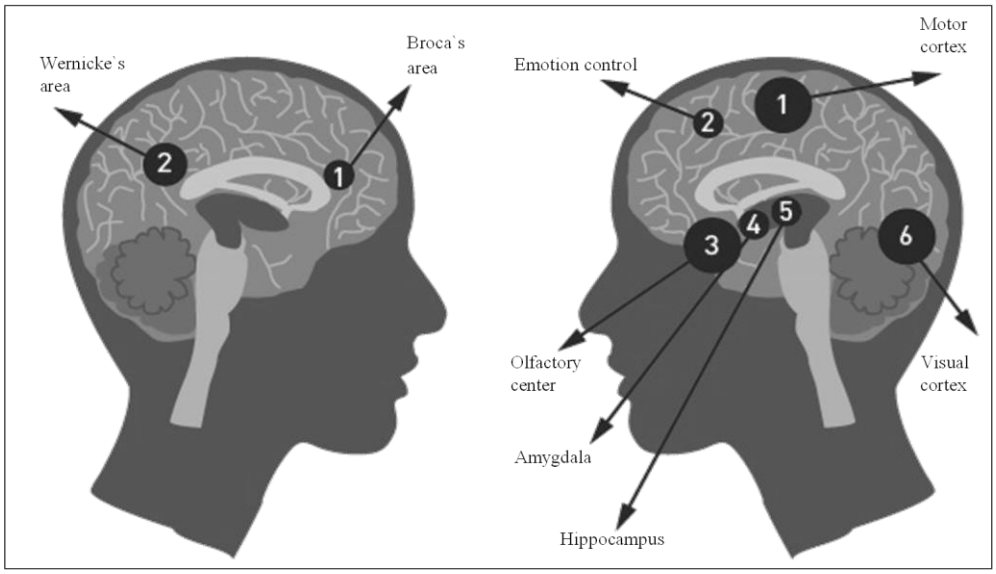
Brain networks foster associative thinking. During pure listening, crucial parts of the language centres in the brain, such as the Broca's area (responsible for language production and grammar) and the Wernicke's area (responsible for language processing and comprehension), are activated (Figure 5). This is where factual information is heard and processed.

In the act of narrating or listening to stories, network-like connections are also created in the DMN. As the DMN supports associative thinking, personal memories and experiences from the episodic long-term memory can establish a sense of identification with the story and consequently, with the narrator. This emotional bonding enhances the impact of the story.

Narratives are amplified in a multisensory and emotional way, a phenomenon facilitated by mirror neurons located in the prefrontal cortex of the brain. These

neurons contribute to empathy, compassionate understanding, and experiential learning (Catmur et al., 2018; Praszkier, 2016).

Figure 5. Active brain regions in pure fact listening (left) and storytelling (right)



Note. From *Current Issues in Primary Foreign Language Teaching: Part Two: Change Is the Only Constant (Heraclitus)*, by H. Böttger, 2022, September 22, Advances in Teaching Foreign Languages to Young Learners (ATFLY), online.

3. Stories: The Emotional Link to Facts

Storytelling promotes long-term memory: Intensive storytelling significantly aids in the long-term retention of knowledge or factual information. Processing isolated bits of information is generally limited in capacity. For instance, memorizing vocabulary in isolation can often be experienced as strenuous work (Nation, 2001). However, when linguistic information is encapsulated within stories, they tend to engage listeners or readers on an emotional level. Consequently, neurotransmitters such as dopamine (commonly referred to as the "*happiness hormone*"), cortisol (the "*stress hormone*"), or oxytocin (the "*bonding hormone")* are released (Zak, 2015). Despite these

neurotransmitters having different general effects, they all enhance the formation of new neural connections and experiences, thus facilitating learning. In essence, the more emotions are evoked, the more intensely the story is experienced, thereby amplifying its long-term retention—a process that we can term as 'emotionally-driven long-term learning'.

In conclusion, stories are believed to be among the earliest forms of education, especially focussing on language education and knowledge transfer. Neuroscientific findings substantiate their power and effectiveness in knowledge transmission. They engage the cognitive, emotional, and imaginative capacities of learners, providing a comprehensive, immersive learning experience that have been standing and will stand the test of time.

4.2.2 **Gamification**

Similar to storytelling, gamification of learning contents is a promising approach to effective learning and teaching of foreign languages in a mainly implicit manner. Gamification, the application of game elements within non-game contexts (Dicheva et al., 2015), has emerged as a potent approach to teaching and learning foreign languages. Often described as playful learning, gamification retains the core focus on the learning process, even as the act of playing is foregrounded for the learner. One of the principal reasons behind gamification's effectiveness is neuroplasticity, which facilitates experiential learning. During our early years, play forms a significant part of our cognitive and emotional development. Brain maturation is intrinsically linked to learning environments that stimulate new experiences, either real or virtual (Gee, 2007). In this regard, play – be it digital or non-digital – serves as a proxy for real-life situations, providing boundless opportunities for practicing and reinforcing technical content in a trial-and-error fashion.

Learning contexts that spur experiential learning are pivotal for brain development. One key aspect of such a context is the lack of restrictions, fostering an environment where learners can experiment, make mistakes, and learn without fear. This freedom is measurable: the oxygen demand of nerve cells in the amygdala, located within the brain's limbic system, diminishes under fear-free conditions. This reduction in activity contrasts with the heightened activation during anxiety-inducing situations (Böttger & Költzsch, 2020).

Depending on the complexity of a game and its challenges, diverse neural networks are engaged. Generally, the more complex and demanding a game, the greater the neural activation. These networks, some of which operate unconsciously, strive to meet the game's demands by creating new synaptic connections, leading to sudden ideas, insights, and creative solutions (Böttger & Költzsch, 2022).

Importantly, playful forms of teaching should not be graded. Any form of mental pressure or fear counteracts creative problem-solving in a game and hinders active retrieval of stored words and information, leading to speech and thought barriers. Thus, overemphasising grades for playful forms of teaching proves counterproductive (Elkind, 2007; Vygotskij & Cole, 1978).

Simultaneously, success in games activates the brain's reward centres. A clever move in a game, or even just envisioning a successful game outcome, triggers the release of dopamine, colloquially known as the "*happiness hormone*." This leads to feelings of wellbeing, joy, and enthusiasm, and engenders a desire for more success. With regards to learning, these positive experiences improve information processing and storage capacity. The dopamine release also enhances the brain's plasticity, increasing adaptability to new learning situations. In essence, success

breeds success: the brain rewards itself for achievement, laying the groundwork for continued learning triumphs (Wise & Rompre, 1989).

Lastly, gameplay exercises the working memory – the brain's system for temporarily holding and manipulating information. For instance, when processing a sentence, the neural networks of the working memory retain the beginning and middle parts as the end is being comprehended, culminating in overall sentence understanding. Depending on the sentence's emotional or significant connotations, it can either be committed to long-term memory or fade from working memory (Cowan, 2008).

5. LEN’s outlined potential

The combination of findings from educational neuroscience, psychology, didactics and applied linguistics on the two main concepts (early start, implicit learning) and the latter’s two methodological approaches (storytelling, gamification) has made it possible to understand the benefits and backgrounds of each in greater detail. In particular, the field of educational neuroscience adds an essential piece of the puzzle to these interrelated fields: It provides the neural basis for how children process and remember foreign language input more broadly. In doing so, it bridges the gap between the other fields' focus on language input and output (R. Ellis, 1994; Krashen, 1982).

Initially, the most important point seems to be to give every child an early start in foreign language learning. This has repeatedly been shown to be beneficial (Enever, 2018) and is rooted in the high neuroplasticity of children's brains – a highly valuable explanation based on neuroscientific research methods. That is, while applied linguists can measure the language performance of children aged 3 and 12 attending the same foreign language classes and uncover differences, neuroscientific research

helps to understand why this is the case. Once again, this flexibility of children's brain structure – or neuroplasticity – in relation to foreign languages shows a downward trend as early as the age of six (see Centre of the developing child). Accordingly, foreign language teaching should begin as early as kindergarten, so as not to deny children their innate potential and the opportunities revealed by neuroscience.

Secondly, neuroscientific research has shown that implicit (foreign language) learning activates both hemispheres of the brain, in contrast to explicit learning, which activates mainly language-related areas in the left hemisphere (Ullman, 2001). This knowledge of the bilateral connections that are established in children's brains through a largely unconscious learning pathway that is similar to natural language acquisition is essential to understanding why translating sentences or using caregiver language, while well-intentioned, should be avoided. As Ellis (2005) states, language teaching should be based on a naturalistic learning process in order to optimise children's language skills and competence. However, without evidence that takes account of (foreign language) processing, this approach may never have had an adequate rationale to counter critics who argue that it is too difficult and overwhelming for children, even if it is simply natural in the sense that it fits the way the human brain works.

Thirdly, educational neuroscience has demonstrated the power and effectiveness of storytelling in conveying information – one important approach to foster implicit learning. For example, stories generally engage children on an emotional level, which leads to the release of neurotransmitters that promote the formation of neural connections – language learning (Böttger & Költzsch, 2022). Furthermore, neuroscience research shows that the default mode network is particularly active

when children are immersed in a story, allowing their minds to wander (Buckner et al., 2008). In summary, it shows that storytelling facilitates learning because it promotes language acquisition by making linguistic input more understandable, meaningful and memorable, thus facilitating the encoding, storage and retrieval of new vocabulary and grammatical structures (Elley, 1989).

Fourth, gamified language learning environments activate the reward centres in children's brains when they succeed. That is, neuroscience has shown that when we succeed in a playful task (e.g. a crossword puzzle), feel-good hormones (e.g. dopamine) are released (Morgan-Short et al., 2012; Panksepp, 2007). This in turn leads to and explains why gamification improves information processing and storage capacity, often without us even noticing (implicit learning). Other findings suggest that combining games with foreign language tasks and physical activities is also particularly valuable for boys (Böttger, 2017, 2023). That is, they need to move to learn more effectively. And while this finding has not been and will not be discussed in detail here, it has been added to show the great further potential of combining the research fields to establish a new constant in research and foreign language teaching.

6. Conclusion

Research on foreign language acquisition has consistently highlighted the advantages of starting language learning at a young age (Enever, 2018). Despite different policies across Europe regarding the start of foreign language instruction, the consensus in the literature suggests that an early introduction improves linguistic proficiency and competence (Eurydice Report, 2023). The implementation of implicit teaching approaches, such as storytelling, gamification, and the use of the target language for communication, complements this early start and provides a highly

promising educational pathway. Such methods, based on theories of implicit memory and learning, make use of the brain's inherent mechanisms for organically absorbing and processing information (Reber, 1989).

The role of implicit memory, a component of long-term memory that is not under conscious control, is instrumental in these processes. This memory system allows individuals to use language automatically through repeated exposure and interaction without explicit instruction, embodying the essence of the implicit learning approach (Cleeremans et al., 1998). Storytelling and gamification are particularly powerful in this regard. Stories not only make language learning engaging but also promote the integration of new information with existing knowledge, facilitating context-based learning. The emotions triggered by stories enhance memory retention and create strong associations that support language recall (Landrum et al., 2019). Similarly, gamification creates a stress-free environment conducive to trial-and-error learning, with games simulating real-life situations. Such experiential learning benefits from the brain’s neuroplasticity, promoting the formation of new synaptic connections. The dopamine released during success in games enhances the joy of learning and motivates further learning success (Dicheva et al., 2015). Combined, implicit learning, storytelling and gamification form a formidable trifecta that underpins a pedagogically sound foundation for early language education. Drawing on the tenets of cognitive science and educational neuroscience and psychology, these interactive and immersive methodologies provide the potential of a paradigm shift in language pedagogy, creating a more naturalistic and engaging environment for young learners to acquire and master a new language. Its roots in the multidisciplinary field termed Language Educational Neuroscience seems promising to lay the foundation for further innovative approaches and perspective on (foreign) language acquisition,

which ought yet to be investigated, researched, and promoted – an auspicious new approach to language teaching and learning.

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