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Review article

Neural Bases of Word Learning in the Context Across Different Age Range: A Narrative Review of International Research

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Abstract. Context is crucial during reading and new word acquisition as it provides important clues that help individuals understand the meaning of unknown words. In early development, children employ words broadly to describe diverse objects and actions. As their vocabulary and conceptual understanding grow, they refine word meanings based on context. Context is particularly critical during schooling, where reading facilitates the acquisition of new vocabulary. Context remains vital for adults, as they use contextual cues to understand unfamiliar words, including in professional environments. The article presents a narrative review of contemporary literature on the neural basis of word learning in different context constraints across different age ranges in the international research field. The review aims to identify experiment designs employed to assess word learning within a context and describe differences and similarities in neural markers across different ages. The majority of the reviewed articles focused on young adults, with fewer studies examining children, and only one study addressing adolescents. In this narrative review, the authors described the used paradigms in word learning in different contexts: weakly, moderately and strongly constrained, meaningful and unrelated, and episodic ones. Among electrophysiological markers the N400, P200, and N300 components were investigated across the reviewed studies, as well as theta, alpha, and low beta bands were analysed to understand the rapid neural responses to novel words.

Keywords: word learning, context, sentence constraint, neural markers, EEG, age range

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Introduction

Vocabulary plays a crucial role in language development and it is closely linked to other aspects of cognitive functioning (Cromley and Azevedo, 2007; Ahmed et al., 2016). Vocabulary extension occurs as a result of the acquisition of new words, which mainly takes place in childhood, continues through school and adolescence, and is maintained throughout our lives. For several decades, educators and psychologists have been fascinated by inquiries into how vocabulary is acquired. Vocabulary growth may be due to explicit instruction, picking up words from everyday situations, encountering unfamiliar vocabulary while reading from a certain context, and implicitly from the context of the perceived speech information (oral and written).

In the initial phase, children tend to use words to describe a broader range of objects, actions, or events (Markman & Wachtel, 1988). As the vocabulary expands children become better at refining the definitions of words. Through this process of learning word meanings, children consistently rely on contextual clues and gradually form clearer concepts of words. Context is especially important during school and adolescence when new words are learnt through reading. It is worth noting that reading accounts for a large portion of the curriculum for schoolchildren and adolescents; therefore, developed reading skill leads to successful knowledge acquisition. Context is also a major source for word learning in adulthood as adults rely on contextual cues to infer the meanings of unfamiliar words, and these cues help them make sense of new vocabulary in real-life situations including professional language.

Context can have different levels of constraints, which is helpful to retrieve the meaning of the words from it. Strongly constraining contexts refer to situations or environments where the meaning of a word or concept is clearly defined or limited by specific conditions, that help to narrow down the possible interpretations of a word (for example, “A woman put on a warm terg”). While weakly constraining context refers to situations where the meaning of a word or concept is not clearly defined or not limited by specific conditions (for example, “A woman pointed at a terg”). In these contexts, there may be ambiguity or multiple possible interpretations of a word, making it more challenging for individuals to determine the intended word’s meaning.

Predictive processing plays an important role in learning of new words from context (Federmeier, 2007; Kutas et al., 2011; Pickering & Gambi, 2018). Brain actively generates predictions about incoming sensory information based on prior knowledge and expectations (Walsh et al., 2020). In the context of acquiring new word forms, predictive processing suggests that the brain uses existing linguistic knowledge to predict and anticipate the structure and meaning of unfamiliar words (Kaan, 2023). Predictive processing takes time to develop and is closely related to age and linguistic experience (Borovsky, Elman, & Fernald, 2012; Mani & Huettig, 2012). Moreover, the extent to which young language learners rely on prediction to connect meanings with new words remains uncertain, as does the amount

of linguistic exposure needed for this process to occur (Huettig & Mani, 2015; Rabagliati et al., 2015).

At the behavioural level some aspects of learning are not always reflected; neuroimaging measures can capture these processes within milliseconds, and thus provide new insights about the novel word acquisition. While the biological foundations of the novel acquisition and the difference between various ages are still poorly understood, recently the researchers have started turning their attention to the field and made attempts to contribute to the neural basis of novel word learning in different aspects, for example, implicit and explicit learning of new words (Shtyrov, 2012, Reber, 2013). Context constraints have been studied in different methods and paradigms, but there is no review of the latest advances in this area. In the current review we include studies with EEG markers (brain event-related potentials, brain rhythmic activity and their localization), since these methods are able to capture the time changes which can reflect the rapid word learning processes. The aim of this review is to summarize the achievements of experimental research with word learning, especially in different context constraints, and to describe differences and similarities in neural markers across different age ranges. First, we will describe the used paradigms in learning new words in various contexts. Then, we will present the neural correlates discovered or tested across the reviewed studies and summarize the difference across different age ranges.

Literature search procedure

To achieve the aforementioned aim, the scientific literature was reviewed without time limitations. The publications were searched in PubMed, Scopus and Web of Science databases by abstracts, titles and keywords using the following search query: ((word learning) OR (novel word) OR (word acquisition) OR (meaning acquisition) OR (meaning retrieval)) AND ((ERP*) OR (EEG) OR (MEG) OR (Electroencephalography) OR (neural basis) OR (neural)) AND ((context) OR (constraint) OR (sentential) OR (sentence constraint) OR (context constraint) OR (context)). The initial total amount of found papers was 239 (Fig. 1). After duplicates across sources were dropped, 136 papers remained. Abstract screening was performed on the next step, leaving 36 publications. Finally, after analysing full-text documents, 22 relevant publications were identified. As a result, there were a total of 14 publications (Fig. 1) examining the neural basis of word learning in contexts after deleting the studies on the second language acquisition as they were outside the current narrative review, also the fMRI studies were excluded as they measured the hemodynamic changes.

The inclusion criteria encompassed empirical articles in any language that investigated the neural correlates of EEG while new word learning or novel word acquisition or meaning retrieval in contexts across different ages. The exclusion criteria comprised studies conducted outside of the contexts and any neural markers.

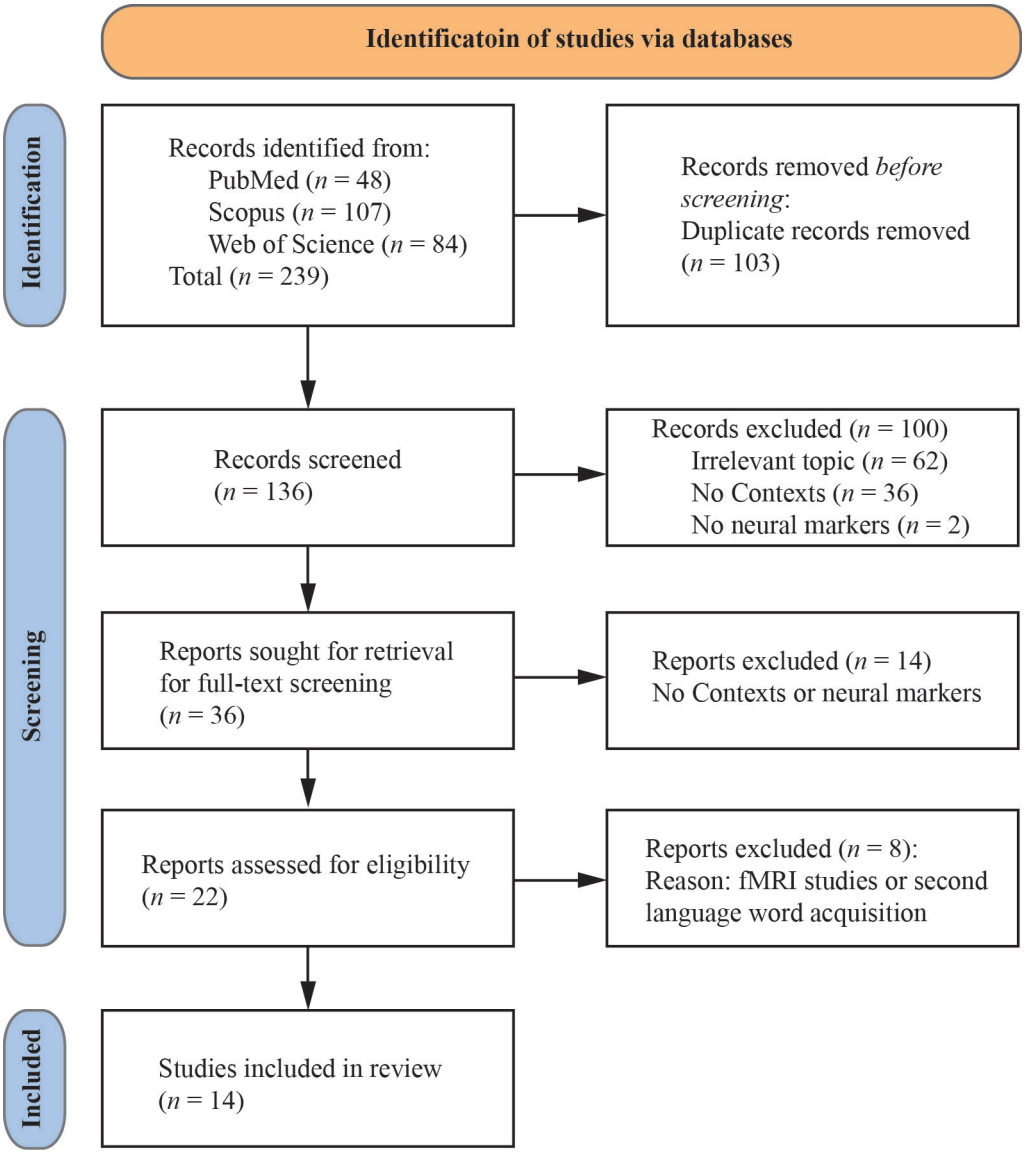

Figure 1. Flowchart illustrating the process of selecting studies for the review

Source: Prepared by Marina Norkina using PRISMA Flow Diagram (https://www.prisma-statement.org/prisma-2020-flow-diagram)

Results

The word learning process can be divided into two stages: initial decoding and later consolidation. The studies of word learning in the context generally are designed firstly presenting the novel word in reading task with different context types, followed by the memory testing.

Context variety and word learning experimental design

By varying contexts, researchers address the question about how novel words are learnt from these contexts at behavioural and neurophysiological levels. Among the reviewed studies, 8 works presented novel words in context with varied

constraints (weak, medium or strong), 5 studies used sentences with and without meaning or related and unrelated contexts. One work stands out with single or multiple episodic contexts. The postmemory tests are also variative across the studies. The lexical and semantic judgement tasks are generally applied (7 studies), although in some studies participants are required to perform the recognition test (5 studies) or answer whether the novel word is a real object or the participants learned a new word (2 studies). Below, we shortly describe the specifics of the design with different types of contexts and memory tasks.

In the studies with context constraint types, the constraint is identified by the extra cloze probability task, when the data is collected prior to the main experiment to differentiate if each sentence is in the weak or strong constraint condition. Generally, participants were presented with a set of sentences or larger texts. Typically, this set consisted of three sentences. However, in some cases, two sentences or even larger texts were used instead. The novel word was presented either in the sentence or at the end of each sentence (Momsen et al., 2022; Momsen & Abel, 2022; Ralph et al., 2020) or only in the last sentence of the presented text (Borovsky et al., 2010; Borovsky et al., 2012; Borovsky et al., 2013). In a few studies the novel word was presented in a single sentence in both weak and strong contexts (Vergilova et al., 2022) or only in one of the conditions (Frishkoff et al., 2011). The stimuli in the reviewed articles were audial or visual modality, with the audial presentation to younger participants from 7 years old in order to level the participants in terms of different literacy at young age. According to the designs of the experiments, during listening or reading the sentences the participants were asked to find the definition of a new word after each of three sentences presented in succession (Mestres-Missé et al., 2007; Momsen et al., 2022; Momsen & Abel, 2022; Ralph et al., 2020). In other studies, the meaning definition was checked using a priming task after the sentences were read (Borovsky et al., 2010; Borovsky et al., 2012; Borovsky et al., 2013). In the priming task, the participants were asked to determine whether the target item was a real word or not by providing a lexical decision response after each target word appeared.

Among the reviewed articles, in addition to the context constraints, there were studies with sentences with and without meaning (in the condition where sentences had no meaning, all sentences were determined to have a low cloze probability, and each of the three sentences was designed to conclude with a different target word) or semantically related and unrelated context (contexts were interconnected in a way that allowed the new word's representation to align with all the contexts in which the novel words were used or in contrast preventing a singular meaning from being linked to the novel words) (Mestres-Missé et al., 2007; Abel et al., 2017; Abel et al., 2020; Momsen & Abel, 2022). In such studies, the word learning activity involved children in determining the meanings of new words within sets of three sentences (Abel et al., 2017; Momsen & Abel, 2022) or completing the recognition task after the learning phase (Batterink & Neville, 2011; Abel et al., 2020). These sentences either offered sufficient context to aid word comprehension or lacked supporting context. The participants were asked about whether the unfamiliar word

corresponded to an actual word and, if so, what the word was. It is worth noting that in the context with meaning and without meaning, close probability measures were also collected, and the constraint for sentences were determined. However, the designs of the experiments using meaningful and meaningless or related and unrelated contexts differed from those using high and low constraint contexts with sets of sentences or larger texts (Momsen et al., 2022; Momsen & Abel, 2022; Ralph et al., 2020). In contexts with and without meaning, related and unrelated contexts there were two conditions where novel words were presented. The first set of sentences had the constraints which were getting stronger to the third sentence, therefore the reader can derive the exact meaning of the novel word. And in the other condition no meaning can be identified as the sentences were all weakly constraint and allowed multiple targets acknowledgments.

One study stood apart from the others by investigating different types of the context, namely, single- or multiple-episodic contexts (Zhang et al., 2018). In each condition, a novel word was used once in two sentences. In the single episodic condition, both sentences referred to the same episode (one situation with an unfolding scenario). In the multiple episodic condition, the two sentences described different situations. Therefore, the multiple episodic contexts provided more opportunities to establish a more stable semantic representation of the novel word as well as in the highly constraint context. The participants' task was to read and report if they had comprehend the sentences and learned the meaning of the novel word. The reading task was followed by the lexical decision task.

The behavioural results of the experiments showed that the participants acquired the novel words, although to different degrees depending on the context. The research findings indicated that learning new words was more effective in high constraint contexts, as accuracy levels were higher compared to low constraint contexts (Borovsky et al., 2010, Frishkoff et al., 2011). In the studies with meaningful and meaningless context, the behavioural results indicated that participants were able to assign appropriate meanings to the novel words, though much less accurately in the meaningless context (Batterink & Neville, 2011; Abel et al., 2018). While the behavioural data confirms that the context can influence word learning, the neural correlates in these studies shed light on the brain's sensitivity and its response to novel word learning in different contexts. Further we describe the investigated neural correlates in the reviewed studies.

Neural correlates of new word acquisition

The reviewed studies of the neurophysiological correlates of learning new words in different contexts analyze such ERP components as P200, N300 and N400, as well as oscillatory brain activity in the theta, alpha and beta bands. Most of the studies (12 out of 14 articles) examined the N400 component of ERPs that is explained by its robust sensitivity to the lexical and semantic stimulus features, while other components and oscillatory brain activity studied in the particular works.

The P200 component is an earlier component which might indicate the initial influence of semantic richness and depict the earlier semantic processing (Segalowitz & Zheng, 2009). The novel words elicited a smaller P200 amplitude over frontal and central regions in the multiple episodic condition compared to those in the single episodic condition (Zhang et al., 2018).

The N300 component is an earlier neural component which is enhanced when a word's meaning is more difficult to process. Immediately after training, words trained in the high-constraint contexts elicited a smaller left temporal N300 compared with words trained in the low-constraint contexts, and both types of the trained words elicited a stronger medial frontal negativity relative to familiar words. Moreover, two days after training the N300 disappeared and was replaced by a later, the left parietal (P600) effect (Frishkoff et al., 2011).

The increased late positivity component (550–600 ms) was interpreted as a marker of episodic memory (specifically, recollection-based memory). The difference for words in the high- versus low-constraint conditions was shown in the research over the left parietal regions, with the words in the low-constraint eliciting an increased positivity (P600 ERP) relative to the high-constraint. The P600 on the rare words (novel words) trained in the low-constraint condition were more positive during this time window compared to the known words; this result was not present for high constraint context (Frishkoff et al., 2011).

Among the studies we reviewed, only Momsen and colleagues (2022) have examined oscillatory activity. Theta band activity, typically occurring at frequencies between 4 and 7 Hz, is commonly associated with memory retrieval processes, both within and beyond language processing (Momsen et al., 2022 Bastiaansen & Hagoort, 2006; Bastiaansen et al., 2010; Hald et al., 2006; Schneider & Maguire, 2018). Alpha (8–12 Hz) and beta (13–30 Hz) frequencies have been linked to the various cognitive functions relevant to language processing, such as memory retrieval, attentional control, predictive processing, and working memory operations (Gao et al., 2017; Hanslmayr et al., 2012; Klimesch, 2012; Piai et al., 2014; Weiss & Mueller, 2012). The analysis of related and unrelated contexts in the reviewed studies revealed a relative suppression of the alpha and beta bands (8–20 Hz) prior to the presentation of final pseudowords in meaningful trials compared to meaningless ones (Momsen & Abel, 2022). Moreover, higher levels of beta band suppression and theta band enhancement during the processing of the initial sentence in a trial, across high, medium, and low contexts, were associated with an increased likelihood of correctly identifying the pseudoword in that trial (Momsen et al., 2022).

As mentioned above, most of the studies on the effect of context on new word learning have analyzed changes in the N400 component as an indicator of new words acquiring semantic meaning. Notably, after just three encounters with new words in a sentence, the amplitudes of the N400 to them were nearly identical to those of familiar words (Abel et al., 2017). Importantly, this N400 amplitude reduction was reliable only for novel words that had initially appeared in a strongly and not weakly constrained context (Borovsky et al., 2012).

Research has shown that the localization of identified alterations in the acquisition of novel vocabulary varies based on the nature of the tasks and the specific conditions under examination, thereby elucidating further intricacies of the cerebral mechanisms involved in word acquisition.

In the study by Vergilova and colleagues, main effects associated with learning new words in different contexts were found in posterior regions. In the learning phase novel words in the strongly and weakly constrained contexts resulted in more negative amplitudes over posterior electrodes compared to frontal and central ones. For the testing phase (priming task) words initially learned in the strongly constrained context had a larger N400 relative to unrelated target words, the largest over the posterior electrodes (Vergilova et al., 2022).

In another study with high, medium and low contexts constraints, the N400 was analysed for novel words presented in each sentence of a triplet from the first to the third sentence. N400 amplitude significant attenuation between presentations of the sentences (from low to high constraints) was found in the frontal and parietal regions (Ralph et al., 2020).

In yet another study with strongly and weakly constrained sentences the analysis of the N400 component in a semantic judgement task after a learning session showed that the semantic relatedness effect (an enhanced negativity to unrelated versus related targets words) was significant for familiar words over frontal and parietal sites. Similarly, rare words (novel words) trained in the high-constraint contexts also elicited significant relatedness effect over the frontal and parietal sites in the testing phase after learning. In contrast, a significantly reduced relatedness effect was observed for words learned in the low-constraint contexts over the parietal regions, whereas no relatedness effect was found over the frontal regions (Frishkoff et al., 2010).

Borovsky and colleagues (2012) also investigated the strongly and weakly constrained sentences, and their results show that in the context sentences a tendency for novel word N400 amplitudes to be larger relative to known words in the left hemisphere and in prefrontal and medial sites (Borovsky et al, 2012).

In the work with contexts of meaningful and non meaningful condition there were following results: by the second presentation non meaningful words evoked a marginally larger N400 relative to meaningful words, significant over left lateral sites (Batterink & Neville, 2011). In another study with the same context settings (meaningful and meaningless), after the third sentence presentation in the triplet the N400 to novel word in meaningful condition was the same to real words, and the N400 to the novel word from the meaningless context was different in central and posterior locations (Mestres-Missé et al, 2007).

In a study with single and multiple episodic contexts, the N400 in the multiple episodic conditions was smaller for related target words compared to unrelated words over the frontal and central regions (Zhang et al, 2018). The results for the localization emphasise few brain areas with a significant N400 neural marker for the novel words learning in high constraint context: posterior regions, frontal and parietal regions, left hemisphere and its lateral regions.

Thus, the use of event-related potentials (ERPs) such as the N400, P200, N300, P600, and late positive components has provided valuable insights into how context influences word learning and processing. The P200 component reflects initial semantic processing, with novel words eliciting smaller amplitudes in multiple-episodic conditions. The N300 component indicates difficulties in processing word meanings, with high-constraint contexts leading to smaller amplitudes immediately after training. The late positivity component, particularly the P600, is associated with episodic memory and shows differences between high- and low-constraint conditions. Additionally, theta, alpha, and beta band activities are linked to memory retrieval processes and cognitive functions relevant to language processing, with the beta band suppression and theta band enhancement associated with correctly identifying pseudowords in trials.

The N400 component, sensitive to lexical and semantic features, shows decreased amplitudes to novel words in congruous contexts and in strongly constrained contexts. Overall, the broad distribution observed across the studies indicates that different brain regions were involved in the novel learning process from different contexts. The reviewed articles mainly investigated the N400 neural marker in various contexts, revealing differences in its localization across studies. The analysis of EEG event-related potentials highlighted significant findings related to novel word acquisition and processing in different contexts. Studies showed that novel words in the strongly and weakly constrained contexts elicited distinct N400 responses over the posterior electrodes compared to the frontal and central ones. Additionally, the N400 amplitude was attenuated between the low- to high-constraint sentences in the frontal and parietal regions. Semantic relatedness effects were observed for familiar and rare words trained in the high-constraint contexts over the frontal and parietal regions, with smaller effects in the low-constraint contexts. The largest N400 effects for words in sentences were found in the left medial, central, and frontal electrode sites. Moreover, the localization of N400 responses highlighted the involvement of the posterior regions, frontal and parietal regions, left hemisphere, and lateral regions in the high-constraint context novel word learning. Overall, these findings underscore the importance of context and neural processes in word learning and comprehension.

The neural correlates between different age ranges

Among the reviewed articles, four studies focused on children and preadolescents from youngest 7 years old to 14 years old, one study researched 8 to 16 years olds (children, preadolescents and adolescents), majority of the studies devoted to adults – 9 articles from 18 to 30 years old.

It has been shown that the performance on behavioural level differs with age. While young children usually associate words with new concepts that are unfamiliar to them (Markman & Wachtel, 1988), adults and school-age children tend to acquire more detailed or specialized meanings for concepts that they are already familiar with and can easily describe (Anglin, 1993). Following we describe the differences of neural correlates in novel word learning in different contexts which changed with age.

Prediction is a widespread language processing strategy among adults that involves effectively using context to anticipate incoming information (Kutas et al., 2011). In language learning, the development of predictive processing is a gradual process that is influenced by factors such as age and linguistic background (Borovsky, Elman, & Fernald, 2012).

Vergilova and colleagues (2022) showed that younger children relied heavily on sentence context to understand new information, but struggled to remember and incorporate this information into their vocabulary after one exposure. Older children effectively utilised highly specific contexts to anticipate the meanings of unfamiliar words and successfully incorporated these new word forms into their vocabulary after just one encounter. The impact of the novel word N400 neural correlate was influenced by both the context in which the completions were introduced and the age of the individuals listening. Additionally, the younger children exhibited more significant changes in N400 activity for new pseudowords compared to real words presented in highly predictive contexts. The study found that the impact of context on N400 responses to word and pseudoword completions decreased as participants aged. The researchers interpreted this pattern as a sign that, in comparison to early adolescents, younger preadolescents depended more on contextual cues to anticipate upcoming words and thus experienced greater difficulty (resulting in larger N400 changes) when encountering novel pseudowords that did not align with their expectations (Vergilova et al., 2022). Early adolescents strengthen their acquisition of new words by making accurate predictions after encountering them three times (Abel et al., 2017).

Adults who encountered made-up words in brief passages were able to link these unfamiliar word forms to their intended meanings after being exposed to them 10 times in a deliberate learning exercise. Subsequently, they exhibited signs of implicit memory consolidation for the new vocabulary (Batterink & Neville, 2011). Likewise, the adult learners successfully utilised highly constrained contexts to accurately produce synonyms for unfamiliar and uncommon words (Frishkoff et al., 2010). Despite having just one learning shot, the adults could rely on highly constrained sentence contexts to generate the prediction about the definitions of unfamiliar pseudowords they have never encountered before (Borovsky et al., 2010; Borovsky, Elman, & Kutas, 2012).

The reviewed articles highlight age-related differences in the novel word learning and processing. Young children tend to associate new words with unfamiliar concepts, whereas the adults and school-age children acquire more detailed meanings for familiar concepts. These differences in behavioural performance are reflected in differences in neural markers that vary with age and developmental stage. Younger children heavily rely on sentence context to understand new information but struggle to remember and incorporate it into their vocabulary,

whereas older children effectively use specific contexts to anticipate the meanings of unfamiliar words and easily incorporate them into their vocabulary.

The development of predictive processing in language learning is gradual and influenced by factors such as age and linguistic background. Younger children show more significant changes in N400 activity for new pseudowords compared to real words in highly predictive contexts, indicating a greater reliance on contextual cues. In contrast, adults can link unfamiliar word forms to their intended meanings after multiple exposures and exhibit signs of implicit memory consolidation for new vocabulary. They can also utilise highly constrained contexts to accurately produce synonyms for unfamiliar words and generate predictions about the definitions of unfamiliar pseudowords after just one encounter. Overall, the findings suggest that age plays a crucial role in how individuals process and learn novel words in different contexts.

Discussion

The reviewed studies on word learning design and context variety explored the impact of varied contextual constraints on novel word acquisition. Researchers used different types of contexts, such as weak, medium, or strong constraints, meaningful and unrelated contexts and episodic contexts. By manipulating these contexts, the researchers aimed to investigate how novel words are learned depending on the contexts on behaviour and neurophysiological levels. Various memory tests were employed post-learning, including lexical and semantic judgement tasks, recognition tests, and real object identification tasks. The results showed that the participants were able to acquire new words to varying degrees, with high-context conditions generally facilitating learning (Vergilova et al., 2022; Abel et al., 2017). Studies with meaningful contexts demonstrated that the participants assigned appropriate meanings to new words.

The reviewed articles focused on investigating the neural correlates associated with novel word acquisition in various contexts. Electrophysiological markers, such as event-related potentials (ERPs) including the N400, P200, and N300 components, as well as theta, alpha, and low beta bands, were analyzed to understand the rapid neural responses to novel words. The N400 component, in particular, showed sensitivity to lexical and semantic features, with higher amplitudes for unrelated words and reductions in amplitude for learned words. The studies showed that the N400 response was reliable for unknown words presented in the strongly constrained contexts, indicating a priming effect for known words in the high-constraint contexts. Additionally, the P200 component indicated initial semantic processing, with smaller amplitudes observed for novel words learned in the multiple episodic conditions. Overall, the studies shed light on the neural processes underlying novel word acquisition and their integration into existing vocabulary.

The articles have highlighted age-related differences in novel word acquisition and neural correlates. Young children tend to associate new words with unfamiliar concepts, while adults and older children acquire more detailed meanings for familiar concepts. The neural markers also vary with age, reflecting differences in the processing and integration of novel words. Younger children heavily rely on sentence context to understand new information but struggle to remember and incorporate it into their vocabulary, while older children effectively use context to anticipate word meanings and integrate new words after just one exposure. The impact of context on neural responses decreases with age, indicating a shift towards more accurate predictions and successful word incorporation with age. Adults show implicit memory consolidation for new vocabulary after multiple exposures and can generate accurate predictions for unfamiliar words in highly constrained contexts even after just one learning instance. Overall, age plays a significant role in the neural processes underlying novel word learning, with different strategies and outcomes observed across developmental stages.

Conclusion

In this article, we have made an overview of recent studies that addressed the challenges of monitoring changes in the dynamics of brain activation in the word-learning process, the experiments designs and varied contexts are described. Most works studied the contexts constraints, few studies applied the meaningful and meaningless contexts, notably both collected the predictability measures to assign the sentences to constraint level (high and/or medium and low constraint).

It was shown that during early adolescence, children are capable of using one-time experiences in restrictive situations to understand the definitions of unfamiliar words and incorporate these new words into their vocabulary. Among the reviewed articles, most of them focused on young adults, less about children, and only one addressed adolescent. Therefore, the adolescent age range should be examined to analyze the performance during the transition period at the behavioural and neurophysiological levels. The impact of context constraints on semantic comprehension, as measured by the N400 component, decreases with age. Furthermore, the diverse range of brain regions identified in the studies suggests that various areas of the brain are engaged in the process of learning new information from different contexts.

The findings of this review may contribute to a fundamental understanding of the neural mechanisms underlying vocabulary acquisition. Furthermore, these results are intended to inform future research within existing experimental paradigms in the field. Additionally, the summarized outcomes of the review underscore age-related differences in the acquisition of new vocabulary, indicating that high-constraint contexts facilitate the learning of new words. These insights should be considered in the development of language education programs.

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Обзорная статья

Нейронные основы усвоения слов в контексте в разных возрастных группах: обзор зарубежных исследований

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Аннотация. Контекст играет ключевую роль при чтении и усвоении новых слов, предоставляя важные подсказки для понимания значения новых слов. Дети активно используют слова для описания окружающего мира. По мере расширения словарного запаса они уточняют значения слов, опираясь на контекст. Значение контекста особенно важно в процессе изучения новых слов в школе и в подростковом возрасте, когда чтение становится ключевой частью образовательной программы. Взрослые также полагаются на контекстные подсказки для понимания незнакомых слов, особенно в профессиональной среде. Рассмотрены современные исследования с применением ЭЭГ, изучающие нейронную активность, лежащую в основе усвоения слов в различных контекстах. Цель обзора – определить методы, используемые в экспериментах для оценки усвоения слов в контексте, а также описать различия и сходства нейрональных маркеров в разных возрастных группах. В большинстве проанализированных работ исследовались выборки взрослых, в нескольких работах рассмотрен детский возраст, и только в одной работе – подростковый возраст. В обзоре рассмотрены парадигмы изучения слов в различных контекстах: слабо-, средне- и сильно ограничивающем контексте, несвязанном и содержательном контексте, а также эпизодическом контексте. Среди электрофизиологических маркеров в рассмотренных исследованиях изучены компоненты N400, P200 и N300, а также проанализированы тета-, альфа- и низкие бета-диапазоны с целью изучения быстрых нейронных реакций во время изучения новых слов.

Ключевые слова: усвоение слов, контекст, чтение, нейрокорреляты, ЭЭГ, возрастные группы

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