

The Intervention of Picture Books on Children with Specific Language Impairment: Progress, Challenges, and Prospects

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Abstract

Compared with ordinary children, children with specific language impairment (SLI) have delayed language development, poor reading comprehension, and greater difficulties in learning. As a widely used teaching intervention method, picture books can promote the development of reading comprehension, oral narrative, emotion, and social communication in the study of language intervention for children with special language impairment. However, the specific mechanism of picture books for children with SLI is still unclear. Therefore, this article sorts out and reviews the language barrier symptoms of specific language impairment, the form of picture book intervention, and the potential mechanism of picture book intervention, and puts forward the current role of picture books in SLI. The challenges faced in the intervention, and a positive outlook on the teaching intervention of picture books in SLI, this research will provide reference and help for the study of picture book intervention in related professional fields and has important guiding significance and reference value for the language correction of SLI children in various countries.

Keywords: specific language impairment, language disorder symptom, picture book intervention

1. Introduction

Specific Language Impairment (SLI), also known as Developmental Language Disorder (DLD). SLI refers to the phenomenon that children with normal nonverbal IQ, no obvious neurological or psychological impairment, no emotional disturbance, and no social impairment affecting language use have deficits in language acquisition and significant delay in language development (Montgomery & Leonard, 1998). SLI is one of the most common children's language development disorders. Leonard found that the probability of English-speaking children suffering from this language disorder was about 7% in the survey of English preschool children (Leonard, 2000, 3-5, 8-11). A long-term follow-up study on SLI children shows that with age, 50% of SLI children still have language problems, and the risk of SLI children in the later stage is still high. Therefore, special language barriers are increasingly popular among teachers and parents—the importance and concern (Prathanee, Thinkhamrop, et al., 2006). Therefore, exploring the language impairment symptoms and effective intervention measures of SLI children is very important to improve the language development and social adaptability of SLI children.

Picture book intervention has obvious advantages in cultivating students' language ability development. Studies have shown that reading picture books can promote children's learning of English as a second language, improve children's English language learning ability and promote the development of their creativity (Hui, Chow, et al., 2019). Research on brain nerves has found that picture books are presented in the form of audio, illustrations, and animations, which can promote the development and integration of preschool children's brain functional networks (Hutton, Dudley, et al., 2020); Reading picture books can stimulate children's emotional awareness and expression ability and improve children's emotional ability (emotion awareness and expression, emotion regulation) and social behavior (Kim, 2010). For the special group of children with autism, reading picture books without words can help children with autism improve their narrative ability, express their inner state more calmly in Language, and have high social validity (Kauschke, van der Beek, et al., 2016). In conclusion, picture books, as an effective intervention tool, have been widely used in the rehabilitation practice of language impairment in preschool children.

However, whether picture books can be applied to the language ability correction of domestic SLI children, the

effectiveness of picture book intervention still needs to be determined. There are still bottlenecks regarding the specific mechanism of picture book intervention. This article first analyzes the language barrier symptoms of SLI, then sorts out the different intervention forms and specific mechanisms of picture books, as well as the effect of picture books after intervention on SLI children in various countries, and finally summarizes the main challenges faced by the existing picture book intervention research. Furthermore, make a positive outlook on studying picture books on SLI children's language ability and teaching intervention. Therefore, it is necessary to systematically sort out the existing picture book intervention research and clarify the specific mechanism of a picture book as an intervention tool to provide a framework for future SLI children's mother tongue or bilingual language intervention research.

2. Language Impairment Symptoms of SLI

2.1 Verbal Impairment Deficit Research

The incidence of SLI is much higher than other types of language barriers. In the 1960s, the SLI research of English-speaking countries in Europe and the United States showed that the prevalence rate of preschool children was about 7%, and the probability of boys suffering from specific language barriers was higher than girls (Leonard, 2000, 3-5, 8-11). Moreover, these children with special language impairments have varying degrees of oral language impairment, Reading impairment, or other hidden learning difficulties after entering school (McArthur, Hogben, et al., 2000). Therefore, the study of language barriers has always attracted the attention of linguists.

Since the 1990s, SLI research on children with other languages has also been carried out one after another. Scholars have investigated various aspects of SLI children's phonetics, vocabulary, grammar, and pragmatic development. In terms of diagnosis, rich research results and intervention programs have been formed, which provide sufficient data and valuable reference experience for subsequent language researchers, as shown in the table below.

Table 1. SLI-related research

| Author | Language | Participant, number | Age at | Objectives |
|---|------------|--|----------------------------|--|
| Ambiado-Lillo, Navarro, and Ibáñez-Alfonso (2020) | Spanish | 44 children (22 TLD children; 22 SLI children) | 6 – 7 | To explore the differential use of executive functions between TLD and SLI |
| Arosio and Guasti (2019) | Italian | 30 children (10 SLI children; 10 chronological age-matched children; 10 children in language-matched children) | 7 | To investigate the production of wh-questions in Italian-speaking children with SLI |
| Bol and de Jong (1992) | Dutch | 16 Dutch SLI children; 16 MLU matched normals | n/a | To compare the production of auxiliaries verbs in English and Dutch children |
| Clahsen, Bartke, and Gollner (1997) | German | 15 children (9 English; 6 German) | 5;8 7;11 | To compare formal features of impaired grammar between English and German children |
| Dromi et al. (1999) | Hebrew | 45 monolingual Hebrew-speaking children (15 SLI children; 30 normal children) | 4;2 - 6;1 | To investigate the use of verb agreement inflections in Hebrew-speaking children with SLI in controlled linguistic contexts |
| Hansson and Nettelbladt (1995) | Swedish | 10 Swedish children (5 SLI children; 5 MLU matched normals) | 5;1 5;11 4;0 - 4;1 | To examine whether children with SLI acquiring Swedish exhibit a different pattern of grammatical impairment compared to English-speaking children with SLI |
| Jakubowicz et al. (1998) | French | 13 French-speaking children with SLI; 20 normal children | 5;7 13;0 | To investigate elicited production and comprehension of determiners and clitic pronouns |
| Niemi (1999) | Finnish | 22 children (12 SLI children; 19 normal children) | 10 – 11 | To investigate the effect of frequency, morphosyntactic transparency, and lexical status on the production of singular and plural nouns and noun-like strings in an offline production task in Finnish |
| Oliveira, Vale, and Thomson (2021). | Portuguese | 39 children (7 DLD children; 21 dyslexia children; 21 TD children) | p. 11 7 – 10 | To investigate the relationship between DLD and dyslexia |
| Sasaki et al. (2021) | Japanese | 68 children (16 SLI children; 52 TD children) | 5;8-10;6 | To investigate the auditory comprehension of Japanese sentences, including relative clauses between SLI and TD children |
| You and Yim (2021) | Korean | 43 children (19 SLI children; 24 SLI children) | 7;0 10;7 7;6 10;7 | To examine online and offline sentence processing using Korean language relative clause sentences between children with SLI and children with TD |

Note. TLD=Typical Language Development; SLI=Specific Language Impairment; MLU=mean length of utterance; TD=typical development; DLD=developmental language disorder

An important prerequisite for researching children with SLI is to clarify the symptoms of their language impairment deficits. Only on this basis can it be possible to determine its cause and propose an intervention or correction plan. However, there are large differences in the language impairment performance of children with

different language SLI. Firstly, the most pronounced language deficits in children with SLI are morphological-syntactic problems, and their language problems vary from Language to Language. For example, tense can be used as a clinical sign for diagnosing English SLI children. English SLI children will have difficulties in expressing third-person singular -s, be verbs, auxiliary verbs, etc. when using sentences (Rice & Wexler, 1996), and it is difficult to use The position of -ed in the past tense of verbs and specific usage rules (Dalal & Loeb, 2005) accurately. German SLI children have expression problems in subject-verb agreement, mainly in the first, second, and third-person singular forms of transitive verbs. The accuracy of understanding the object beginning declarative sentences is relatively low (Stegenwallner-Schuetz & Adani, 2021). In processing relative clauses, Korean SLI children have lower accuracy in offline comprehension tasks of clauses and lower efficiency in online processing tasks (Yoo & Yim, 2021). However, the main problem of Spanish and Italian SLI children is not tense. However, the obvious expression problems in using articles and direct object attachment forms and the obvious delay in comprehension compared with ordinary children (Bedore & Leonard, 2005). Japanese SLI children misexpressed the continuum of pronouns and adjectives when understanding relative clauses (Sasaki, Schwartz, et al., 2021).

Secondly, besides morphological-syntactic problems, children with SLI commonly have vocabulary comprehension and learning deficits. Compared with normal children of the same age, SLI children's vocabulary processing speed and working memory are slower than children with normal development, which makes children prone to inattention when comprehending new information (Leonard, Ellis Weismer, et al., 2007). Moreover, such children have difficulty learning new words, and children with a lack of vocabulary have difficulty learning words phonetically and semantically (Nash & Donaldson, 2005). At the same time, in the rapid mapping vocabulary learning task, SLI children's response time for vocabulary comprehension and vocabulary learning is significantly longer than that of children of the same age, and it also affects children's phonetic memory (Alt & Spaulding, 2011). Studies have shown that SLI exhibits large delays in processing, storing, and retrieving new words. These difficulties in vocabulary acquisition severely limit semantic understanding and effective processing of phonetic information (Gray, 2004). However, the vocabulary defect and phonetic acquisition defect of SLI children limit their voice information capacity, affect the information capacity and information storage time of their short-term memory, and the elimination speed of voice information is faster than that of ordinary children (G. Conti-Ramsden, Botting, et al., 2001). At the same time, studies have pointed out that SLI children have a particularly difficult time learning new referents in vocabulary retrieval tasks, and it is difficult to predict their new word learning (Barak, Degani, et al., 2022), which will further lead to children's difficulty in reading sentences. Poor comprehension and discourse affect the development of children's reading ability (Coloma, De Barbieri, et al., 2020). In addition, SLI children also have semantic and pragmatic problems, such as a high error rate in the acquisition of universal quantification, definiteness, and exhaustivity of special interrogative sentences, and problems in the use of rules. Mixing is difficult (Marinis, 2011).

Thirdly, in addition to morphosyntactic and lexical comprehension and learning deficits, children with SLI also have auditory and pronunciation problems. In reading and speaking test tasks, SLI children have higher literacy and oral performance error rates, and rapid auditory processing deficits are specifically related to written and oral language impairment (McArthur & Bishop, 2001). The behavioral responses of children with SLI to auditory reverse identification of masked stimuli and unmasked tones, regardless of the speed at which the sounds were presented, showed that such children had a poor ability to discriminate between sound frequencies, were characterized by relatively poor non-word reading skills, and found that special Language. The disorder may be characterized by the immaturity of the auditory cortex (McArthur & Bishop, 2004). On auditory processing tasks measuring sound amplitude timing and sound duration, the SLI children group performed five percentage points lower than age-matched controls on amplitude and persistence cues important for perceiving hypersegmented language rhythm and stress patterns with low sensitivity. It is not easy to extract short, fast sequential auditory cues (Corriveau, Pasquini, et al., 2007). Compared with normally developing children, children with SLI have poorer waveform shape and shallower peaks in auditory processing, suggesting that the signals in the auditory pathway of these children are distorted in temporal processing, which may affect language development (Barman, Prabhu et al., 2022). Since SLI children have impairments in auditory processing, they must also have pronunciation difficulties. For example, severe expression difficulties in complex syllable structures are a homogeneous feature of patients with specific language disorders, the main indicator of impaired speech development, rather than just considering slow growth (Orsolini, Sechi, et al., 2001). Suppose children need to obtain a large amount of correct auditory information. In that case, there must be information loss when converting auditory symbols into spoken pronunciation expressions, and the storage time in the brain will be shortened, and the loss speed will be fast. For a long time, SLI children's verbs Language development will lag behind normal children of the same age.

Fourthly, narrative competence refers to the ability to produce a coherent story, which enables the audience to understand the background, characters, sequence of events, and complexity and resolution of the story (Rumpf, Kamp-Becker, et al., 2012). Oral narrative ability is one of the earliest thinking abilities of young children and one of the most widely used forms of human experience, also known as storytelling (Bruner, 1990). In recent years, as narrative research is an important aspect of language research, linguists have begun to conduct much oral narrative research on children's Language. Weckerly et al. studied SLI children, SLI children with biological age matching and language ability matching ordinary children, trying to compare the differences in oral fluency of these three types of children, and found that children with SLI had obvious deficits in language fluency (Weckerly, Wulfeck, et al., 2001). Studies have shown that it is difficult for SLI children to express the complete plot in the oral narrative of the story. The retelling of the story is short in length, with few elements of the story. The narrative's ending could be clearer and contain more relevant information, and the entire structure needs more logic (Merritt & Liles, 1987). Some scholars have pointed out that the length of oral narration of SLI children is only 68% of that of biological age-matched children, the fluency and complexity of oral narration are low, the vocabulary expression is single, and tense syntactic errors occur (Scott & Windsor, 2000). In the tasks of story retelling and story generation, SLI children scored significantly lower than normal developing children on several narrative indicators, sustained auditory attention, and oral working memory. While the story retelling task relates to word list recall, correlation leads to varying cognitive skills, such as attention and memory difficulties in children with SLI (Duinmeijer, de Jong et al., 2012). In the individualized narrative intervention study on school-age SLI children, the complexity of verbal narrative in SLI children after Story Champs intervention was greatly improved, the narrative plot of the story was complete, and the narrative at the end of the story was more emotional (Hessling & Schuele, 2020).

2.2 Nonverbal Impairment Deficit Research

In addition, studies have shown that in addition to language development delays, SLI children also have significant barriers in non-language areas. Using the Children's Behavior Checklist, Coster et al. examined the behavioral functioning of 56 children with Specific Language Impairment (SLI) aged 8, 10, and 12 years. The data showed that 48% of children with SLI were considered to be behaving at home or with school problems (Coster, Goorhuis-Brouwer, et al., 1999). Specific problem behaviors include withdrawal, anxiety, depression, social isolation, aggression, rule violations, etc. These behaviors can obscure the recognition of language barriers, so parents, teachers, or scholars should increase timely and appropriate intervention opportunities (Maggio, Granana, et al., 2014). Flapper et al. evaluated the prevalence of Developmental Coordination Disorder in 65 SLI children aged 5-8. They found that the mean scores of motor, autonomy, and cognitive domains of SLI children were lower than that of control children. About one-third of Children with SLI may also be diagnosed with DCD (Flapper & Schoemaker, 2013). Other scholars have shown that compared with children with normal development. Some SLI children have attention deficit, hyperactivity, and mental health problems (Helland et al., 2014). Due to impaired language and communication skills, their emotional state expression The ability is relatively weak, and there will also be non-verbal emotional processing deficits (Bahn, Vesker, et al., 2021). Conti-Ramsden et al. investigated SLI children's education and employment experience after completing compulsory education. The study found that young people with specific language impairments performed poorly in education and employment compared with their peers. The language impairment of some SLI children is very likely to accompany them throughout their lives (Gina Conti-Ramsden & Durkin, 2012).

3. The Forms of Picture Book Intervention

Picture books are mainly paintings supplemented by text content and must use English to tell specific emotions and themes. It is a unique literary form that combines visual images and English language arts. Canadian scholar Perry Nodelman believes that English picture books are children's books that convey information or tell stories through the interaction and combination of coherent pictures and a small number of English words (Nodelman, 1989). Swiss writer Maria Nikolajeva believes that English picture books describe the story's plot through Language and visual pictures and convey the theme and central emotion in literary works through pictures (Nikolajeva & Scott, 2006).

The research on children's picture books abroad has more than 100 years of history. It started early and is relatively mature. Its research fields involve all aspects of picture books, with all-encompassing themes and various styles of works. It is the first choice for children's books for family education in Western countries. Many scholars have applied it to empirical research in the educational field. In the early learning and development of preschool children, it has been proved that reading picture books are beneficial to children's language development (Dowdall, Melendez-Torres, et al., 2020), cognitive participation (Elia, Heuvel-Panhuizen, et al., 2017) and art and creative thinking (Hsiao, 2010). In the intervention study of specific language impairment,

some researchers used picture books as an intervention tool and believed that picture book intervention positively affected the language development of SLI children. For example, Tae-Im et al. used picture books to study the rapid mapping characteristics of children with special language impairments. The experiment showed that SLI children have the same rapid mapping ability as ordinary children. They believe it is necessary to apply picture books to the natural context of children's language acquisition Medium(Im & Park, 2019). Smeets et al. used electronic storybooks to support vocabulary acquisition in children with special language impairments. Studies have shown that even without adult support, SLI children can familiarize themselves with difficult vocabulary by reading electronic storybooks on computers(Smeets, van Dijken, et al., 2014). In the grammatical learning transformation of bilingual children, Gutierrez et al. found that using wordless picture books can help SLI children carry out grammatical transformation more smoothly(Gutierrez-Clellen, Cerejido, et al., 2009). SLI children have grammatical and vocabulary difficulties when telling stories. AlejandraAuza and others guided SLI children to read picture books with scripts and found that the language performance of such children was greatly improved after reading picture books. Different language skills were activated simultaneously (Alejandra Auza, Towle Harmon, et al., 2018).

However, issues that deserve further attention are how to use picture books to promote children's learning and development and how different forms of picture books respond to brain mechanisms. Hutton et al. found that the learning of picture book stories in the form of traditional picture illustrations, audio and visual animations in the form of picture book story learning interventions for preschool children will cause differences in the functional connectivity of the brain(Hutton, Dudley, et al., 2020), as shown in the figure below shown.

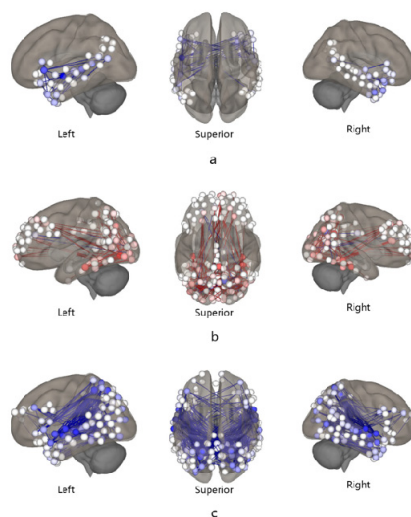


Figure 1. Functional connectivity of the brain

In the figure above, nodes represent regions of interest, red reflects positive contributions to changes in functional connectivity, blue reflects negative contributions to changes in functional connectivity, white reflects no changes, and the color's depth reflects the impact's size. Among them, panel A depicts changes in functional brain connectivity in the language network as an audio diagram. Panel b shows changes in the functional connectivity between visual perception and the default mode network relative to the graphical form of audio. Panel c depicts changes in functional connectivity between visual imagery and language networks in animation format relative to illustrations. It can be seen that there are substantial differences in the vision, Language, default mode, and cerebellar network functional connectivity of preschool children in the three different presentation forms of picture books in audio, illustration, and animation, which shows that picture books provide children with Language and learning. It provides good support and neurobiological evidence for picture book intervention from a new perspective.

3.1 Graphic Picture Book Intervention

Good picture books use simple words and images to show the basic characteristics of an object or event, avoid flowery words and detailed elaborations, and usually repeat in a spiral manner according to difficulty, thus helping children obtain the described concept. These images also provide opportunities for more complex conceptual elaborations, such as reflections on the meaning of events, their causes, and the intentions and

perspectives of characters(Murray, 2014). In their study, Simcock and DeLoache found that children aged 18-30 months could read books with more iconic images (photographs) than books with fewer iconic images (line drawings)—better imitating novel actions on novel objects in the real world. The research results prove that children's imitation performance after reading interaction is related to age and the iconicity level of pictures in the book(Simcock & DeLoache, 2006). Ganea et al. explored how young children transfer novel information between picture books and the real world and found that infants aged 15-18 months can extend newly learned labels from pictures to objects and from objects to pictures. However, the extent to which babies do this is influenced by how similar objects and pictures are. The results showed that the higher the perceived similarity between a symbol and reference, the more transparent the reference relationship was, thus helping children to transfer information between the two. Thus, the interactive educational function of early picture books may be best served by realistic illustrations(Ganea, Pickard, et al., 2008). Dowdall et al. conducted a systematic review and meta-analysis of shared picture book Reading interventions for children's language development. They found that such interventions are expected to promote children's language development, at least in the short term. Children's picture books can be a powerful tool for young children's language learning(Dowdall, Melendez-Torres, et al., 2020).

Graphic picture books can positively impact children's language learning and behavioral representation but also help children relax muscles and relieve pain during intravenous injection treatment or surgery, effectively reducing preoperative anxiety. For example, pain from needle-related procedures is a major concern in preschool care. A study developed a medical picture book to support preschool children facing venipuncture and determined the effectiveness of this book intervention in reducing behavioral distress(Tsao, Kuo, et al., 2017). Some studies use pictures in picture books to explain the upcoming surgery process. Parents say that knowing the surgical process makes them and their children feel safe, indicating that picture books can help children prepare before and during surgery and distract children. Moreover, try to reduce children's fear of surgery(Nilsson, Svensson, et al., 2016).

These studies have shown that when children learn picture books, to a certain extent, they rely on the similarity between the image symbols presented in picture books and the symbols in the real world; when the similarity between them becomes higher and higher, children The more we can understand the relationship between the two, the more we can unify the cognitive information represented by the image with the physical designation represented in reality. Children can predict the content of the picture book story based on the picture information and their existing knowledge and further pay attention to the content's trend or the plot's development, forming new concepts of events or characters. In this process, children learn a language and cultural background knowledge, analyze and appreciate Language, experience, viewpoint, and expression, and finally form a unique understanding of the picture book content and closely connect with life experience.

3.2 Audio Picture Book Intervention

Audio-based picture book reading has become an important language input method for children's second language learning, especially when bilingual or multilingual social environments are relatively scarce. More and more children and teenagers read through picture books with audio. Learn English. For example, in a study of natural functional near-infrared spectroscopy that explored the effects of audio picture book reading on prefrontal cortex activation in bilingual preschool children, the study showed that under the condition of picture book Reading plus English audio, cognitive control, and Language processing in early bilinguals were significantly improved. The effect of prefrontal cortex activity is more active (Li, Ding, et al., 2020). When the picture book story was presented to the children in the form of sound stimulation, the magnet-electroencephalographic (MEG) experimental data was analyzed according to the schema theory. Under the condition of, children's behavioral data are significantly correlated with neural network properties, children's brain networks are active, and the functional connectivity of the whole brain is greatly enhanced(Hasegawa, Takahashi, et al., 2021). Hutton et al. analyzed the functional connectivity of the brain's attentional, visual, and language networks during preschool children's learning of stories through audio, illustrations, and animations. They found that attention between audio and illustrations Force dynamics were similar but likely due to the limited capacity of images, connectivity patterns during audio suggested suboptimal support for language networks in the brain(Hutton, Dudley, et al., 2019).

Audio picture books can also be used in children's grammar learning. For example, Brilmayer et al. used the German version of the audiobook "The Little Prince" to compare the event-related potentials (event-related potential, ERP) responses. It was shown that first-person markers are attentional cues for self-relevance, central to successful narrative comprehension(Brilmayer, Werner, et al., 2019). Audio storytelling is a supportive scaffolding tool, allowing children to listen to stories independently without needing a living reader. Although

audiobooks do not require a live partner, audio storytelling can increase reading engagement among preschoolers (O'Toole & Kannass, 2018). As computers are increasingly integrated into classrooms, new attention has been drawn to the potential impact of interactive media on children's ability to comprehend and retain information. "Living books" with features such as audio or animation combine audio and visuals to help children maintain attention to the story and deepen their overall understanding (Segers, Takke, et al., 2004).

In the medical field, audio picture books can also diagnose and treat children requiring anesthesia or deep sedation. For example, children with brain tumors must undergo repeated MRI examinations. Some studies have used picture books, storybooks, and audio-visual media to intervene with children. They found they can help children successfully accept MRI examinations while awake and obtain sufficient clear, high-resolution images—quality image quality (Tornqvist, Mansson, et al., 2015).

3.3 Video Picture Book Intervention

Video animation can turn some inanimate and inactive objects into living and moving images through artistic and technical processing. As an art of space and time, video animation is well suited to conveying information about inner dynamics. With the continuous advancement of modern technology, the forms and styles of video animation have become more and more diverse. It has become one of the most popular forms of film and television expression for the public. Video-style picture books have also been widely used in empirical research by researchers.

A study of preschool children learning Dutch as a second language explored the effects of video and static-mode stories on children's narrative skills. In the static mode, the story is read aloud by voice while the picture appears on the screen. In contrast, the video mode is based on the same story, supplemented by multimedia functions such as animation, music, and sound effects. It was found that after repeated viewing of the video version, the children who watched it scored higher in terms of story comprehension, vocabulary, and grammar compared to the group of children in the static mode (Verhallen, Bus, et al., 2006). There are also studies with similar conclusions. Diehm et al. explored the impact of forms of presentation in picture book stories (static picture books and animated videos) on children's narrative retelling. They found that compared with static picture book retelling of the same story, children with normal development were more likely to retell short videos, may produce longer narrative retelling, use a more diverse vocabulary, and use more complex grammar (Diehm, Wood, et al., 2020). Ricci and Beal studied the effect of interactive media on children's story memory in experiments, compared the effects of using pure audio stories, audio-visual (TV), and interactive computer ways to display picture book stories, and found that adding visual information to storytelling is helpful. Visual stimuli have additional value for children's memory for understanding and recalling picture book stories (Ricci & Beal, 2002). A South Korean project team organized content from Language, mathematics, art, music, and sports and designed and developed a supporting picture book video based on picture books and picture books, providing a preliminary solution for developing children's creativity (Jeong-jin, 2006). Moreover, the project team conducted empirical research on children in the later stage, trying to verify the effect of creative problem-solving based on pictures and videos. The experimental results showed that the creativity scores of children who learned through picture books and videos were significantly higher than those of ordinary children (Jeong-jin & 임정하, 2011).

However, the visual presentation mode only sometimes positively impacts children's learning development. For example, children with specific language impairments (SLI), studies have shown that such children have serious difficulties learning new words. During an experimental intervention, children listened to four stories on random repeat. Two were presented in a static format and two in a video format. The results show that video animations and static illustrations are equally effective in learning new words for SLI children. However, the presence of music or sound that interferes with the processing of the oral story text may inhibit word learning for these children, so it is best to use it in its purest form. Text is presented as static illustrations (Smeets, van Dijken et al., 2014). Klop et al. took third-grade children whose mother tongue is Afrikaans as the research object. The experiment compared the dynamic visual presentation (silent animation video presentation) with the static visual presentation (silent picture book). They asked the children to be asked to tell the story to the researchers immediately after the intervention in this way. They found that the video animation method may be more interesting to the children. However, video animation stimulation is not better than static picture stimulation to help children better narrate the picture book. On the contrary, using the wordless picture book may be more practical, affordable, accessible, and potentially less time-consuming than using video (Klop & Engelbrecht, 2013).

3.4 AR Picture Book Intervention

Augmented Reality (AR for short) is a technology that calculates the position and angle of the camera image in

real time and adds the corresponding image. It is a new technology that "seamlessly" integrates real-world information and virtual-world information. This technology aims to put the virtual world on the screen and interact with the real world. AR picture books are the product of combining picture books and AR technology. Through 3D interactive technology, the images in the original picture books can be transformed into three-dimensional animations and immersive interaction with children. Today, picture books such as teaching, exhibition, and science and technology are gradually adopting AR technology. AR picture books have been widely used in education, and AR picture book intervention is becoming a new trend in empirical research.

By interacting with synthetic audio-visual content, AR technology can enhance children's understanding of book content and increase interaction, thereby enriching children's learning process (Dias, School, et al., 2009). Therefore, studying the impact of augmented reality reading on student learning may be an interesting question worth exploring. AR-based Reading has a significant awakening effect on the reader's emotional state, and its reading effect is better than real Reading (Dasdemir, 2022). Some studies have pointed out that when children and parents share AR picture book reading together, through a series of behavioral patterns and cognitive achievement analysis, it is found that when children actively participate in the interactive process of AR picture book reading with their parents, whether it is appearance description or Generalized description, they showed more learned behaviors and cognitive achievements (Cheng & Tsai, 2014). A research team in South Korea developed an AR picture book program and verified its effectiveness on children's social and emotional development. The study found that the developed AR picture book project has a positive impact on children's social and emotional development and the establishment of pro-social behavior, which has important demonstration and leading significance for the promotion of AR materials and digital devices to the field of early childhood education (Bang & Yi-Jeong, 2020). Most kindergarten children showed verbal and non-verbal expressions such as surprise, joy, doubt, and frustration when reading AR picture books. Children said AR picture books are interesting and easy to read (Hyun, Min, et al., 2011).

Affected by the new crown pneumonia epidemic, the current development of AR virtual and real educational applications has made AR picture books play a very important role in online learning. A study in Taiwan applied a set of mobile AR learning systems to primary school marine education courses and found that AR-assisted teaching can change traditional learning methods, help students master the knowledge content of marine education, and improve students' academic performance and learning efficiency, enhance students' motivation and willingness to learn online and promote the development of distance teaching projects (Hsieh, 2021). A study in Taiwan used augmented reality digital picture books (AR) as a learning method for interactive environmental education to investigate the impact of AR picture books in environmental education courses on environmental attitudes and environmental behaviors of children from different cultures. The study results show that students with higher self-efficacy in science learning are more likely to participate in conservation actions related to the natural environment in their daily lives. These studies show that a picture book's AR hypothesis model structure has good reliability, convergent validity, and discriminant validity, and the hypothesis model itself has been verified (Chen, 2022).

The importance of teaching content and teaching tool design with the help of modern information technology to improve the quality of education and teaching is self-evident. Gu et al. proposed that AR picture books can be used as a carrier for text presentation and key learning content annotation and discussed the application effect of AR picture books in German teaching. Studies have shown that when students use AR picture books for learning, the higher their satisfaction with the picture books, the more active their learning status and the better the learning effect (Gu, Chen, et al., 2022). Incorporating entertaining content elements into the educational content design of AR picture books can improve children's learning interest and Reading participation, and based on direct experience and continuous participation, maximize the overall educational effect for children, satisfy children's experience, and strengthen perception (Cho & Sunghoon, 2019).

4. Potential Mechanisms of Picture Book Intervention

4.1 Based on the Mechanism of Action of Various Types of Children's Language Learning

Research has suggested that, in educational and clinical settings, often only a child's language ability and current level of language development need to be considered when engaging in shared book reading activities. However, children's underlying cognitive mechanisms must be considered in picture book Reading activities, as they may be closely related to children's language learning performance (Wonjeong & Yim, 2020). A study took bilingual children as a sample. It analyzed the impact of differences in picture book stories on bilingual children's narrative output using a series of non-word picture book stories in English and Spanish. The results found that when different picture book stories were used to assess the narrative Language of bilingual children, the number

of different words was clinically significant in both English and Spanish.

In contrast, other indicators of productive Language were non-clinically significant in both languages. Differences (Heilmann, Rojas, et al., 2016). Fiestas and Pena explored the influence of Language on the generation of narrative samples for Spanish-English bilingual children, asking children to write stories in each Language for each task in the none-word picture book narrative task and the static picture narrative task. Clinical results showed that children wrote equally complex narratives in the reading task regardless of Language. However, it was clear that children were more verbally active when completing narrative tasks in their mother tongue (Spanish) (Fiestas & Pena, 2004).

Children with specific language impairments are slower to learn new words. This difficulty in learning words results in deficits of both breadth (number of words known) and depth (detailed knowledge of words) vocabulary throughout the school years (Mcgregor, Licandro, et al., 2013). Vocabulary deficiency will affect reading decoding and comprehension (Ouellette & Gene, 2006), causing these children's academic performance to fall further behind their peers (Morgan, Farkas, et al., 2011). A study invited 27 SLI children to participate in a preliminary clinical trial. English picture book stories were used as intervention materials. During the shared interactive reading process, children were asked to complete a naming test to see if they could promote word learning for SLI children. The results showed that interactive picture book Reading could treat word learning deficits in children with SLI (Storkel, Komesidou, et al., 2017). A study took Asperger Syndrome (Asperger Syndrome, AS) and ADHD (Hyperactivity Disorder, ADHD) as clinical sample subjects, allowing children to use wordless picture books to perform oral narratives and analyze their narrative ability and internal language state. It was found that children with Asperger's syndrome and ADHD both had pragmatic difficulties in picture book narration, but children with ADHD had more difficulty than children with AS; Asperger's Syndrome children have good grammatical ability, but they cannot grasp the main content of the story when they narrate picture books, and their coherence is not good (Rumpf, Kamp-Becker, et al., 2012). In the clinical diagnosis and treatment of language intervention for adolescents with Down syndrome, compared with simple situational narratives, the images in picture books without words can help adolescents with Down syndrome increase the average length of utterance (MLU), indicating that picture books can have a positive impact on Down syndrome. It positively impacts the language learning of patients with MDS (Miles, Chapman, et al., 2006).

4.2 MRI-Based Mechanism of Action

Because the MRI technique is very sensitive to body movement, which would otherwise be prone to artifacts, and the MRI examination lasts about 45 minutes, children undergoing the examination usually require sedation or anesthesia. A study intervened with children using picture book storybooks and audio/visual media and found that most children in the picture book story group could undergo MRI examinations while awake (Tornqvist, Mansson, et al., 2015). In the process of picture book stories, some studies used functional magnetic resonance imaging technology to visualize and analyze the brain region network of children in passive listening mode and active response mode story processing. The results showed that children's story processing had similar activation patterns in passive listening and active response tasks. Both tasks activated the primary auditory cortex, bilateral superior temporal gyri, and left inferior frontal gyrus (Vannest, Maloney, et al., 2019). Children rely on the ability of the brain and related information processing when listening to stories. Studies have used fMRI to explore the relationship between story listening and processing speed in preschool children. It is related to the degree of activation of the lateral prefrontal cortex (Horowitz-Kraus, Farah, et al., 2017). Hutton et al. used neuroimaging technology to conduct functional magnetic resonance imaging scans after preschool children completed the established picture book story tasks to explore the relationship between parent-child shared Reading quality and brain function when children listened to picture book stories. The results showed a positive relationship between preschool children's brain function when listening to picture book stories. The quality of parent-child shared Reading suggests that the home reading environment can affect basic emerging literacy skills and highlights that reading interventions with picture book dialogue can promote brain function and healthy development (Hutton, Phelan, et al., 2017).

For the elderly group, a study launched an intergenerational program, allowing the elders to read picture books for kindergarten and elementary school students to explore whether picture book reading activities can prevent hippocampal atrophy and cognitive decline in the elders to maintain or improve the elderly cognitive and physical function. Results of the study show that reading picture books to children by elders can help maintain the volume of the hippocampus in elders, improve the cognitive ability of the elders, and promote the healthy growth and development of children (Sakurai, Ishii et al., 2018). Yogev-Seligmann et al. used functional magnetic resonance imaging to explore the underlying neural mechanisms by letting the elders with amnesia and mild cognitive impairment narrate different versions of the story. They found that the elders with amnesia and

mild cognitive impairment experienced high-order auditory information processing and functional transition resulting from a functional response to the concurrent or impending loss of neurons or synapses (Yogev-Seligmann, Oren et al., 2016).

4.3 MEG-Based Mechanism of Action

Magnetoencephalography (magnetoencephalography, MEG) is a new technology for locating functional brain areas and evaluating their status by measuring brain magnetic field signals. It mainly reflects changes in the magnetic field generated by cells in different functional states, which can provide relatively the functional information of the nervous tissue that has been applied in the functional research and clinical application of the human brain. Because MEG has the characteristics of no invasion and no damage to the human body, it can be applied to the research of children's Language and human brain science. It is especially suitable for the early differential diagnosis and later treatment of children's language deficits. For example, extremely premature infants are at high risk for cognitive impairment and potential language deficits. A study used a story-listening task to describe extremely premature infants' language network representation and connectivity. The results of MEG data showed that premature infants' continuous frequency band functional connectivity was significantly increased. Under language stimulation, the bilateral temporal lobe and The parietal region are activated(Barnes-Davis, Merhar, et al., 2018). Children with autism spectrum disorder often also show a series of language production deficits. After listening to audiobook stories and completing related tasks, the neural signal data of magnetoencephalography can predict the children's sentence comprehension process, and it is found that children aged 3-6 Children are very sensitive to sentence context when making language predictions(Brennan, Lajiness-O'Neill, et al., 2019).

Parent-child Reading can stimulate children's brain development and strengthen parent-child relationships, thereby developing Language, literacy, and social-emotional skills that children need for life(Donoghue, Glassy, et al., 2014). Some studies have used magnetoencephalography (MEG) technology to explore the influence of parent-child familiarity on children's brain networks when children listen to picture book stories and read. The results show that under the conditions of parent-child picture book reading, the functional connectivity of the α -band of the children's brain is enhanced, and the whole-brain network of the α -band presents a small-world property of high local separation and high overall integration. It shows that mothers reading picture books to their children can activate the child's brain network structure and strengthen the connection. It also makes brain activity more efficient and promotes the child's development(Hasegawa, Takahashi et al., 2021). When listening to stories, because the stories you have heard have different effects on different brain regions, some studies have proved that MEG data can be used to analyze and explore the response rules of brain signals. MEG data can reflect the activities of the early auditory regions of the brain but also mirrors the broader temporal and posterior cortex and tracks in the sub-frontal and motor/somatosensory areas(Koskinen & Seppa, 2014).

To sum up, some researchers have affirmed the clinical diagnosis of picture book story intervention in MEG and fruitful research results have been achieved in various fields, indicating that picture books can be used as an effective intervention tool for special Language in research on speech therapy for disorders.

5. Challenges of Picture Book Intervention in the Research of Specific Language Impairment

This review complements previous studies, focusing in detail on language impairment representations of specific language disorders, the form of picture book interventions and data analysis of the impact on children, and the potential mechanism of action of picture book interventions, which emphasizes the importance of picture books as an intervention tool in Positive effects arising from research.

Limitation 1: The potential mechanism of picture book intervention on SLI must be clarified. The researchers used extremely premature infants, preschool children, adolescents with Down syndrome, and elders as samples to illustrate the corresponding effectiveness observations of the brain when picture books are used as an intervention tool, but considering the heterogeneity of SLI itself However, the potential mechanism of picture book intervention for children with SLI is still not completely clear, and it is worthy of further study.

Limitation 2: SLI picture book stem research lacks sample representativeness and general applicability. Picture book interventions have been relatively small in SLI studies, lacked sample diversity across languages , and lacked comparisons with normally developing peers. Most positive outcomes occurred in highly structured and predictable contexts and controlled environments designed by highly trained experimenters(Alejandra Auza, Towle Harmon, et al., 2018; Gutierrez-Ciellen, Cerejido, et al., 2009; Im & Park, 2019; Smeets, van Dijken, et al., 2014), while in other unstructured environments (such as families) and non-professionals (such as parents), the extent to which picture book intervention can benefit children requires further research.

Limitation 3: The complexity of the process and the uncertainty of the maintenance effect of picture book intervention in SLI research. This review of picture book intervention forms and potential mechanisms shows that the main feature of specific language impairment is language difficulties, but intelligence is unaffected. Picture book intervention may be beneficial for correcting language impairment in children with SLI, but the process and effect of picture book intervention Persistence remain to be seen.

6. Prospects of Picture Book Intervention in the Research of Specific Language Impairment

Support the use of picture books as an intervention tool for cross-lingual research. In the studies mentioned above, most of the picture book intervention studies were conducted on English or American-speaking populations. Since there are many differences in the language characteristics of different languages, the results of these studies cannot be assimilated. Therefore, the research objectives should be further expanded. The future study of SLI picture book intervention Research supports cross-language research, such as Mandarin, Cantonese, Italian, Spanish, German, Korean, Japanese, etc., as well as bilingual children's groups. Support the use of picture book intervention in different forms in the process of correcting SLI children's language barriers, explore the impact of multiple picture book intervention modes on SLI children's language ability, evaluate the effect of using picture book language intervention, and the effect of different picture book intervention modes Conduct comparative analysis. With the increasingly innovative development of virtual reality (AR), metaverse, human-computer interaction, and other technologies, convenient and efficient artificial intelligence technology can be applied to picture book research. Researchers may still face challenges depicted in this study, and educators are called on to combine picture book intervention with artificial intelligence, closely combined to explore a new picture book intervention method for further action research studies to promote language ability and various aspects of the development of SLI patients.

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References

- Alejandra Auza, B., Towle Harmon, M., & Murata, C. (2018). Retelling stories: Grammatical and lexical measures for identifying monolingual Spanish speaking children with specific language impairment (SLI). *Journal of communication disorders, 71*, 52-60. <https://doi.org/10.1016/j.jcomdis.2017.12.001>
- Alt, M., & Spaulding, T. (2011). The effect of time on word learning: an examination of de memory trace decayed vocal rehearsal in children with and without specific language impairment. *Journal of communication disorders, 44*(6), 640-654. <https://doi.org/10.1016/j.jcomdis.2011.07.001>
- Bahn, D., Vesker, M., Schwarzer, G., & Kauschke, C. (2021). A Multimodal Comparison of Emotion Categorization Abilities in Children With Developmental Language Disorder. *Journal of Speech-Language and Hearing Research, 64*(3), 993-1007. https://doi.org/10.1044/2020_JSLHR-20-00413
- Bang, H.-S., & Yi-Jeong, K. (2020). The development and effects of the social and emotional development program for young children using AR-based picture books. *Korean Journal of Early Childhood Education Research, 22*(2), 1-33. <https://doi.org/10.15409/riece.2020.22.2.1>
- Barak, L., Degani, T., & Novogrodsky, R. (2022). Influences of bilingualism and developmental Language disorder on how children learn and process words. *Developmental psychology, 58*(5), 821-834. <https://doi.org/10.1037/dev0001324>
- Barman, A., Prabhu, P., Mekhala, V. G., Vijayan, K., & Swapna, N. (2022). Auditory Processing in Children with Specific Language Impairment: A FFR Based Study. *Indian Journal of Otolaryngology and Head and neck surgery: Official publication of the Association of Otolaryngologists of India, 74*(Suppl 1), pp. 368-373. <https://doi.org/10.1007/s12070-020-02127-x>
- Barnes-Davis, M. E., Merhar, S. L., Holland, S. K., & Kadis, D. S. (2018). Extremely preterm children exhibit increased interhemispheric connectivity for Language: findings from fMRI-constrained MEG analysis. *Developmental science, 21*(6), e12669-e12669. <https://doi.org/10.1111/desc.12669>
- Bedore, L. M., & Leonard, L. B. (2005). Verb inflections and noun phrase morphology in the spontaneous speech of Spanish-speaking children with specific language impairment. *Applied Psycholinguistics, 26*(2), 195-225. <https://doi.org/10.1017/S0142716405050149>
- Brennan, J. R., Lajiness-O'Neill, R., Bowyer, S., Kovelman, I., & Hale, J. T. (2019). Predictive sentence comprehension during story-listening in autism spectrum disorder. *Language Cognition and Neuroscience, 34*(1), 1-15. <https://doi.org/10.1080/01691864.2019.1611111>

- 34(4), 428-439. <https://doi.org/10.1080/23273798.2018.1560483>
- Brilmayer, I., Werner, A., Primus, B., Bornkessel-Schlesewsky, I., & Schlewsky, M. (2019). The exceptional nature of the first person in natural story processing and the transfer of egocentricity. *Language Cognition and Neuroscience*, 34(4), 411-427. <https://doi.org/10.1080/23273798.2018.1542501>
- Bruner, J. S. (1990). Acts of Meaning. *Lectures on Mind & Culture*, 9.
- Chen, S.-Y. (2022). To explore the impact of augmented reality digital picture books in environmental education courses on environmental attitudes and environmental behaviors of children from different cultures. *Frontiers in Psychology*, 13, 1063659-1063659. <https://doi.org/10.3389/fpsyg.2022.1063659>
- Cheng, K.-H., & Tsai, C.-C. (2014). Children and parents' Reading of an augmented reality picture book: Analyses of behavioral patterns and cognitive attainment. *Computers & Education*, 72, 302-312. <https://doi.org/10.1016/j.compedu.2013.12.003>
- Cho, H., & Sunghoon, K. (2019). A Study on the Edutainment Contents Elements in Augmented Reality(AR) Educational Contents Design. *Journal of the Korean Society of Design Culture*, 25(1), 441-452. <https://doi.org/10.18208/ksdc.2019.25.1.441>
- Coloma, C. J., De Barbieri, Z., Quezada, C., Bravo, C., Chaf, G., & Araya, C. (2020). The impact of vocabulary, grammar, and decoding on reading comprehension among children with SLI: a longitudinal study. *Journal of communication disorders*, 86. <https://doi.org/10.1016/j.jcomdis.2020.106002>
- Conti-Ramsden, G., Botting, N., & Faragher, B. (2001). Psycholinguistic markers for specific language impairment (SLI). *Journal of child psychology, Psychiatry, and allied disciplines*, 42(6), 741-748. <https://doi.org/10.1111/1469-7610.00770>
- Conti-Ramsden, G., & Durkin, K. (2012). Postschool educational and employment experiences of young people with specific language impairment. *Language, speech, and hearing services in schools*, 43(4), 507-520. [https://doi.org/10.1044/0161-1461\(2012/11-0067\)](https://doi.org/10.1044/0161-1461(2012/11-0067))
- Corriveau, K., Pasquini, E., & Goswami, U. (2007). Basic auditory processing skills and specific language impairment: a new look at an old hypothesis. *Journal of Speech, Language, and hearing research: JSLHR*, 50(3), 647-666. [https://doi.org/10.1044/1092-4388\(2007/046\)](https://doi.org/10.1044/1092-4388(2007/046))
- Coster, F. W., Goorhuis-Brouwer, S. M., Nakken, H., & Spelberg, H. C. L. (1999). Specific language impairments and behavioral problems. *Folia Phoniatrica Et Logopaedica*, 51(3), 99-107. <https://doi.org/10.1159/000021484>
- Dalal, R. H., & Loeb, D. F. (2005). Imitative production of regular past tense -ed by English-speaking children with specific language impairment. *International journal of language & communication disorders*, 40(1), 67-82. <https://doi.org/10.1080/13682820410001734163>
- Dasdemir, Y. (2022). Cognitive investigation on the effect of augmented reality-based Reading on emotion classification performance: A new dataset. *Biomedical Signal Processing and Control*, p. 78. <https://doi.org/10.1016/j.bspc.2022.103942>
- Dias, A., School, I. B., & Portugal. (2009). Technology-enhanced learning and augmented reality: an application on multimedia interactive books. *edições universitárias lusófonas*, 1(1), 69-79.
- Diehm, E. A., Wood, C., Puhlman, J., & Callendar, M. (2020). Young children's narrative retells in response to static and animated stories et al. *International journal of language & communication disorders*, 55(3), 359-372. <https://doi.org/10.1111/1460-6984.12523>
- Donoghue, E., Glassy, D., DelConte, B., Earls, M., Lieser, D., ... McFadden, T. (2014). Literacy Promotion: An Essential Component of Primary Care Pediatric Practice. *Pediatrics*, 134(2), 404-409. <https://doi.org/10.1542/peds.2014-1384>
- Dowdall, N., Melendez-Torres, G. J., Murray, L., Gardner, F., Hartford, L., & Cooper, P. J. (2020). Shared PictureBook Reading Interventions for Child Language Development: A Systematic Review and Meta-Analysis. *Child development*, 91(2), e383-e399. <https://doi.org/10.1111/cdev.13225>
- Duinmeijer, I., de Jong, J., & Scheper, A. (2012). Narrative abilities, memory, and attention in children with specific language impairment. *International journal of language & communication disorders*, 47(5), 542-555. <https://doi.org/10.1111/j.1460-6984.2012.00164.x>
- Elia, I., van, den H.-P. M., & Georgiou, A. (2010). The role of pictures in picture books on children's cognitive

- engagement with mathematics. *European Early Childhood Education Research Journal*. <https://doi.org/10.1080/1350293X.2010.500054>
- Fiestas, C. E., & Pena, E. D. (2004). Narrative discourse in bilingual children: Language and task effects. *Language, speech, and hearing services in schools*, 35(2), 155-168. [https://doi.org/10.1044/0161-1461\(2004/016\)](https://doi.org/10.1044/0161-1461(2004/016))
- Flapper, B. C. T., & Schoemaker, M. M. (2013). Developmental coordination disorder in children with specific language impairment: co-morbidity and impact on quality of life. *Research in developmental disabilities*, 34(2), 756-763. <https://doi.org/10.1016/j.ridd.2012.10.014>
- Ganea, P. A., Pickard, M. B., & Deloache, J. S. (2008). Transfer between Picture Books and the Real World by Very Young Children. *Journal of Cognition & Development*, 9(1), 46-66. <https://doi.org/10.1080/15248370701836592>
- Gray, S. (2004). Word learning by preschoolers with specific language impairment: predictors and poor learners. *Journal of Speech, Language, and hearing research: JSLHR*, 47(5), 1117-1132. [https://doi.org/10.1044/1092-4388\(2004/083\)](https://doi.org/10.1044/1092-4388(2004/083))
- Gu, C., Chen, J., Yang, C., Wei, W., Jiang, Q., ... Jiang, L. (2022). Effects of AR Picture Books on German Teaching in Universities. *Journal of Intelligence*, 10(1). <https://doi.org/10.3390/jintelligence10010013>
- Gutiérrez-Clellen, V. F., Simon-Cerejido, G., & Erickson Leone, A. (2009). Code-switching in bilingual children with specific language impairment. *International Journal of Bilingualism*, 13(1), 91-109. <https://doi.org/10.1177/1367006909103530>
- Hasegawa, C., Takahashi, T., Ikeda, T., Yoshimura, Y., Hiraishi, H., ... Nobukawa, S. (2021). Effects of familiarity on child brain networks when listening to a storybook reading: A magneto-encephalographic study. *Neuroimage*, 241, 10. <https://doi.org/10.1016/j.neuroimage.2021.118389>
- Heilmann, J. J., Rojas, R., Iglesias, A., & Miller, J. F. (2016). Clinical impact of wordless picture storybooks on bilingual narrative language production: A comparison of the "Frog" stories. *International journal of language & communication disorders*, 51(3), 339-345. <https://doi.org/10.1111/1460-6984.12201>
- Helland, W. A., Helland, T., & Heimann, M. (2014). Language Profiles and Mental Health Problems in Children With Specific Language Impairment and Children With ADHD. *Journal of Attention Disorders*, 18(3), 226-235. <https://doi.org/10.1177/1087054712441705>
- Hessling, A., & Schuele, C. M. (2020). Individualized Narrative Intervention for School-Age Children With Specific Language Impairment. *Language Speech and Hearing Services in Schools*, 51(3), 687-705. https://doi.org/10.1044/2019_LSHSS-19-00082
- Horowitz-Kraus, T., Farah, R., DiFrancesco, M., & Vannest, J. (2017). The Involvement of Speed-of-Processing in Story Listening in Preschool Children: A Functional and Structural Connectivity Study. *Neuropediatrics*, 48(1), 19-29. <https://doi.org/10.1055/s-0036-1593531>
- Hsiao, C.-Y. (2010). Enhancing Children's Artistic and Creative Thinking and Drawing Performance through Appreciating Picture Books. *International Journal of Art & Design Education*, 29(2), 143-152. <https://doi.org/10.1111/j.1476-8070.2010.01642.x>
- Hsieh, M.-C. (2021). Development and Application of an Augmented Reality Oyster Learning System for Primary Marine Education. *Electronics*, 10(22). <https://doi.org/10.3390/electronics10222818>
- Hui, A. N. N., Chow, B. W.-Y., Chan, E. S. M., & Leung, M.-T. (2019). Reading Picture Books With Elements of Positive Psychology for Enhancing the Learning of English as a Second Language in Young Children. *Frontiers in Psychology*, 10, 2899-2899. <https://doi.org/10.3389/fpsyg.2019.02899>
- Hutton, J. S., Dudley, J., Horowitz-Kraus, T., DeWitt, T., & Holland, S. K. (2019). Functional Connectivity of Attention, Visual, and Language Networks During Audio, Illustrated, and Animated Stories in Preschool-Age Children. *Brain Connectivity*, 9(7), 580-592. <https://doi.org/10.1089/brain.2019.0679>
- Hutton, J. S., Dudley, J., Horowitz-Kraus, T., DeWitt, T., & Holland, S. K. (2020). Differences in functional brain network connectivity during stories presented in audio, illustrated, and animated format in preschool-age children. *Brain Imaging and Behavior*, 14(1), 130-141. <https://doi.org/10.1007/s11682-018-9985-y>
- Hutton, J. S., Phelan, K., Horowitz-Kraus, T., Dudley, J., Altaye, M., ... DeWitt, T. (2017). Shared Reading Quality and Brain Activation during Story Listening in Preschool-Age Children. *Journal of Pediatrics*, p.

- 191, 204-+. <https://doi.org/10.1016/j.jpeds.2017.08.037>
- Hyun, E.-J., Min, Y. H., & 최경. (2011). Usability of Augmented Reality Picture Book for Young Children. *The Journal of the Korea Contents Association*, 11(12), 182-189. <https://doi.org/10.5392/JKCA.2011.11.12.182>
- Im, T.-I., & Park, H. J. (2019). Fast Mapping Characteristics in Children with Specific Language Impairments Using a Picture Book. *Journal of Special & Gifted Education*, 6(2), 103-116. <https://doi.org/10.33125/kdps.2019.6.2.7>
- jeong-jin, Y. (2006). The Development of Creativity Problem Solving Program for Young Children Using Picture Book Based Video. *The Korea Association of Child Care and Education*, 47, 285-311. Retrieved from <https://www.kci.go.kr/kciportal/ci/sereArticleSearch/ciSereArtiView.kci?sereArticleSearchBean.artiId=ART001025651>
- jeong-jin, Y., & 임정하. (2011). The Effect of a Creativity Problem Solving Program for Young Children Using Picture Books Based Video. *The Korean Journal of Human Development*, 18(1), 109-132. Retrieved from <Go to ISI>://KJD:ART0015379d
- Kauschke, C., van der Beek, B., & Kamp-Becker, I. (2016). Narratives of Girls and Boys with Autism Spectrum Disorders: Gender Differences in Narrative Competence and Internal State Language. *Journal of Autism and developmental disorders*, 46(3), 840-852. <https://doi.org/10.1007/s10803-015-2620-5>
- Kim, J. (2010). An analysis of the effects of emotional awareness and expression program using picture books on 3-year-olds' emotional competence and social behavior. *The Journal of Korea Open Association for Early Childhood Education*, 15(5), 59-87. Retrieved from <https://www.kci.go.kr/kciportal/ci/sereArticleSearch/ciSereArtiView.kci?sereArticleSearchBean.artiId=ART001493071>.
- Klop, D., & Engelbrecht, L. (2013). The effect of two different visual presentation modalities on the narratives of mainstream grade 3 children. *The South African Journal of communication disorders = Die Suid-Afrikaanse tydskrif vir Kommunikasiefwykings*, 60, 21-26. <https://doi.org/10.4102/sajcd.v60i1.6>
- Koskinen, M., & Seppa, M. (2014). Uncovering cortical MEG responses to listening to audiobook stories. *Neuroimage*, 100, 263-270. <https://doi.org/10.1016/j.neuroimage.2014.06.018>
- Leonard, L. B. (2000, 3-5, 8-11). *Children with Specific Language Impairment*: Cambridge MA, MIT Press.
- Leonard, L. B., Ellis Weismer, S., Miller, C. A., Francis, D. J., Tomblin, J. B., & Kail, R. V. (2007). Speed of processing, working memory, and language impairment in children. *Journal of Speech, Language, and hearing research: JSLHR*, 50(2), 408-428. [https://doi.org/10.1044/1092-4388\(2007\)029](https://doi.org/10.1044/1092-4388(2007)029)
- Li, C., Ding, K., Zhang, M., Zhang, L., Zhou, J., & Yu, D. (2020). Effect of Picturebook Reading with Additive Audio on Bilingual Preschoolers' Prefrontal Activation: A Naturalistic Functional Near-Infrared Spectroscopy Study. *Frontiers in Psychology*, p. 11, 1939-1939. <https://doi.org/10.3389/fpsyg.2020.01939>
- Maggio, V., Granana, N. E., Richaudeau, A., Torres, S., Giannotti, A., & Suburo, A. M. (2014). Behavior Problems in Children with Specific Language Impairment. *Journal of Child Neurology*, 29(2), 194-202. <https://doi.org/10.1177/0883073813509886>
- Marinis, T. (2011). On the nature and causes of Specific Language Impairment: A view from sentence processing and infant research. *Lingua*, 121(3), 463-475. <https://doi.org/10.1016/j.lingua.2010.10.010>
- McArthur, G. M., & Bishop, D. V. (2001). Auditory perceptual processing in people with Reading and oral language impairments: current issues and recommendations. *Dyslexia (Chichester, England)*, 7(3), 150-170. <https://doi.org/10.1002/dys.200>
- McArthur, G. M., & Bishop, D. V. M. (2004). Which people with specific language impairments have auditory processing deficits? *Cognitive Neuropsychology*, 21(1), 79-94. <https://doi.org/10.1080/02643290342000087>
- McArthur, G. M., Hogben, J. H., Edwards, V. T., Heath, S. M., & Mengler, E. D. (2000). On the "specifics" of specific reading disability and specific language impairment. *Journal of child psychology and Psychiatry, and allied disciplines*, 41(7), 869-874. <https://doi.org/10.1111/1469-7610.00674>
- Mcgregor, K. K., Licandro, U., Arenas, R., Eden, N., Stiles, D., ... Bean, A. (2013). Why Words Are Hard for Adults With Developmental Language Impairments. *Journal of Speech-Language & Hearing Research Jslhr*, 56(6), 1845-1856. [https://doi.org/10.1044/1092-4388\(2013\)12-0233](https://doi.org/10.1044/1092-4388(2013)12-0233)
- Merritt, D. D., & Liles, B. Z. (1987). Story grammar ability in children with and without language disorder: story

- generation, retelling, and comprehension. *Journal of Speech and hearing research*, 30(4), 539-552. <https://doi.org/10.1044/jshr.3004.539>
- Miles, S., Chapman, R., & Sindberg, H. (2006). Sampling context affects MLU in the Language of adolescents with Down syndrome. *Journal of Speech, Language, and hearing research: JSLHR*, 49(2), 325-337. [https://doi.org/10.1044/1092-4388\(2006/026\)](https://doi.org/10.1044/1092-4388(2006/026))
- Montgomery, J. W., & Leonard, L. B. (1998). Real-time inflectional processing by children with specific language impairment: effects of phonetic substance. *Journal of Speech, Language, and hearing research: JSLHR*, 41(6), 1432-1443. <https://doi.org/10.1044/jslhr.4106.1432>
- Morgan, P. L., Farkas, G., & Wu, Q. (2011). Kindergarten Children \s Growth Trajectories in Reading and Mathematics: Who Falls Increasingly Behind? *Journal of learning disabilities*, 44(5), 472-488. <https://doi.org/10.1177/0022219411414010>
- Murray, L. (2014). *The psychology of babies: how relationships support development from birth to two*: Hachette UK: Constable & Robinson.
- Nash, M., & Donaldson, M. L. (2005). Word learning in children with vocabulary deficits. *Journal of Speech, Language, and hearing research: JSLHR*, 48(2), 439-458. [https://doi.org/10.1044/1092-4388\(2005/030\)](https://doi.org/10.1044/1092-4388(2005/030))
- Nikolajeva, M., & Scott, C. (2006). *How picturebooks work*: New York: Routledge.
- Nilsson, E., Svensson, G., & Frisman, G. H. (2016). Picture book support for preparing children ahead of and during day surgery. *Nursing children and young people*, 28(8), 30-35. <https://doi.org/10.7748/ncyp.2016.e749>
- Nodelman, P. (1989). *Words about Pictures: The Narrative Art of Children's Picture Books*, 212-214.
- O'Toole, K. J., & Kannass, K. N. (2018). Emergent literacy in print and electronic contexts: The influence of book type, narration source, and attention. *Journal of experimental child psychology*, 173, 100-115. <https://doi.org/10.1016/j.jecp.2018.03.013>
- Orsolini, M., Sechi, E., Maronato, C., Bonvino, E., & Corcelli, A. (2001). Nature of phonological delay in children with specific language impairment. *International journal of language & communication disorders*, 36(1), 63-90. <https://doi.org/10.1080/13682820150217572>
- Ouellette, & Gene, P. (2006). What's meaning got to do with it: The role of vocabulary in word reading and reading comprehension. *Journal of Educational Psychology*, 98(3), págs. 554-566. <https://doi.org/10.1037/0022-0663.98.3.554>
- Prathanee, B., Thinkhamrop, B., & Dechongkit, S. (2006). Specific language impairment: effect on later language development: a literature review. *Journal of the Medical Association of Thailand*, 89(10), 1775-1787.
- Ricci, C. M., & Beal, C. R. (2002). The Effect of Interactive Media on Children's Story Memory. *Journal of Educational Psychology*, 94(1), 138-144. <https://doi.org/10.1037/0022-0663.94.1.138>
- Rice, M. L., & Wexler, K. (1996). Toward tense as a clinical marker of specific language impairment in English-speaking children. *Journal of Speech and hearing research*, 39(6), 1239-1257. <https://doi.org/10.1044/jshr.3906.1239>
- Rumpf, A.-L., Kamp-Becker, I., Becker, K., & Kauschke, C. (2012). Narrative competence and internal state language of children with Asperger Syndrome and ADHD. *Research in developmental disabilities*, 33(5), 1395-1407. <https://doi.org/10.1016/j.ridd.2012.03.007>
- Sakurai, R., Ishii, K., Sakuma, N., Yasunaga, M., Suzuki, H., ... Murayama, Y. (2018). Preventive effects of an intergenerational program on age-related hippocampal atrophy in older adults: The REPRINTS study. *International Journal of Geriatric Psychiatry*, 33(2), E264-E272. <https://doi.org/10.1002/gps.4785>
- Sasaki, M., Schwartz, R. G., Hisano, M., & Suzuki, M. (2021). Relative Clause Sentence Comprehension by Japanese-Speaking Children With and Without Specific Language Impairment. *Journal of Speech-Language and Hearing Research*, 64(6), 1929-1943. https://doi.org/10.1044/2021_JSLHR-19-00054
- Scott, C. M., & Windsor, J. (2000). General language performance measures in spoken and written narrative and expository discourse of school-age children with language learning disabilities. *Journal of Speech, Language, and hearing research: JSLHR*, 43(2), 324-339. <https://doi.org/10.1044/jslhr.4302.324>

- Segers, P., Takke, L., & Verhoeven, L. (2004). Teacher-Mediated Versus Computer-Mediated Storybook Reading to Children in Native and Multicultural Kindergarten Classrooms. *School Effectiveness and School Improvement*, 15(2), 215-226. <https://doi.org/10.1076/sesi.15.2.215.30430>
- Simcock, G., & Deloache, J. (2006). Get the picture? The effects of iconicity on toddlers' reenactment from picture books. *Developmental psychology*, 42(6), 1352. <https://doi.org/10.1037/0012-1649.42.6.1352>
- Smeets, D. J. H., van Dijken, M. J., & Bus, A. G. (2014). Using electronic storybooks to support word learning in children with severe language impairments. *Journal of learning disabilities*, 47(5), 435-449. <https://doi.org/10.1177/0022219412467069>
- Stegenwallner-Schuetz, M., & Adani, F. (2021). Number Dissimilarity Effects in Object-Initial Sentence Comprehension by German-Speaking Children With Specific Language Impairment. *Journal of Speech-Language and Hearing Research*, 64(3), 870-888. https://doi.org/10.1044/2020_JSLHR-19-00305
- Storkel, H. L., Komesidou, R., Fleming, K. K., & Romine, R. S. (2017). Interactive Book Reading to Accelerate Word Learning by Kindergarten Children With Specific Language Impairment: Identifying Adequate Progress and Successful Learning Patterns. *Language Speech and Hearing Services in Schools*, 48(2), 108-124. https://doi.org/10.1044/2017_LSHSS-16-0058
- Tornqvist, E., Mansson, A., & Hallstrom, I. (2015). Children having magnetic resonance imaging: A preparatory storybook and audio/visual media are preferable to anesthesia or deep sedation. *Journal of Child Health Care*, 19(3), 359-369. <https://doi.org/10.1177/1367493513518374>
- Tsao, Y., Kuo, H. C., Lee, H. C., & Yiin, S. J. (2017). Developing a medical picture book for reducing venipuncture distress in preschool-aged children. *International Journal of Nursing Practice*, 23(5), 8. <https://doi.org/10.1111/ijn.12569>
- Vannest, J., Maloney, T. C., Tenney, J. R., Szaflarski, J. P., Morita, D., ... Byars, A. W. (2019). Changes in functional organization and functional connectivity during story listening in children with benign childhood epilepsy with centrotemporal spikes. *Brain and Language*, pp. 193, 10-17. <https://doi.org/10.1016/j.bandl.2017.01.009>
- Verhallen, M., Bus, A. G., & Jong, M. D. (2006). The promise of multimedia stories for kindergarten children at risk. *Journal of Educational Psychology*, 98(2), 410-419. <https://doi.org/10.1037/0022-0663.98.2.410>
- Weckerly, J., Wulfeck, B., & Reilly, J. (2001). Verbal fluency deficits in children with specific language impairment: Slow rapid naming or slow to name? *Child Neuropsychology*, 7(3), 142-152. <https://doi.org/10.1076/chin.7.3.142.8741>
- Wonjeong, P., & Yim, D. (2020). Correlation Analysis on the Preschoolers' Processing Capacity, Processing Speed, Story Comprehension Performance, and the Eye Movement Patterns. *Journal of speech-language & hearing disorders*, 29(3), 57-67. <https://doi.org/10.15724/jslhd.2020.29.3.057>
- Yogev-Seligmann, G., Oren, N., Ash, E. L., Hendler, T., Giladi, N., & Lerner, Y. (2016). Altered Topology in Information Processing of a Narrated Story in Older Adults with Mild Cognitive Impairment. *Journal of Alzheimer's Disease*, 53(2), 517-533. <https://doi.org/10.3233/JAD-150845>
- Yoo, J., & Yim, D. (2021). Relative Clause Sentence Processing in Korean-Speaking School-Aged Children With and Without Specific Language Impairment. *Journal of Speech-Language and Hearing Research*, 64(2), 510-530. https://doi.org/10.1044/2020_JSLHR-19-00373

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