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Adapting the Picture Exchange Communication System for toddlers with hearing impairments in inclusive classrooms

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***Abstract*—** The Picture Exchange Communication System (PECS) is widely recognised as initially developed for children with autism and has since been identified as beneficial for individuals with hearing impairments. This study, therefore, seeks to explore the adaptation of PECS for toddlers with hearing impairments in inclusive classroom settings. The structured six-phase protocol of PECS, emphasising visual and tactile supports, is examined for its potential to bridge communication barriers and foster independent interaction. Special attention is given to integrating situational visual cues, such as photographs and tangible symbols, to enhance engagement and contextual understanding during playtime, a critical developmental activity for young children. Parental involvement and environmental adjustments are pivotal factors in successfully implementing PECS for toddlers with hearing impairment. Training parents to use PECS in naturalistic contexts, such as play, improves communication consistency and motivation. The paper highlights the role of customised PECS strategies in supporting communication development and toddlers' social and emotional well-being. Despite promising outcomes, this study underscores the need for further research to validate the effectiveness of PECS adaptations for this specific population, particularly in fostering spontaneous communication and joint attention.
Keywords: Picture Exchange Communication System, Toddlers with hearing impairment, Inclusive classroom, Augmentative and alternative communication.

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I. INTRODUCTION

THE Picture Exchange Communication System (PECS) has emerged as a transformative tool in augmentative and alternative communication (AAC), particularly for individuals with developmental and communication challenges. Originally developed for children with autism, PECS has since been adapted to address the needs of various populations, including toddlers with hearing impairments. Its structured six-phase protocol guides learners from basic picture exchanges to complex communication, fostering independence and reducing frustration associated with traditional verbal communication barriers. By leveraging visual symbols, PECS provides a practical means for toddlers to express their needs, participate in social interactions, and build foundational communication skills.

This paper delves into the adaptation of PECS for children aged 0 to 3 years with hearing impairments in inclusive classroom settings. It emphasises the integration of situational visual cues and tactile supports to bridge the gap between abstract symbols and real-world interactions. Furthermore, it explores the critical role of parental involvement, environmental adjustments, and play-based strategies in enhancing communication outcomes. This study contributes valuable insights into applying PECS as a versatile and inclusive communication system focusing on the unique sensory and developmental needs of toddlers with hearing impairment.

II. PICTURE EXCHANGE COMMUNICATION SYSTEM (PECS)

The Picture Exchange Communication System (PECS) was initially designed for children with autism but has since been modified to address various communication needs, including those of children with hearing impairments. This system is structured into six phases that help children progress from basic picture exchanges to more advanced communication techniques. Each phase is built on the previous one, allowing for the gradual development of communication skills in an organised manner (Frost & Bondy, 2002). The Picture Exchange Communication System (PECS) was developed in 1985 by Andy Bondy, PhD, and Lori Frost, MS, CCC-SLP, PECS was first used with preschoolers diagnosed with autism at the Delaware Autism Programme. It has since been successfully implemented worldwide, benefiting thousands of individuals across different age groups who face cognitive, physical, and communication challenges (Magnetaba, 2024; PECS United Kingdom, 2024). PECS is a systematic communication method for individuals with developmental disabilities, enabling them to express their needs and desires through picture symbols (Frost & Bondy, 2002).

The Picture Exchange Communication System (PECS) framework is grounded in B.F. His seminal work Verbal Behaviours (1957) introduced Skinner's theory of verbal behaviors. Skinner's theory departs from traditional linguistic models by analysing language not as a structural or grammatical system but as behaviours that serve specific functional purposes in an individual's environment. This behaviourist perspective views language as operant behaviours learned, shaped, and maintained through interaction with the environment via reinforcement and consequences. In Skinner's model, verbal behaviours are categorised into several functional units based on the contingencies governing them. PECS relies heavily on these categories to conceptualise communication and guide intervention. The relevant verbal operants in Skinner's theory include the following:

Mand: A mand is a verbal behaviour that functions as a request, asking for something the speaker wants or needs. The function of a mand is reinforced directly by the acquisition of the desired object or outcome (e.g., a request for water is reinforced when the individual receives water). Mands form the foundation of PECS. **In Phase 1**, learners are taught to exchange a picture symbol to request an item, effectively teaching the "mand" in non-vocal children. Manding allows children to see the immediate utility of communication, as it produces a directly satisfying result.

Tact: A tact is a label or commentary about the environment. For example, seeing a dog and saying "dog" is tact. The reinforcement of tacts is typically social (e.g., praise or acknowledgment), rather than directly related to obtaining the object. Later phases of PECS incorporate tacting by encouraging learners to label objects and people using picture symbols. For children who use PECS, this allows them to describe their surroundings and engage in shared attention by labeling their experiences.

Echoic: An echoic refers to verbal behaviours involving repetition or mirroring another person's verbal behaviours. For example, if one person says "apple" and another repeats "apple," this is echoic behaviours. While PECS typically does not rely on vocal replication, it employs similar principles in teaching visual exchange. Prompts in PECS may echo the required action during initial training as part of the pairing process.

Intraverbal: Intraverbals refer to verbal behaviours that respond to a conversational or social stimulus. For example, answering questions like "What's your name?" involves intraverbal behaviours. In PECS, later phases aim to teach intraverbal behaviours by encouraging learners to use symbolic communication to answer questions, such as responding to "What do you want?" with a sequence of images forming a sentence.

Autoclitics: Skinner also introduced the concept of autoclitics, which are verbal behaviours that modify the meaning of other verbal behaviours. These include elements like adjectives, word order, or qualifiers. In PECS, advanced training may incorporate autoclitic elements such as expanding the structure of sentences (e.g., moving from "I want car" to "I want the blue car").

Skinner's emphasis on the function of communication rather than its form aligns closely with the goals of PECS, which aims to teach intentional and functional communication to individuals who may not use speech. This framework is applied systematically through applied behaviours analysis (ABA) principles. For example:

Motivating Operations: In Skinner's framework, a mand is initiated by a motivating operation (e.g., hunger leads to a request for food). PECS capitalises on these natural motivations by mand training in Phase 1, where learners must request items or activities, they strongly desire, ensuring high levels of motivation and reinforcement.

Reinforcement: Reinforcement is fundamental to the Skinnerian theory and central to PECS. When children perform a desired behaviour, such as exchanging a picture for a preferred item, the immediate consequence (receiving the item) is a reinforcement. This strengthens the likelihood of future exchanges.

Shaping: Verbal behaviour is often shaped gradually toward more complex communication. PECS employs shaping techniques across its six phases. For example, starting with basic picture exchanges (Phase 1), it progresses to constructing sentences with multiple symbols (Phase 4), ensuring the learner's abilities expand with practice and reinforcement.

Prompting and Fading: Skinner's theory acknowledges prompts' role in facilitating learning. PECS incorporates prompts (e.g., physical guidance or gestural direction) during training but fades these systematically to ensure independence. Similarly, error correction redirects the learner and provides additional opportunities for correct behaviours.

Skinner's concept of generalisation, or the transfer of learned behaviours to new settings, individuals, or stimuli, is crucial to PECS. Verbal behaviours are only effective if they can generalise beyond the therapy setting. In PECS, generalisation is emphasised by training communication across multiple partners, contexts, and items. For instance, once a learner master's manding with a therapist, the skill is extended to family members, peers, and different environments, ensuring that communication becomes functional in everyday life. PECS directly applies Skinner's verbal behavioural theory, using picture-based exchanges to teach functional communication. By relying on core concepts like minds, reinforcement, and shaping, PECS aligns with Skinner's focus on the contingencies that govern language development and extends it to nonverbal communicators. This foundation ensures the immediate utility of communication and the potential for progressive skill development.

Related research has explored the adaptation of the PECS with visual cues for toddlers aged 0-3 years with hearing impairments. However, direct evidence for the specific population during playtime remains limited. Visual cues, such as photographs, situational images, or tangible symbols, are effective tools for fostering communication, especially when they bridge the gap between abstract PECS's symbols and contextual play scenarios (Loots & Devisé, 2003; Ivy et al., 2020). Research indicates that visual support enhances predictability, reduces frustration, and improves interaction engagement, particularly when environmental adjustments are made to integrate these cues naturally into everyday contexts like play (Rutherford et al., 2019; Roberts, 2019).

The effectiveness of PECS in hearing-impaired toddlers depends on its customisation to meet sensory needs and parental involvement to ensure consistency and motivation in communication (Loots et al., 2005; Roberts, 2019). These adaptations enhance communication and positively impact the toddler's social engagement, emotional well-being, and cognitive development. The PECS is an effective communication intervention for young children, particularly those with hearing impairments and other communication challenges. This system is designed to help children initiate communication by exchanging pictures, making it suitable for inclusive classroom settings. As play is a critical developmental activity for toddlers, adapting PECS with situational and concrete visual symbols, such as depicting toys, familiar activities, or photographic routines, could foster more meaningful exchanges, joint attention, and symbolic understanding. Such efforts must also address barriers faced by hearing family members who lack sign language knowledge, potentially by combining visual PECS symbols with environmental structuring and family coaching (Curtin et al., 2024; Kim et al., 2023).

Studies have primarily focused on the role of parental involvement and naturalistic contexts in supporting communication development. For example, Roberts (2019) demonstrated that parent-implemented interventions using visual supports increased communication skill use and quality of interaction during play sessions. However, findings suggest that hearing parents typically require training to consistently use visual (and other multimodal) supports to meet the sensory-specific needs of their toddlers with hearing impairment (Loots et al., 2005; Curtin et al., 2024). Despite these advancements, research on PECS adaptations with visual cues specifically for hearing-impaired toddlers during play contexts is generally sparse. Tangible symbol-based adaptations of PECS have shown promise for individuals with sensory challenges but have not been thoroughly tested for this demographic (Ivy et al., 2020).

The PECS is a widely used AAC system designed to help individuals with communication challenges express their needs, participate in social exchanges, and learn to initiate conversations. It has been specifically effective for children with developmental delays, autism spectrum disorders, and other speech or language impairments. PECS emphasises teaching the functional use of communication through picture symbols, encouraging intentional interaction between communication partners (Frost & Bondy, 2002). This system is particularly relevant for toddlers with hearing impairments, as it provides visual interaction independent of spoken or sign language. Research has shown that visual tools like PECS reduce the frustration associated with communication barriers and promote functional and social communication, supporting

emotional and cognitive development (Ivy et al., 2020; Roberts, 2019).

For toddlers with hearing impairments, adapting PECS to include situational visual cues (e.g., images of toys, objects, or play scenes) and tactile supports (e.g., textured symbols) can provide essential context and sensory stimulation. These adaptations help bridge the gap between abstract picture representations and concrete play interactions, fostering better parent-child interaction and symbolic understanding in naturalistic settings like home playtimes (Curtin et al., 2024; Loots et al., 2005).

III. PROCEDURE OF PECS

The PECS protocol is structured and implemented in six progressive phases, each designed to teach specific communication skills. These phases are:

Phase 1: Teaching how to communicate

In the initial phase, learners are introduced to communication by exchanging a picture symbol for a desired object, such as a photo of their favorite toy. This stage is facilitated through physical prompts encouraging the child to exchange behaviours.

Phase 2: Increasing spontaneity

During the second phase, children initiate communication independently by approaching the picture symbols to request items. This process reinforces their understanding of the association between symbols and their meanings.

Phase 3: Picture discrimination

In this phase, toddlers learn to differentiate between symbols representing different objects or activities. This skill enables them to communicate more specifically about their needs and desires.

Phase 4: Sentence structure

As children progress, they combine symbols into simple sentences using a sentence strip. For example, they might construct a sentence like "I want + [picture symbol]." This phase helps them understand basic sentence structure.

Phase 5: Answering questions

During this phase, children participate in activities to help them answer simple questions, such as "What do you want?" They learn to identify and utilise the correct symbols to effectively communicate their responses.

Phase 6: Initiating conversations

The final phase emphasises fostering conversational exchanges. Children use symbols to express their needs, comment on their environment, or share their thoughts, enhancing their overall communication skills (Frost & Bondy, 2002). For toddlers with hearing impairments, additional supports such as situational visual cues (e.g., photos or environmental symbols) and tactile feedback (e.g., textured cards) may need to be integrated into each phase to accommodate their sensory preferences and communication needs (Ivy et al., 2020; Rutherford et al., 2019).

Applying the PECS to toddlers with hearing impairments necessitates specific modifications and strategies to ensure effective implementation.

The adaptation of picture symbols is crucial. It is essential to use situational or environmental symbols that are easily recognisable and familiar to the child. This could include photographs of toys, daily routines, or family members engaged in activities. Incorporating tactile elements, such as textured pictures or raised symbols, can provide sensory feedback that reinforces the meaning associated with each symbol (Ivy et al., 2020). These adaptations help make the symbols more relatable and cater to the sensory preferences of toddlers with hearing impairments. Training and collaboration with parents and caregivers are vital in successfully applying PECS. Parents should receive training on implementing PECS at home, particularly during playtime. Techniques such as coaching and video feedback can assist parents in effectively incorporating tactile and visual supports into their natural interactions with their children (Curtin et al., 2024). For instance, parents can practice initiating communication by combining tactile prompts such as gently tapping the child's hand with pointing to or presenting picture symbols. This approach fosters an interactive environment that encourages communication.

Integrating PECS into play contexts is essential for practical application. Children can engage in meaningful exchanges using symbols to represent toys, actions, or interactions during play scenarios. For example, during a tea party activity, using symbols for "cup," "pour," and "drink" can facilitate joint attention and encourage children to express their wants and needs effectively. Placing these symbols within the child's immediate environment helps ensure clarity and context, making it easier for them to understand and use the symbols in relevant situations (Roberts, 2019). Building engagement through reinforcement is another critical aspect of applying PECS for toddlers with hearing impairments. Utilising play-based rewards can significantly enhance the child's motivation to communicate. For example, when a child exchanges a PECS symbol for a picture of a toy, they should receive the toy immediately. This immediate reward establishes a clear connection between their communication efforts and positive outcomes.

Evaluating progress is essential to ensure toddlers develop their communication skills effectively. Regular assessments using pre-linguistic communication metrics such as increased communication initiation, joint attention, and turn-taking can provide valuable insights into the child's development. Family members can document interactions to track subtle improvements over time (Kim et al., 2023). This ongoing evaluation allows for adjustments in strategies as needed to support the child's growth in communication better; applying PECS for toddlers with hearing impairments involves thoughtful adaptations of symbols, active involvement of parents, integration into play contexts, reinforcement strategies, and regular progress evaluations. These components work together to create an effective communication framework that meets the unique needs of these children.

IV. BENEFITS OF PICTURE EXCHANGE COMMUNICATION STRATEGY

The Picture Exchange Communication System (PECS) offers numerous benefits for children with hearing impairments, enhancing their ability to communicate effectively and engage with their environment. Visual learning is a significant advantage of PECS, as it utilises visual symbols that are particularly beneficial for children with hearing impairments. These children rely more on visual cues to understand and express themselves, making using pictures, symbols and photographs an effective communication method. By providing a clear visual representation of concepts, PECS supports children in articulating their thoughts and needs without depending on verbal language. This visual approach not only aids comprehension but also encourages children to participate actively in communication, fostering a sense of independence and confidence in their ability to express themselves.

Increased engagement is another crucial benefit of PECS. The tangible nature of the symbols encourages active participation in communication, which can significantly enhance engagement levels in inclusive classroom environments. When children use physical symbols to express their needs or desires, they interact more with peers and adults. This active participation is essential for developing social skills and building relationships. Research has shown that when children engage in meaningful communication exchanges, they are more likely to build confidence in their abilities to express themselves, leading to improved social interactions and overall communication competence (Yoder & Lieberman, 2009). Communicating effectively also allows children to advocate for themselves, enhancing their engagement in social settings.

PECS facilitates the generalisation of skills across different contexts and partners, which is vital for children in inclusive settings. Studies indicate that the skills learned through PECS can be applied in various environments, enabling children to communicate effectively with

individuals, family members, teachers, or peers. This ability to transfer communication skills enhances their overall social integration and participation in diverse activities. Communication skills are particularly important for children with hearing impairments, enabling them to navigate different social situations confidently and effectively (Yoder & Lieberman, 2009). Using PECS, children can learn to adapt their communication strategies based on the context and audience, which is essential for successful interactions. The benefits of PECS for children with hearing impairments extend beyond mere communication; they contribute to a child's engagement, social development, and ability to generalise learned skills across various settings. By leveraging visual learning strategies and promoting active participation, PECS is a powerful tool for enhancing communication outcomes for these children.

V. IMPLEMENTATION STRATEGIES FOR PECS

Structured training is essential for successfully implementing the Picture Exchange Communication System (PECS). Teachers and caregivers must receive comprehensive training in the six phases of PECS to ensure consistency and effectiveness in teaching. This training should cover selecting motivating symbols that resonate with the child's interests and preferences, which is vital for encouraging communication. Additionally, caregivers must learn effective prompting techniques that facilitate exchanges between the child and communication partners. Equipping educators and caregivers with the necessary skills and knowledge can create a supportive environment that fosters the child's communication development.

Collaboration with specialists, such as speech-language pathologists, can significantly enhance the implementation of PECS. Working alongside these professionals allows for the integration of PECS with other therapeutic strategies tailored to each child's specific needs (Hartnett, 2010). Speech-language pathologists can provide valuable insights into best practices for using PECS effectively and help assess the child's progress. This collaborative approach addresses all aspects of the child's communication needs, promoting a more holistic support method.

The use of technology also plays a vital role in augmenting the effectiveness of PECS. Tools such as speech-generating devices can provide additional means for children to express themselves, enhancing their communication capabilities (Yoder et al., 2020). Technology can serve as a bridge for children who may struggle with traditional methods of communication, allowing them to engage more fully in interactions. Educators can offer varied communication options that cater to individual preferences and abilities by integrating technology into the PECS framework. Implementing PECS effectively requires structured training for teachers and caregivers, collaboration with specialists, and the incorporation of technology. These strategies work together to create an environment supporting children's communication development, ensuring they have the tools and resources necessary to express themselves confidently.

VI. CONCLUSION

The integration of visual cues into the PECS for hearing-impaired toddlers aged 0-3 during play is supported by adjacent research, focused experimental validation remains necessary to optimise its application for spontaneous parent-child interactions. PECS provides a robust framework for supporting communication development in children with hearing impairments within inclusive classrooms. Its structured approach fosters language acquisition and promotes social interaction and engagement among peers.

Research indicates that visual learning strategies, such as those employed in PECS, are particularly beneficial for children with hearing impairments. These children often rely on visual cues to understand and express their needs (Adeduyigbe et al., 2024), making PECS an effective tool for enhancing communication skills (Malandraki & Okalidou, 2021). PECS helps bridge the communication gap by using visual symbols, allowing these children to articulate their thoughts and emotions more effectively. The benefits of PECS extend beyond mere communication; it also plays a significant role in facilitating social interactions. The structured phases of PECS encourage children to engage with their peers, fostering an inclusive environment where they can develop essential social skills. Studies have shown that children who use PECS improve their communication ability and experience increased social engagement and participation in group activities (Yoder et al., 2020). This is particularly important in inclusive settings, where social interaction with peers is crucial for overall development.

Generalising skills learned through PECS are vital for children in inclusive classrooms. Research suggests that the communication skills acquired through PECS can be transferred across different contexts and with various communication partners (Hartnett, 2010). This ability to generalise skills enhances the child's overall social integration and allows them to interact more confidently in diverse environments. While existing studies provide a strong foundation for the effectiveness of PECS in supporting communication development among children with hearing impairments, further experimental validation is needed to refine its application. Future research should explore how specific adaptations of PECS can enhance spontaneous interactions between parents and children during play. By addressing these gaps, educators and therapists can optimise the implementation of PECS, ensuring that it meets the unique needs of hearing-impaired toddlers.

In summary, PECS represents a powerful intervention for promoting communication and social skills among young children with hearing impairments. Its structured approach not only aids in language acquisition but also fosters engagement and interaction within inclusive classroom settings. Continued research and validation will further enhance its effectiveness and support the communication development of these children.

VII. CONFLICTS OF INTEREST

There are no conflicts of interest in this study.

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