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The magic of gamified interventions: An exploration of applications for young children with Sensory Integration Dysfunction in household settings

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Abstract

Focusing on the growing detection rate of sensory integration dysfunction in Chinese preschool children, this study analyzes the weaknesses of current intervention models and explores a gamified sensory intervention model adapted to a home setting. Home-based gamified sensory intervention stimulates children's interest in participation. It achieves better results supported by parent–child communication and emotional care, including flexible schedules and high personalization, compared with institutional interventions. Strategies such as parent training and professional support, proposed to tackle difficulties in implementation, provide theoretical and practical evidence for home-based interventions.

Keywords

Sensory Integration Dysfunction; Gamified Intervention; Young Children; Home Setting/Home Scene

1. Introduction

1.1. Research background

In recent years, the detection rate of sensory integration dysfunction among preschool children in China has shown a significant upward trend. Unusual sensory integration development has become a widespread issue in children's growth research. Based on national surveys up to 2023, the prevalence of preschoolers accounted for the range of 25%–35%, covering a high percentage and affecting a large number of children. Sensory integration plays an important role in brain maturation, body coordination, emotional management, and social adaptability in children. The critical period for rectifying and correcting children's sensory integration abilities is between 3 and 6 years of age. Without timely and scientific

intervention during this period, children with SID may have many long-term problems, including distracted attention, poor coordination of movements, poor mood control, poor sense of rules, and trouble in group activities. These symptoms are prone to gradually deteriorate with advancing school age, further harming children's learning efficiency, social skills, and all-round development. These issues will form long-term and lasting weaknesses. Hence, carrying out early and regular sensory integration intervention has great practical significance for young children.

1.2. Description of problem

With rising public awareness of family education, parents pay far more attention to children's sensory integration growth and early-stage ability intervention. Nevertheless, home interventions commonly have practical barriers, including lack of professionalism, disorganized approaches, and non-continuous training. The majority of parents have little access to relevant theoretical knowledge and practical therapy, making it difficult to provide accurate, supportive training in daily life at home. The prevailing model of sensory integration therapy remains largely confined to hospitals and specialized rehabilitation institutions. Such interventions rely on large professional equipment, standardized sites, and therapist guidance. Noticeable limits exist within this model. First, training follows fixed timetables with limited sessions—usually short, concentrated sessions 1–3 times a week. Long intervals and daily breaks prevent lasting neurological input and the consolidation of skills. Second, professional institutions' training brings relatively high costs, which places an economic burden on ordinary families for long-term participation. Third, institutional training is separated from children's real life. Training contents can hardly transfer to daily behavior and habits, and intervention effects easily relapse. In addition, spatial constraints of the home preclude the installation of large-scale professional therapeutic equipment, which makes direct replication in hospitals impossible. The frequency and duration of training are restricted; hence, daily home-based practice yields significantly superior results to intermittent short-term training. Hence, constructing gamified sensory integration intervention programs adapted for daily home scenes to make up for current models has become an urgent problem in the field of young children's sensory integration intervention.

1.3. Research purpose

Based on the background and identified issues, this study aims to develop a home-adapted game intervention tailored to everyday family routines. It analyzed the practical value and impact of children with SID and established a complete set of training systems that fit common family environments with easy operation, interesting form, and normalization implementation. In addition, this research provided scientific, practical, and implementable home training plans for children with SID, helping them improve their sensory integration abilities during critical

growth periods and compensate for the deficiencies of current intervention systems. It also provides a reference and practical basis for lifestyle research on early sensory intervention for young children.

2. Literature review

2.1. Theoretical basis

Sensory Integration Theory was proposed by Ayres A. J. in the 1960s. It emphasizes that individuals receive, organize, and process external information through the sensory system to achieve coordinated interaction between the body and the environment [3]. According to the theory, children's growth in cognition, emotion, and action relies on sensory integration. SID refers to an abnormal condition in which ineffective brain processing of sensory input results in behavioral, learning, and social problems. Gamified intervention as an emerging approach integrates sensory integration training into activities. It stimulates children's enthusiasm for participation based on their natural interest in games to promote the development and integration of the sensory system [3]. Research indicates that gamified intervention effectively alleviates children's negative attitudes toward professional training, enhances engagement, and improves intervention results, which offers new strategies for SID intervention [6].

2.2. Domestic and international research progress

In recent years, global scholars have carried out extensive research on intervention methods for sensory integration dysfunction, achieving remarkable progress in gamified intervention and family scene intervention. Foreign studies generally adopt multidisciplinary methods and design intervention exercise prescriptions by integrating virtual simulation technology. Empirical experiments have verified their significant positive effects on improving children's sensory integration abilities [2]. For instance, based on the Theory of Multiple Intelligence, a research formulated exercise intervention programs applicable at home and kindergartens. Statistical results indicated notable score improvements in children's sensory integration performance after training ($P < 0.05$) [2]. Chinese studies place greater emphasis on integrating traditional physical activities with sensory training. Events including basketball, soccer, and martial arts can effectively alleviate children's sensory integration disorders [4]. In addition, several studies have explored the effect of sensory integration therapy combined with sandplay therapy on autistic children. The results show that the combined intervention group gains greater improvement in autistic behaviors and sensory integration abilities than the single intervention group [10]. Nevertheless, present research contains certain deficiencies. Gamified intervention designs are unsystematic, and the implementation of family scene intervention is limited by parents' professional knowledge and available time [5].

2.3. Research gap

Although some studies have achieved certain results in the intervention for sensory integration dysfunction, there is still a lack of systematic research on game-based intervention for young children in the family setting. First, the existing literature mostly focuses on institutionalized intervention or applications in school environments, while there is a scarcity of research on the specific implementation strategies and effect evaluations of game-based intervention in the family scenario [8]. Second, the existing game-based intervention designs often lack personalized considerations for the specific needs of young children, resulting in limited operability and applicability of the intervention plans [5]. Moreover, as the main implementer of family setting's intervention, parents' professional knowledge level and participation have not been fully valued in the impact on intervention effects [8]. This study aims to fill the aforementioned research gaps by systematically exploring the application principles, implementation strategies, and effect evaluations of game-based intervention in the family setting, providing scientific basis and practical guidance for family intervention for young children with sensory integration dysfunction.

3. Overview of Sensory Integration Dysfunction and gamified intervention

3.1. Definition of Sensory Integration Dysfunction

Sensory integration dysfunction (SID) is a neurodevelopmental disorder in which individuals struggle to process external sensory information, leading to impaired behavioral, emotional, and cognitive functions. As stated in Sensory Integration Theory, the integration of multisensory input is essential for the brain to produce adaptive behavioral reactions [4]. When this process is disturbed, individuals may show abnormal behaviors such as sensory hypersensitivity, sensory hyposensitivity, and sensory seeking. Three types of SID are identified as tactile defensiveness, vestibular functional impairment, and proprioceptive disorders, which separately cause avoidance of weak touch stimuli, balance and coordination deficits, and awkward body movement [7]. These types can be diagnosed using standardized assessment tools, providing a reliable basis for targeted intervention.

3.2. The impact of SID on young children

Sensory integration dysfunction has a negative impact on the physical development, cognitive learning, emotional, and social interaction of young children. Physically, vestibular dysfunction affects gross motor skills (such as crawling and walking), while proprioceptive disorder limits the development of fine motor skills (such as holding a pen and dressing oneself).[5] Cognitively, the disorder interferes with attention and reduces learning efficiency.[8] Emotionally, children are prone to mood swings, irritability, or anxiety due to their inability to respond to external

stimuli. Socially, abnormal behavior may lead to peer rejection, exacerbating feelings of loneliness and inferiority, and their social skills scores are also significantly lower.

3.3. The principles and characteristics of gamified intervention

Gamified intervention stimulates children's interest through game elements and conducts sensory integration training in an enjoyable atmosphere. Games serve as a developmental approach for children's development, capable of mobilizing their intrinsic motivation. The intervention embeds training tasks into fun activities, such as using play dough to exercise touch and fine motor skills, and improving vestibular sense and balance through swinging.[9] It is autonomous and flexible, allowing for adjustments based on children's interests and abilities to meet individual needs. Moreover, game-based intervention can enhance emotional connection through parent-child interaction, create a supportive growth environment, and provide an efficient and easily acceptable rehabilitation path for children with sensory integration disorders.

4. The necessity and feasibility of gamified intervention in household settings

4.1. The significance of household settings in the development of children with SID

The family environment is a crucial microsystem for children’s sensory integration development. Studies have shown that sensory stimulation and early feeding patterns in infancy directly affect the formation of sensory integration abilities. Parents provide sensory input through daily interactions such as touching and hugging, which promotes tactile development and emotional security, laying the foundation for sensory integration. The family's physical space, toys, and activity arrangements offer diverse sensory experiences, shaping sensory processing abilities. However, excessive protection may limit sensory exploration and increase the risk of disorganization. [8] Thus, family settings serve as the fundamental site for children’s sensory and training. Parent–child interaction plays a prominent role during early childhood. Through play, communication, and collaboration, children obtain sensory stimulation in natural contexts and integrate it into adaptive behaviors. For example, crawling competitions engage multiple sensory pathways, and parental encouragement further amplifies the intervention effect. Awareness of scientific home-based care and early intervention can reduce the incidence of sensory integration dysfunction. The family provides necessary conditions for the development of sensory integration and enhances children's sensory processing ability through parent–child interaction, laying a foundation for their future learning and social interaction.

4.2. The advantages of implementing gamified interventions in household settings

Gamified intervention in family scenes possesses advantages, including time flexibility, emotional support, and personalized training design. The flexibility of time makes the intervention more easily integrated into daily life. Parents can arrange it flexibly according to children's schedules and interests, thereby enhancing its feasibility and participation. In terms of emotional support, parents convey support through encouragement and physical contact, stimulating children's enthusiasm and self-confidence. For instance, accompanying the swing game promotes vestibular sense development and strengthens the parent–child relationship. The advantage of personalized design allows for customizing game content based on children's needs and interests. For children who are sensitive to touch, setting up games where they can touch different materials at home can relieve tactile defense in a safe environment.[1] This design conforms to children's psychological characteristics and stimulates their participation interest. Studies have shown that family gamified intervention can significantly improve sensory integration ability, with high parental satisfaction and feasibility.[2] Therefore, the family setting is an ideal choice for gamified intervention.

Comparison Dimension	Traditional Institutional Training Mode	Household Gamified Intervention Mode	Interpretation of Core Differences
Intervention Environment	Standardized clinic/sensory integration classroom, professional equipment yet unfamiliar	Authentic household environment (living room, bedroom, bathroom); familiar and natural	Ecological validity: The household environment is more conducive to the transfer of skills into daily life
Intervention Frequency	Low frequency (usually 1–3 times per week), fixed duration of 45 minutes per session	High frequency; fragmented activities embedded in daily routines	Neuroplasticity: High-frequency short-duration stimulation is more beneficial to the remodeling of young children's brain networks
Children's Status	Prone to tension, separation anxiety, and unstable compliance with instructions	Relaxed with a strong sense of security; participation driven by intrinsic motivation	Emotional regulation: The secure base effect reduces defensive responses and expands the effective input window
Implementer	Led by therapists; parents mostly serve as observers or home executors after training sessions	Led by parents; therapists provide intervention plans and remote supervision	Empowerment level: The improvement of parental capacity is a key predictor of long-term prognosis
Level of Gamification	Predominantly structured tasks; games are adopted as rewards or introductory approaches	Games are the intervention itself; intervention objectives are hidden in playful activities	Intrinsic motivation: Children shift from 'being told to do' to 'wanting to play,' and compliance is significantly improved
Economic Cost	High cost (session fees, transportation costs, and time costs); difficult to maintain in the long term	Low cost (using household supplies) with strong sustainability	Accessibility: Lower thresholds broaden the coverage of early intervention populations
Assessment and Feedback	Periodic assessment with standardized scales, featuring strong hysteresis	Real-time observational records and dynamic adjustments with fine-grained data	Response speed: Instant feedback cycles based on daily performance achieve higher agility

Table 1. Comparative Analysis of Gamified Intervention for Young Children with SID Implemented in Household Settings and Traditional Institutional Modes

4.3. Feasibility of implementing a gamified intervention in household settings

The feasibility of implementing a gamified sensory integration intervention for children with sensory integration dysfunction in household settings can be verified

from three core dimensions: parental operability, resource accessibility, and cost-effectiveness. In terms of parental operability, such intervention protocols feature a simplified design that requires no professional rehabilitation competencies or dedicated training devices. Accordingly, primary family caregivers are capable of mastering and implementing the interventions efficiently. Classic sensory integration training activities, including tactile stimulation, bath towel dragging, and ball-catching training, are easy to operate and highly adaptable, which can be seamlessly integrated into daily household routines and parent–child interaction scenarios. Furthermore, standardized intervention guidelines and instructional videos available on diverse online platforms have further lowered the implementation threshold of household intervention and enhanced the practicability of intervention protocols.

In terms of resource accessibility, household daily supplies, idle toys, and conventional furniture can be repurposed as sensory training tools, eliminating the need to purchase additional professional rehabilitation equipment. For instance, sofa cushions can be utilized for jumping and balance training, while non-toxic kitchen utensils can serve as auxiliary tools for children's tactile stimulation training. This localized intervention strategy not only effectively reduces the economic cost of household intervention but also alleviates the implementation burden on caregivers, thereby significantly promoting parental participation in parent–child intervention. In addition, public resources, including free community parent–child sensory integration courses and professional household intervention schemes released by authoritative educational institutions, provide adequate supplementary support, thereby optimizing the integrity of the household gamified intervention system.

From a cost-effectiveness perspective, the household-centered gamified intervention model avoids additional expenses such as transportation costs and professional rehabilitation service fees incurred by off-site institutional training. It substantially reduces the economic burden on families and saves the time cost of caregivers' accompanying trips. Empirical studies have confirmed that sustained household gamified intervention can effectively improve children's multi-dimensional sensory integration abilities (tactile sense, vestibular sense, and proprioception) and ameliorate sensory integration dysfunction. In the long term, low-cost early household intervention can prevent the progressive deterioration of children's sensory integration disorders, reduce the risk of subsequent learning disabilities and behavioral problems, and minimize long-term derivative costs for special education, psychological intervention, and professional rehabilitation at both family and social levels. Collectively, household-based gamified sensory integration intervention possesses low implementation barriers, abundant accessible resources, and superior long-term benefits, which verifies its high practical feasibility in family scenarios.

5. Specific applications of gamified intervention in household settings

5.1. Game design for different sensory channels

5.1.1. Tactile games

Tactile training games constitute a core component of household sensory integration intervention for children. By delivering diversified tactile stimulation, such games target the training of children's tactile sensory system and effectively improve their tactile discrimination capability, emotional regulation, and sensory adaptive functions. Commonly adopted household tactile intervention activities include tactile material recognition and plasticine modeling training. Parents can guide children to perceive items with distinct textures (sandpaper, fluff fabrics, and plastic products), enabling children to distinguish differential tactile sensations such as roughness, softness, and smoothness, and effectively enhancing their tactile discrimination sensitivity. In addition, plasticine creation delivers sustained and abundant tactile feedback through hand movements, including squeezing, kneading, and shaping. It also optimizes children's fine motor skills and promotes the development of hand–eye coordination.

During the implementation of the household tactile game intervention, safety should be the primary principle. Caregivers shall prioritize non-toxic, non-irritating, and hypoallergenic game materials and maintain a hygienic training environment to prevent potential risks, including material contamination, skin allergies, and accidental injuries. Meanwhile, game design should be tailored to children's age characteristics and interest preferences. Interesting forms, such as themed modeling and interactive breakthrough games, can be adopted to strengthen children's participation initiative and intervention persistence. In summary, household tactile game intervention can not only activate children's tactile senses and improve tactile perceptual functions, but also foster children's operational ability and creativity, which serves as a vital support for the comprehensive improvement of children's sensory integration competencies.

5.1.2. Vestibular games

Vestibular training games primarily stimulate the development of children's inner ear vestibular organs through the adjustment of head posture and physical movement, which act as crucial intervention approaches to ameliorate vestibular dysfunction and enhance children's balance competence and spatial perception ability. Swinging and stationary rotation are the most representative and operable vestibular training activities in household settings. They can effectively activate the vestibular nervous system and optimize physical balance control, spatial orientation, and limb coordination. In household environments, caregivers can set up simple and safe swing devices or adopt stable office chairs to guide children in slow rotational training, realizing standardized vestibular intervention at a low economic cost.

Caregivers shall scientifically regulate training intensity based on children's chronological age and physical tolerance to prevent adverse reactions, including dizziness, nausea, and irritability induced by excessive vestibular stimulation. In addition, the single training duration is strictly recommended to last 5 to 10 min to guarantee the safety and effectiveness of the intervention. Empirical research indicates that persistent and regular vestibular game training can significantly improve children's motor coordination, alleviate typical problems derived from vestibular dysfunction, such as scattered attention and poor sitting persistence, and cultivate children's motor control and sustained attention capabilities. This lays a solid foundation for children's academic performance, daily life adaptation, and social development in the long run. Accordingly, integrating low-intensity vestibular games into daily household parent–child interactions is a convenient, safe, and efficient sensory integration intervention strategy with prominent popularization value for family application.

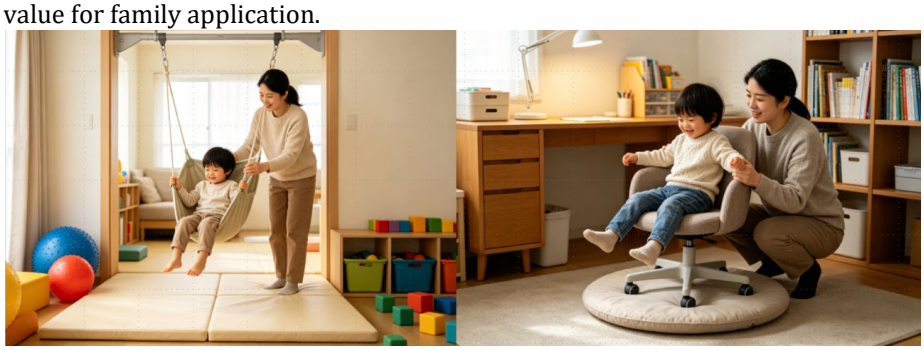


Figure 1. Examples of Vestibular Games (swing activities and slow rotation on office chairs)

5.1.3. Proprioceptive Games

Proprioceptive games aim to deliver stimulation through movements of large muscle groups, helping children perceive the position and motion state of their own bodies to strengthen their proprioceptive capacity. Climbing and jumping are two common proprioceptive training games, and these activities can significantly improve children's body awareness and movement control ability. For instance, parents can set up simple climbing areas with staircases or soft cushions at home and encourage children to engage in crawling and climbing exercises. Meanwhile, jumping over obstacles or drawing hopscotch patterns on the ground can also effectively stimulate the development of proprioception. During implementation, parents shall guarantee the safety of the gaming environment and avoid accidental injuries caused by slippery floors or unstable obstacles. In addition, the design of proprioceptive games should lay emphasis on fun and challenge. For example, setting climbing routes or jumping tasks of varying difficulty levels can stimulate children's desire for exploration and their sense of achievement. Research demonstrates that systematic training via proprioceptive games can substantially improve children's motor planning and organizational capabilities, offering support

for their daily life and academic performance [5].

5.2. Implementation Strategies for Gamified Intervention

5.2.1. Creation of a Gaming Environment

Constructing a safe and enriching sensory integration gaming environment within household settings is an important prerequisite for securing the outcomes of gamified intervention. First, parents need to rationally arrange domestic space and ensure that the gaming zone is spacious, bright, and free from obvious safety hazards. For example, ground clutter can be cleared away and soft foam mats laid to reduce impact forces during falls. Meanwhile, large gaming equipment such as climbing frames or swings can be placed against walls or in corner areas to fully utilize space and guarantee safety. Second, the preparation of gaming materials should balance diversity and age appropriateness, including toys with varied textures, colors, and functions. For example, tactile-rich balls, jigsaw puzzles, and rotating chairs for vestibular training can be prepared to satisfy training demands targeting different sensory channels. Furthermore, parents need to inspect and maintain gaming equipment regularly to ensure proper working conditions and prevent safety incidents triggered by damaged facilities. Through scientific spatial layout and material selection, household gaming environments can not only arouse children's willingness to participate but also supply comprehensive sensory integration stimulation.

5.2.2. Parent-child Interaction Skills

Parent-child interaction constitutes the core segment of gamified intervention in household scenarios, and effective interaction techniques can remarkably enhance intervention effects. First, parents should be adept at providing verbal guidance. Positive encouragement and specific instructions can help children engage in games better. When conducting tactile games, for example, parents can describe the characteristics of objects, such as 'This plasticine is soft, just like a marshmallow,' guiding children to concentrate on tactile experience. In vestibular games, vivid language can be adopted to build a situational atmosphere, for instance, 'We are boarding a pirate ship now and setting off on an adventure!' Moreover, physical encouragement acts as a vital interactive approach. Parents can express recognition and support for children through facial smiles, nods, or clapping, boosting their self-confidence and sense of accomplishment. In addition, parents ought to attach importance to emotional connection with children, maintain patience and concentration, and avoid displaying impatience or critical attitudes during games. Studies indicate that high-quality parent-child interaction can not only raise children's engagement in games, but also facilitate the healthy development of their emotions, furnishing sound psychological support for sensory integration training [3].

5.3. Case Sharing of Household Gamified Intervention

This section demonstrates the specific application and effects of gamified intervention in household settings via a practical family intervention case. A four-year-old boy from a certain family was diagnosed with mild sensory integration dysfunction, which was mainly manifested as tactile sensitivity and underdeveloped vestibular function. Targeting these problems, the parents designed a series of gamified intervention activities under professional guidance. In terms of tactile training, the parents arranged 15-minute 'tactile tray exploration' time every day, allowing the boy to touch fabrics, toys, and raw food materials of diverse textures, such as coarse linen, smooth silica gel, and sticky dough. After two months, the boy's tactile sensitivity decreased notably, and he could contact various daily objects more freely. In vestibular training, the parents purchased a balance board at home for balance training and accompanied the boy to play on a swing for 10 minutes each day. Meanwhile, rotating chairs and hopscotch games were combined to further stimulate vestibular development. After the intervention, the boy's balance ability and level of attention concentration improved significantly, and impulsive behaviors in daily activities were also greatly reduced. The parents stated that gamified intervention not only ameliorated the child's sensory integration ability but also strengthened parent-child bonds and created a more harmonious family atmosphere. This case reveals that a household-based gamified intervention delivers prominent effects and has promotion value.



Figure 2. Case Diagram of Gamified Sensory Integration Intervention for Young Children in Household Settings

6. Challenges and Solution Strategies of Gamified Intervention in Household Settings

6.1. Major Challenges

The implementation of gamified intervention in household settings faces several prominent challenges. Primarily, primary caregivers generally lack professional expertise in sensory integration, which hinders their accurate assessment of children's sensory integration conditions and the design of targeted intervention activities. Furthermore, some parents hold misconceptions regarding sensory integration dysfunction, which may lead to delayed intervention. Secondly, parents are constrained by limited time and energy resources, making it difficult to ensure the sustainability and systematicness of intervention activities. Caregivers' fatigue also negatively affects the quality of parent–child interaction during intervention. In addition, the design of household intervention programs is generally unsystematic. Most families rely on fragmented game-based activities while neglecting comprehensive training covering multiple sensory channels. Meanwhile, the uneven quality of commercially available intervention resources further exacerbates the difficulties in program design and implementation.

6.2. Countermeasure Approaches

A multi-dimensional strategy framework is required to address the aforementioned challenges. First, capacity building for primary caregivers should be strengthened. Systematic professional training is essential to popularize fundamental knowledge of sensory integration and improve caregivers' practical operational skills. The training content should cover children's behavioral observation and dynamic adjustment of intervention strategies. Second, the establishment of a multi-level professional support network is crucial. Specific measures include integrating community guidance services, constructing online resource databases, and promoting collaborative cooperation between professional therapists and families to assist families in formulating and optimizing personalized intervention plans. Finally, the development of standardized intervention program packages serves as an effective solution to fragmented intervention design. Such standardized packages should contain systematic training content for diverse sensory channels, provide detailed operational guidelines, and prioritize game fun to enhance children's participation compliance. The comprehensive application of the above strategies can optimize the current situation of household intervention and provide scientific and efficient practical solutions for family-based sensory integration training.

7. Conclusion

7.1. Research Summary

This study systematically explores the application of household gamified interventions for young children with sensory integration dysfunction and demonstrates its significant intervention effects and unique advantages. The research findings indicate that a gamified intervention designed in accordance with children's psychological development characteristics can effectively stimulate

children's participation motivation and promote the development of comprehensive sensory integration capabilities through entertaining and autonomous game-based activities [1]. In household intervention scenarios, parent–child interaction and emotional support further amplify intervention efficacy, enabling children to receive adequate and comprehensive sensory stimulation and training in a safe and familiar environment [4]. Furthermore, household-based gamified interventions possess distinctive strengths, including high temporal flexibility and strong personalization, which are superior to institutional intervention models. Targeting prevalent problems such as parents' insufficient professional knowledge and unsystematic game design, this study proposes targeted optimization strategies, including professional parental training and standardized professional resource support, which provides theoretical basis and practical guidance for the optimization and promotion of household sensory integration intervention.

7.2. Research Limitations and Future Prospects

Despite the valuable findings obtained from this study regarding household gamified intervention application, several limitations remain. First, the research sample scope was relatively limited, focusing primarily on children from specific regions and family backgrounds, which may restrict the generalizability of the research results. Second, constrained by the research cycle, this study failed to conduct a long-term follow-up evaluation of sustained intervention effects, making it difficult to fully examine the long-term impacts of gamified intervention on children's sensory integration development.

Future research should expand the sampling scope to cover children from diverse regions, cultural backgrounds, and family structures to verify the universal applicability of the proposed intervention strategies. Additionally, long-term follow-up mechanisms should be established to evaluate the stability and sustainability of intervention outcomes. Furthermore, with the advancement of digital technology, emerging technologies such as virtual reality (VR) and augmented reality (AR) have created new possibilities for gamified intervention innovation. Future studies can explore the potential application value of such technologies in household intervention scenarios to further promote the innovation and sustainable development of intervention approaches for children's sensory integration dysfunction.

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