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자폐 아동의 시지각 향상을 위한 게슈탈트 시각 운동 통합 학습의 효율성

박 윤 · 양 장 훈*
서울미디어대학원대학교 뉴미디어학부

Efficacy of Gestalt Visual Motor Integration Learning (GVMIL) to Improve Visual Perception in Children with Autism

Yoon Park · **Janghoon Yang***
Department of New Media, Seoul Media Institute of Technology, Seoul 07590, Korea

[요 약]

미디어 기술의 발달에 따라서 자폐 아동을 위한 다양한 중재 방법들에 새로운 미디어 기술이 활용되고 있다. 이 연구에서는 움직임 기반 게임의 대표적인 플랫폼 중에 하나인 키넥트를 이용하여 시지각 발달을 위한 중재 프로그램을 개발하였다. 이 프로그램의 주요 과정은 게슈탈트 원리와 게슈탈트 요법에서의 알아차림과 포용에 기반하여 설계되었다. 제안된 시각 운동 통합 학습과정은 키넥트의 움직임 인식 기능을 이용하여 아이들이 제시된 그림의 외곽선에 맞추어 신체 자세를 취하는 것을 강화하는 형태로 구성되었다. 개발된 프로그램의 효율성을 확인하기 위해서 2명의 7살 자폐 아동과 2명의 일반 아동을 주에 2회씩 12주에 걸쳐 총 24회의 통합 교육을 실시하였다. 시지각 발달 검사 (MVPT-3)를 중재 전과 후에 실시하여 자폐 아동과 일반 아동 모두 원점수나 환산 연령이 크게 증가함을 확인하였다. 또한, 정성적으로 감정의 공유등과 같은 이전에 관찰되지 않았던 사회적 행동들도 자폐 아동에게서 발견되었다.

[Abstract]

With advances in media technology, emerging media forms have addressed interventions for children with autism. Kinect, a popular platform for motion-based games, was adopted to develop an intervention program to improve visual perception. The primary contents of this program are based on gestalt principles and inclusion and awareness in gestalt therapy. Visual motor integrated learning, in which children try to match their body posture to the outline of a presented image, is facilitated by the functionality of motion recognition in Kinect. To evaluate the efficacy of the proposed method, two 7-year-old children with autism completed 24 sessions over 12 weeks in an integrated education environment with two typically developing children. The motor-free visual perception test (MVPT)-3 showed that the raw scores or the age equivalences of the children with autism and the typically developing children increased substantially. In addition, previously unseen social behaviors such as sharing emotion were also observed.

색인어 : 자폐 스펙트럼 장애, 게슈탈트 원리, 시지각, 사회성, 중재
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***Corresponding Author; Janghoon Yang**
Tel: +82-2-6393-3237
E-mail: jhyang@smit.ac.kr

Ⅰ. Introduction

Autism spectrum disorder (ASD) is a developmental disorder characterized by two primary symptoms, persistent deficits in social communication and restricted, repetitive behaviors. Although autism is represented by a wide spectrum of symptoms, it is often considered to be strongly associated with perception and cognition. Of many different perceptions, visual perception may be fundamental to creating all functional activity. People with autism are known to learn best by visual means, which can be supported by many vision-based educational contents [1]. Visual content also provides important information used for both social and cognitive processes. For instance, colored overlay was observed to enhance the perception of facial expressions presented in photographs [2]. Behrmann, Thomas and Humphreys [3] argued that a perceptual difficulty may be significant in the impairment of facial information processing, although there is a contradictory result [4]. The performance of identification discrimination by faces differs significantly in people with autism, which may imply that local processing or integrative processing in visual perception differs from that in typical people [5].

Gestalt processing in autism has been extensively studied to explain how persons with autism perceive experiences differently. One peculiar characteristic of autism is a bias toward local processing. Perceivers experience the whole by subjectively structuring the raw pieces of data [6]. Quantitative analysis of gestalt groupings such as proximity and similarity showed that people with autism performed these functions at a chance level [7]. This result implies that people with autism may have problems in perceiving objects properly because of failing to process inter-relationships, although some results in this area are contradictory [8][9]. Atypical visual perception in autism was attributed to an imbalance between feed-forward processing associated with the global aspect and feedback processing for visual detail from the neurobiological point of view [10]. However, improvement in visual perception was also observed after considerable practice, which indicates the potential for proper intervention to improve the visual perception of children with autism.

Visual perception is closely associated with sensorimotor function. Through interactions with the physical environment, sensorimotor capacities not only develop cognitive processes originating from embodied experience but also enhance some higher-level cognitive skills such as memory, reasoning and problem solving [11]. To enhance cognitive skills, gesture-based intervention has frequently been studied in the form of imitation or games. Indeed, coordinated joint attention in young children increased with learning object imitation skills [12], and reciprocal imitation training (RIT) implemented by parents increased spontaneous imitation in children with autism [13]. An overview of field studies exploring motion-based games for children with autism having low-moderate cognitive deficit showed that such games often trigger positive emotions and that their benefits are retained over time [1].

To improve cognition in autism, interventions with interactive media have recently been attempted. Interactive media forms have the potential to improve social behaviors and cognition because proper affordance as the physical property of media influences the people using the media [14]. Among many interactive media devices that realize interactivity by capturing, identifying, and classifying movements, Kinect is an efficient motivational intervention tool whose intervention content is easy to create and personalize, although its academic and therapeutic evaluation is at a preliminary stage. Kinect has the potential to boost playful and enjoyable activities and self-motivated participation in intervention. Kinect facilitates natural user interfaces for skeletal, facial and gestural recognition. Recently, Kinect was incorporated into special education programs at some institutions such as De Ruimte in Holland and the Lakeside Center and Steuart Weller Elementary School in the U.S. Comparing a Kinect-based recognition algorithm with an algorithm developed by a professional-grade embedded processor for detecting the stereotypical motor movements of people with autism in real time creates the possibility of developing a cost-effective tool [15]. A Kinect-based game for imitation training showed potential for improving the basic motor skills of children with autism using games that are fun [16].

The purpose of this study was to assess the potential of visual motor integration learning using Kinect to enhance the visual perception of children with autism. We developed an intervention program that exploits gestalt principles and gestalt therapy to improve global processing by embodied cognition, which is realized by visual motor integration. Several existing studies support such a program, as structured imitation is often used to encourage children to learn appropriate behavior [17]. Children have also been observed to connect their body motions to the concepts embedded in games [18]. Furthermore, touchless body motion without contact with physical devices can enhance engagement, creating a better user experience [1]. With these supporting studies, the current study sought to discover the potential of visual motor integration in learning to improve visual perception.

Ⅱ. Gestalt Visual Motor Integration Learning (GVMIL)

2-1 Background

Children with autism generally show atypical cognition, which is sustained or becomes worse unless children receive proper therapy or interventions. Thus, it is important to provide children with proper interventions to develop typical cognition and behaviors. Among many different methods of intervention, art-based intervention is known to be effective in enforcing active cognition [19]. Contending that visual perception is a cognitive activity, Arnheim [20] argued that artistic expression is a method of visual communication. This concept allows room for improving communication with artistic activity. More importantly, art-based intervention can not only reduce atypical behaviors by improving visual perception but can also improve sociality by visual communication.

"Form" in art implies a structure that is systemized by visual perception. In particular, people typically recognize the whole rather than parts. By viewing the essence of an object as a systemized whole, gestalt psychology insists that people tend to perceive something simply and symmetrically, which is considered to be the basic principle of human visual perception. Tacca [21] argued that visual perception and cognition are similar in terms of their structural property of systematicity. Thus, art activities associated with visual perception and gestalt psychology may have the potential to improve visual perception during childhood development. Visual perception is not only reinforced by art intervention but can also be reinforced by imitating body motion. Interventions exploiting imitation have successfully improved the behavior of children with autism as well as young children without ASD [22]. Han [23] argued that an intervention with body motion integrated into sensory training could significantly influence the development of visual perception and the sense of movement in children with developmental disabilities.

Intervention evolves with advances in technology, and new forms of media have the potential to be cost-effective educational materials. In particular, new media can enrich interactivity using digital technology and networks. Whereas conventional multimedia interventions use motion pictures with children, such media are limited in realizing interactivity, which is generally rendered possible by a teacher or parents. Brown [24] contended that digital media enable behavior to induce knowledge so that problems can be solved by integrated thinking. Recently, growing interest in edutainment content exploiting new media to enforce creativity has enhanced the importance of self-motivated learning. Edutainment has the potential to generate self-motivation and enforce interaction through active participation. Exploiting this property, new media intervention is a promising method to improve visual perception with personalization in a cost-effective manner.

2-2 A prototype of edutainment content with motion recognition

The interactivity and natural user interface of edutainment present new possibilities for intervention in children with autism. In prior work [25], we developed a prototype of edutainment content for recognizing body posture in response to a presented image. Because the proposed intervention program is based on that prototype, we reproduced some important results from the prior work. The prototype uses Kinect to recognize the natural motion of children and is designed to allow children to imitate what is recognized with body movement. The prototype also facilitates collaboration among children by completing a given mission together.

The prototype comprises three sections, introduction, main body, and ending, which are played in sequence. The introduction is an animated motion picture that asks participants to follow the motion of animated characters and explains what will occur in the main section. Children are requested to fit their bodies to figures presented on a screen or monitor in the main section. When the child and the figure are matched to a high degree, some other figures are continuously presented several times. In the final section, animated characters compliment what the children have achieved, causing the children to feel accomplished. Characters are also developed to make children feel intimate and build strong bonds with the content. The characters are colored with high color saturation, bright hues and asymmetric body shapes in which the head is larger than the torso. The characters are designed by combining the basic figures of circles, triangles, and rectangles with pandas, foxes, and owls, respectively. These animals have some characteristics in common with each basic geometric figure. Their names are easily pronounced by young children and are associated with the name of the basic figure. In a pilot test conducted with 5-year-olds, the children actively participated and enjoyed this content, which demonstrated its potential to serve as edutainment content.

2-3 GVMIL Program

The prototype of edutainment content developed in the prior work was used to create an intervention program for young children with autism. The program, which is called gestalt visual motor integration learning (GVMIL), is designed to improve visual perception by imitating objects that are the basic elements of formal composition, such as plants, animals and transportation. The point, line, and plane approach can help children with autism understand how the whole can be constructed from parts to form gestalt. In this approach, connecting points becomes a line; a collection of lines becomes a plane; and a collection of points, lines, and planes compose the image of an object. Defining visual thinking as visual perception integrated with thinking, Arnheim [20] argued that visual perception allows human beings to truly understand experience. Experiencing the parts of an object by embodied cognition may help children with autism form the concept of the whole, which may induce improved cognition.

The GVMIL program also uses the inclusion and awareness characteristics of gestalt therapy to cause children with autism to experience and express gestalt. Inclusion is naturally immersing oneself as fully as possible into the experience of the other while simultaneously retaining a sense of one's autonomous presence [26]. Similarly, awareness, or being in touch with one's own existence, exists on a continuum with both ends, foreground and background. Once awareness is fully experienced as gestalt in the foreground, awareness can be integrated into the background. Analyzing eye tracking, Klin et al. [27] contended that weak social interaction is exacerbated by attention to non-salient features in the background rather than a stimulus associated with social cognition. Allowing children to imitate objects in the foreground and background may provide an opportunity to properly improve shifting focus. This program introduces inclusion to allow children with autism to experience foreground and background, which may help these children experience gestalt. Shifting between the foreground and background in gestalt therapy is embodied cognition, which can occur in the entire person [28]. Motion following visual perception in GVMIL provides an opportunity for participants to experience embodied cognition.

GVMIL is also designed to encourage collaboration among participants. Adams and Robinson [22] argued that Kinect enables children to play in teams, which facilitates children cooperating with one another. Bianchi-Berthouze, Kim, and Patel [29] argued that increased body movement in an educational game can increase engagement and social experience through multi-plays. Young children in a small group with GVMIL intervention may have to collaborate to fit their bodies onto the images of the objects presented. As a result, GVMIL can increase natural interaction among children, which can provide an opportunity to improve sociality. GVMIL can also be applied to integrated education, in which students from special education can be integrated into regular classrooms. Children with autism may have a better chance of naturally imitating the behaviors of typically developing children by integrated education.

GVMIL comprises 12 sections; each group of 4 sections reflects a different aspect of gestalt psychology and therapy. The sections are constructed in the order of experiencing the gestalt principles of inclusion and awareness and the formation of gestalt. The first group of 4 sections addresses gestalt principles such as proximity, similarity, continuation, and closure, which are primarily expressed with points and lines to train typical basic visual perception with the basic elements of formal composition. Children learn by matching the outlines of images with their body posture in the middle 4 sections. These sections attempt to realize inclusion in gestalt therapy by encouraging children to imitate the form of an object with their bodily motions. The experience of the human being is determined by the gestalt into which sections of the environment are subjectively structured [6]. GVMIL encourages participants to focus on an outline that is an articulated and simplified whole and is designed to be played collaboratively among participants to guide natural body contact to improve sociality. The visual perception of given outlines can elicit association with corresponding objects. Thus, the images of familiar objects, such as writing materials in a classroom, plants, and animals, are used.

The last 4 sections are designed to help children understand the concepts of foreground and background and to experience gestalt by playing with those concepts. GVMIL forces participants to experience the foreground, which may result in an awareness that engenders a change in cognition. Each section is articulated with a unique theme and multiple outlines of different objects. In section 9, participants are requested to select the image corresponding to the parts of the body in their peers. If the body parts are selected correctly, the outline of the corresponding image is shown on screen to be played. The theme of section 10 is animal houses. The outlines of an animal, such as a cat, fish, or bird, and the house of the animal are presented in different sizes to illustrate the concept of foreground and background. When the animal and the house are successfully matched with a body pose, a short motion picture including animals and their houses is played so that both the animal and house can be recognized in a more realistic context, which may help children with autism to properly identify typically perceived objects. Section 11 is designed with the same structure but with the theme of transportation. In the last section, participants are asked to form an image freely to enforce imagination and collaboration. An instant change of a collaboratively formed image with the children's motion may present an opportunity to experience embodied cognition and gestalt. The goal and content in each section of the GVMIL program are summarized in Table 1. Some screen shots of the GVMIL program are presented in Figure 1 to present more concrete information on this program.

GVMIL also satisfies all four of the principles of therapeutic educational intervention proposed by Cain and Seeman [30]: repetitive exercise; personalization; a combination of visual, auditory, and kinesiology stimuli; and step-wise activities with frequent feedback. GVMIL also includes some desirable properties defined by Parsons & Mitchell [31] for social skills training, such as the repetition of a target skill, ease of use for schools, and affordability for the home environment. From the observation that children with autism may prefer objects producing a sensory effect such as light or sound for imitating actions [12], the sound "oh-Yes" was developed to inspire children to participate when they successfully match their bodies to the image of a presented object.

Ⅲ. Method

3-1 Material

Software for GVMIL was developed separately for each section. GVMIL was installed on the desktop computer located in the classroom in which the intervention occurred. The computer was connected to a speaker and projector so that the children could play while watching a large screen rather than a computer monitor. Kinect was also connected to the computer so that it could feed information on the body parts and the joint positions of each participant to recognize the motions of each participant in the software for GVMIL. Because the software included an introduction, a main body, and a concluding section all together, each session began with clicking a starting button and ended when the motion picture in the conclusion was over. No additional materials were used for this intervention.

3-2 Participants

A typically developing 5-year-old boy, a typically developing5-year-old girl, and two 7-year-olds with autism formed a group to apply the intervention in the form of integrated education. This intervention was executed with the consent of the parents of the children participating in the intervention. Because the children with autism had previously been diagnosed to qualify for a government welfare benefit, additional diagnosis was not conducted. Throughout this paper, the two children with autism are referred to as Aron and Billy. Aron often talks with friends without looking at their faces although he makes eye contact for a short time if necessary. Aron also tends not to listen to peers and takes comments out of context. Aron can also easily express his

그림 1. GVMIL 프로그램의 스크린 캡쳐 샘플 (첫 번째 행 : 도입부, 두 번째 행: 중심부, 세 번째 행: 결론부)
Fig. 1. Sample Screen Shots of the GVMIL Program (The first column: Intro Section, The second column: Main body, The third column: Concluding section)

표 1. GVMIL 프로그램 요약
Table 1. Summary of the GVMIL Program

Sec.	Form	Goal and Content
1-2	Point	To enforce the concept of the point, which is the most basic element in formal composition 1. Proximity, 2. Similarity
3-4	Line	To teach how lines are formed by points and how basic shapes are related to lines 3. Continuation, 4. Closure
5-8	Plane	To teach how an object can be perceived by experiencing how parts are combined into a whole, and to facilitate natural interaction with peers and objects by putting oneself into the image of the object with body posture 5. Abstract image 6. Writing materials to facilitate interest in objects in the classroom to develop relations with those objects, 7. Plants to naturally facilitate an understanding of plants' relation to the environment 8. Animals to naturally understand the relations between animals and the environment
9-12	Objects	To enforce the concept of foreground and background in perception, and to improve sociality by natural collaboration 9. Parts of the human body to experience the connections among participants and to generate interest in peers, 10. The foreground and background from the perspective of an animal and its house, 11. The foreground and background by being a means of transportation, 12. Freely expressing an imagined image to experience gestalt by collaboration

negative opinion about what he does not like and has a short attention span, even for preferred activities. Aron often wanders around the classroom by himself rather than playing with other children. Billy appears to have milder symptoms than Aron. When calling to his friend, Billy makes eye contact for a short period and then turns his head away. Billy knows the names and faces of every classmate and can understand statements such as "Stop it" and "Don't do it", although Billy tends to continue the behavior and generally does not follow orders and rules. Billy can focus on preferred activities for a long time and tends to avoid non-preferred activities.

3-3 Analysis

The primary purpose of this intervention, i.e., improvement in visual perception, was quantitatively analyzed. We also made some qualitative observations on visual perception and sociality, which are implicitly expected from the relation between cognition and sociality. The motor-free visual perception test-3 (MVPT-3) [32] was selected to evaluate the degree of visual perception. Although there are other tests for visual perception, such as the Bender visual motor gestalt (BGT) [33] and the developmental test of visual-motor integration 6 (VMI-6) [34], those tests include motor integration to test visual perception, and their accuracy can largely depend on the skills of the examiner and the degree to which the children understand the instructions. Conversely, the MVPT-3 does not require motor integration because this test comprises multiple choice-type questions. The MVPT-3 is likely to be the most appropriate test for the evaluation of this intervention because we are interested in visual perception rather than motor skills.

Ⅳ. Results

4-1 Quantitative Analysis of Visual Perception

The results of evaluating visual perception with the MVPT-3 in the baseline phase are summarized in Table 2. When comparing the effects of the intervention on visual perception between children with autism and typically developing children, the test results of typically developing children named Carol and David were included. The age equivalences of the visual perception ability of children with autism are substantially lower than their chronological ages, whereas the age equivalences for typically developing children are marginally higher than their chronological ages. Table 3 summarizes the MVPT-3 results obtained post-intervention. All four children improved their raw scores on the MVPT-3, although Aron's age equivalence remained less than 4 years old, which is the minimum equivalent age measurable with the MVPT-3. More significant improvement

표 2. MVPT-3 기초선 결과

Table 2. MVPT-3 Results for Baseline Phase

Participants	Chronological Age (Years, Months, Days)	Raw Score	Age Equivalences (Years, Months)
Aron	(7,6,27)	10	(<4,0)
Billy	(6,10,1)	22	(4,6)
Carol	(5,9,9)	28	(6,6)
David	(5,11,17)	27	(6,2)

표 3. MVPT-3 중재 후 결과

Table 3. MVPT-3 Results for Post-intervention

Participants	Chronological Age (Years, Months, Days)	Raw Score	Age Equivalences (Years, Months)
Aron	(7,10,11)	14	(<4,0)
Billy	(7,1,21)	27	(6,2)
Carol	(6,0,2)	29	(7,0)
David	(6,3,7)	30	(7,6)

in raw scores for children with autism may suggest that the GVMIL program can be more effective for children with visual perception issues. Billy demonstrated the greatest improvement in age equivalence, i.e., 1 year and 8 months over less than 4 chronological months, and David showed similar improvement. These results support the concept that GVMIL can be a promising intervention for improving the visual perception of children with autism and possibly even for children without autism.

4-2 Qualitative Observations

Aron did not show much interest in the GVMIL intervention at the beginning. Often, Aron stood without trying to play with the GVMIL or played reluctantly with other children, without much motivation. However, Aron was observed to make some progress in participating more spontaneously after session 8. After session 15, Aron began to show interest in the intervention session even during the normal daily activity session and was also observed to make natural physical contact with other children and even ask for the opinions of other children regarding some issues while actively participating in the intervention sessions.

Billy was responsive to new stimuli in the intervention program, although he did not actively participate in the intervention. Billy enjoyed making the image of himself appear on the screen in the beginning. After becoming accustomed to new stimuli, Billy appeared to lose interest in this intervention.

He generally focused for a short period of time with the help of other participating children while often wandering around the classroom during the intervention session. Although Billy was not interested in this intervention for the entire session, he did exhibit interest in the activities of other children during the intervention. Billy also appeared to be more comfortable with physical contact with other children as the intervention continued.

Many different types of interactions occurred between the typically developing children and the children with autism. In the beginning, the typically developing children often attempted to partner with Aron because interacting with Billy was more difficult. However, as the intervention continued, the children tended to attempt to help whichever friend was sitting next to them without discriminating. Although the children were awkward playing together in the beginning, the typically developing children began to help Aron and Billy become properly positioned to fill in the outlines in the intervention. Whereas one typically developing child showed a tendency to monopolize activities during the intervention, the other child was actively attempting to help Aron and Billy. In addition, Aron and Billy were observed to imitate the behaviors of Carol and David and share emotions with the typically developing children.

Ⅴ. Discussion

5-1 Visual Perception

Pellicano [35] showed through longitudinal research that weak central coherence associated with local processing did not significantly improve over the course of 3 years, whereas capacities for empathy and executive functions among children with autism showed significant changes. The GVMIL program, which led to improvements in visual perception, may represent a promising method in this respect, although the program requires additional evidence and longitudinal research. Although body posture in the GVMIL program is used as a method of realizing embodied cognition to improve visual perception, one may consider body posture to be an intervention for visual-motor integration. Ayres [36] developed sensory integration therapy to enforce the relation between sensory experience and motor activities. However, in our research, visual motor integration was not the goal, but rather the means. Moreover, Dawson and Watling [37] argued that sensory motor therapies have not been properly validated despite numerous associated interventions. Although we used the method of integrating vision with body posture, we do not know which sensory integration is the most useful for improving cognition; this question requires further attention.

Significant improvement in visual perception with the proposed intervention may serve as evidence for the importance of interventions to support proper cognition at a young age. Pellicano [35] argued that bias in local processing emerges early during the course of development. Despite the efficacy of the proposed intervention, more refined articulation adapted to the level of development in cognition and age may render this type of intervention more effective.

5-2 Social Skills

There is a close association between sociality and cognition. Kaiser and Shiffrar [38] suggested two different views explaining how visual perception and social cognition in autism are related. People with autism may have typical visual perception and may process perceived information inadequately. Conversely, people with autism may have abnormal visual perception, whereas their social cognition processing works well. From the perspective of cognition as embedded in the experience resulting from the effect of body motion on surrounding environment, social cognition can be considered experience associated with actions connected with social interaction [27]. Information produced by cognition has significant effects on human behavior, whereas sociality forms behavior and cognition [39]. Sociality builds on the capability of social perception, such as recognizing subtle emotional cues and picking up relevant information.

Bauminger [40] defined social cognition as the ability to read spontaneously and interpret social and emotional cues correctly. In terms of this definition, some previously unseen social behaviors resulting from social cognition were noted. Moreover, children appeared to share emotions with peers in some cases. These findings highlight that the GVMIL program may help to improve sociality to a degree. Intervention to improve perception has been reported to be more important than intervention directly remediating social behaviors [5]. The GVMIL program does not teach specific skills; rather, the program attempts to strengthen the foundation for proper behavior by enforcing typical visual perception.

5-3 Educational Implications

One of the essential implications of this research is that visual perception in autism can be improved by natural play. In addition to emotional development, cognitive development is required for social play. Cognitive development is known to be associated with moving through the sensory exploration of objects [41]. The GVMIL fosters collaborative play by having children match presented outlines with combinations of their own body posture. From this perspective, the GVMIL may enforce social play during the intervention. Children with autism may learn new skills from peers and share the joy of achievement from collaboration, which is implicitly provided by the GVMIL.

Improved visual perception may imply a reduction in a bias toward local processing, which results in cognitive functions. The GVMIL may help to change an unusual cognitive style to allow children with autism to integrate information in a more relevant context. Milne and Griffiths [42] noted that children with autism demonstrate a literal understanding of spoken language without being overly influenced by sentence context. Improvement in cognition through GVMIL intervention may have a latent effect on language processing in autism, and improving visual perception is expected to have consequential effects on the development of important behaviors required for typical interaction. The pre-requisite for proper social behavior is likely to be having proper information. Indeed, many human behaviors are based on visual information. In this regard, GVMIL intervention may influence social behaviors such as reading social cues, expression of emotion and establishing shared attention. The GVMIL may also contribute to learning complex motor skills and having appropriate body posture.

Although we could not determine which function in visual perception was further developed with this intervention, interpreting improvement in visual perception as being a result of having more proper information has several educational implications in social behaviors and learning. Maynard [43] contended that although social interactions involve concerted actions having an intrinsic gestalt structure, people with autism often have more locally organized orientation and sensibility driven by the local analysis of social information. Joint attention is considered to be important in the sense of a shared experience [41], and joint attention as a cognitive process is strongly associated with available information. This connection implies that developing visual perception may improve joint attention and help to develop a sense of shared experience. Vetrayan, Zin, and Paulraj [44] showed the strong relation between imitation and visual perception using motor-reduced visual perception, the unstructured gesture and object imitation in the school functions of children with autism. From this result, the authors argued that visual perception substantially affects the skills required to function in school such as paying attention and reading. This result implies that the GVMIL may improve school functions, which can enhance the efficacy of other education and develop the new learning behavior.

5-4 The GVMIL Program

Pares et al. [45] contended that children with autism cannot be typified because of the wide spectrum of disorders covered by autism, although users must be typified in the design of an interactive application. These authors designed an interactive space called MEDIATE with the primary goal of creating a playground in which children with autism could have fun. They only used abstract images to remove the possible dependency on the content represented in an image rather than the space itself. Similarly, the target users of the GVMIL program were young children with autism. However, we used both abstract images and representational images. With the help of friendly-looking characters, children showed only positive responses to the presented images. However, because images can occasionally be problematic, images causing a negative response must be replaced by consultation before beginning an intervention.

Infants are known to develop the basic communication skills required for proper social interactions during the first two years of life [46], and the current GVMIL program may not be appropriate for infants. Thus, refined adaptation for infants is needed to render the program applicable for more efficient intervention in younger subjects. Applying Kansei engineering to improve the emotional quality of GVMIL can be a candidate approach to make it realized efficiently as it has successfully improved interaction of mobile web [47]. .

Ⅵ. Conclusions

In this research, we developed a GVMIL intervention program based on the prototype of edutainment content with motion recognition. Exploiting gestalt principles and gestalt therapy, the intervention was shown to improve the visual perception of young children with autism as well as typically developing children. Desirable social behaviors such as sharing emotions and asking opinions, which had not been observed previously, were observed during the intervention period. Improvement in visual perception is relatively consistent with improvement in speech production resulting from music training in children with ASD at ages ranging from 3 to 5 [48]. In that intervention, improvement was greater with music training for low-functioning participants than was speech training. This result may suggest that learning in a natural manner can be more effective, such as in the case of the GVMIL program.

Despite significant improvements in visual perception using an intervention with the GVMIL program, its efficacy remains tentative because this trial was a preliminary trial with a small number of subjects, and autism is renowned for being a wide-spectrum disorder. Thus, further research with more children with autism in a variety of age groups and across the autism spectrum is required to ensure truly efficient methods for improving cognition. There are also complicated interactions between gestalt principles, types of image, body motion, characters, motion pictures, and sounds in the GVMIL. Although we speculate that gestalt principles and the utilized images may be significant in improving visual perception, we cannot conclude how much other elements contribute to the intervention and in what manners.

High predictability of language skills at age 4 and motor imitation at age 2 [49] may suggest that motor intervention at an early age can be a promising manner in which to improve the communication skills of children with autism. This possibility stipulates an evaluation of the efficacy of the GVMIL program in improving the skills of younger children with autism and a longitudinal study. The GVMIL program may also be further refined in several aspects. For instance, a personalization feature may be added systematically through investigation, and a testing program measuring the current level of visual perception could be developed by examining an interactive program systematically and statistically. Once the current level and its weakness in visual perception can be measured, adapting the GVMIL program may automatically result in more efficient interventions. The GVMIL program can also be extended to include other sensory perceptions such as sound and touch so that multi-sensory stimuli can enforce embodied cognition. Cognition of language is also strongly associated with gestalt principles. Thus, a GVMIL-type program could be developed to improve speech production or natural language processing in children with autism.

Evolving forms of media are launching a new era for disease intervention. With the development of mobile technology, virtual reality (VR) technology, which utilizes a computer-generated reality, is now emerging as a method to enrich a mobile ecosystem. Simultaneously, such technology has great potential to generate efficient tools for developing cognitive and social skills. Kandalaft et al. [50] observed that eight young adults with high-functioning autism showed improvements in social cognition with an intervention using VR. Easy facilitation of behaviors in real life and visual representation similar to the real world provides an opportunity to learn social interaction naturally. As a result, significant attention must be focused on the exploitation of VR to develop an efficient intervention program.

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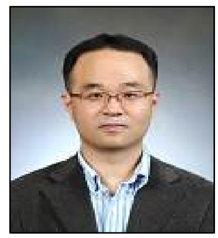
박윤(Yoon Park)

2011년 : 가천대학교 회회과 서양화 전공(학사)
2015년 : 서울미디어대학원 뉴미디어학과 미디어공학전공 (석사)

※관심분야 : 유아 미술 교육, 에듀테인먼트 콘텐츠



양장훈(Janghoon Yang)

2001년 : University of Southern California (공학박사)

2001년～2006년: 삼성전자, 책임연구원
2006년～2010년: 연세대학교, 연구교수
2010년～현 재: 서울미디어대학원 뉴미디어학부, 부교수
※관심분야 : 중재 기술, 감성 공학, 간사이 공학, 정보이론, 이종 시스템 제어, 무선통신, 무선 네트워크, 뇌공학