Learning impacts of using data glove and stereoscopic projection with virtual environment for enhancing the social etiquettes in Autistic Spectrum Conditions

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The deficit of social interaction is main difficulty in children with Autistic Spectrum Conditions (ASCs). They have limited capability in social etiquettes, which affects their social life and friendship network. The purpose of this study is to investigate the performance of using data glove cooperated with stereoscopic projection to assist the impairment of social etiquettes for children with ASCs. The 3D virtual park (3DVP) system cooperated data glove and 3D-glasses were designed. Participant can use a "data glove" to interact with virtual objects and characteristics; and a "3D-glasses" immersed in the virtual environment. This study involved a multiple baseline design to observe performance of the social etiquettes skills and explored evaluation of using the 3DVP system intervention for participants with ASCs. The experimental study consisted of 3 months length, and the preliminary results indicate that children with ASC were beneficial by using this 3DVP system.

Keywords: Autistic Spectrum Conditions (ASCs), Social etiquettes, data glove, Virtual environment, Multiple baseline design

Introduction

Autistic spectrum Conditions (ASCs) is developmental disabilities caused by congenital brain lesions (DSM-IV; American Psychiatric Association (APA), [1]. It is likely to display the following 'triad of impairments' to varying degrees: impaired relationships, impaired verbal and non-verbal communication, and a difficulty with social imagination. In more specific terms, children with ASCs have impairments in social etiquettes, which may affect relationship between the peers in lack of enjoyment and interests [2]. The children with ASCs is unable to engage in appropriate social etiquettes to lead to some serious consequences, such as difficult to develop friendship [3], feel depression [4], and failure in school [5].

In more specific terms, children with ASCs have impairments in social etiquettes, which may affect relationship between the peers in lack of enjoyment and interests [2]. Tse [6] indicated that people with ASCs have deficit in social interaction skills, such as feeling expression, eye contact, nonverbal cues, negotiation, and social etiquettes. The children with ASCs is unable to engage in appropriate social etiquettes to lead to some serious consequences, such as difficult to develop friendship [3], feel depression [4], and failure in school [5].

It may be difficult for children to develop their social competence as the age creased, especially for those children with ASCs [7] (Happé, 1995). Therefore, began to develop from childhood, learning from each other between the peers of the same age besides, continuing and practicing social etiquettes for children with ASCs is necessary [8]. Further, social etiquettes skill is an important component of an individual social behavior for people with ASCs, which impacts multiple areas of their social life [2]; such as improving conversational skills, peer entry and exiting skills, developing friendship networks, good host behavior during get-togethers, changing bad reputations, and handling teasing, bullying, and arguments [2], improving self-esteem, and decreasing anxious and depressive symptoms [9]. However, learning appropriate social etiquettes can be improving the quality of friendships for people with ASCs, which may promote positive social interactions skills. Therefore, improving social etiquettes skills among children with ASC is a particularly important issue.

In recent years, due to the computer technology is growing and brings many innovation technologies, involving computer-aid instruction and virtual environments. Virtual Environments (VEs) is a three-dimensional space to simulate the real world situation, the users can explore freely and safely in a designed environment, or interact with

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virtual objects and characters. Some researchers demonstrated that using VEs to teach social skills for children with ASC successfully. For instance, Mitchell [10] using the café VEs system as an instruction tool for teaching social skills interaction. The system requests the task of how can find a place to sit to users, and how can you ask someone to have a seat for you. The results indicated the VEs can be generalized learning for teaching social skills. Mengue-Topip [11] presented that the individual with ASCs to learn finding a shortest and optimization routes in 300m*300m regular grid of streets for a map of VEs. More recent study [12] investigated that using virtual reality improves social skills, social cognition, and social functioning for people with high- functions with autism. Their study indicated virtual reality is a promising tool for improving social skill in this people with autism.

A data glove is one of application in VEs, it can detect different levels of motor functions for user's hand movement (e.g. grabbing virtual objects, or shake hands with someone) and the data-glove representation displays simultaneously on stereoscopic projection or 3D glasses for users. Some studies have proposed that the use of virtual environments combined with the data gloves can assist the deficits of children with autism. For executing tasks, Bruno and Maurizio [13] designed a 3D virtual reality microwave and used data gloves to allow participants learning how to use the microwave and assess the feasibility. Pabon [14] designed a kitchen scene of virtual reality and the use of data gloves with vibro-tactile stimulation to assist physical rehabilitation with ASCs. Regard of social interaction, Cheng and Huang [15] created a simulated environment to promote joint attention skills for children with PDD. Their system enables participants to practice their joint attention skills using the data glove. Their experiment results reveal that the participants have further extension in improving the joint attention skills in their daily life by the data glove. Therefore, it's a trend that data glove could be beneficial for children with ASCs.

However, a very few studies used a data glove to practice social etiquettes skills for children with ASCs. The purpose of this study is to investigate the performance of using data glove cooperated with stereoscopic projection to assist the impairment of social etiquettes and explored the evaluation of using the 3DVP system intervention for participants with ASCs. Thus, the 3D virtual playroom system is developed in this propose.

The 3D virtual amusement park system development

- *The design content of system*

The teaching content designed in an amusement park where participants can enjoy playing and interact with others. A 3D virtual amusement park (3DVP) was developed (Figure 1). The proposal system is to consider 5 topics in social etiquette relevant, such as “saying Hello”, “basic conversation”, “praising others”, “helping others” and “getting attention”. Participants can learn how to interact with other people in playing time, as well as the concepts of social behaviors and social understandings are also implemented in this context.

Furthermore, users wear 3D-glasses cooperated with a dual stereoscopic projector to navigate the virtual amusement park. The first-person view is presented, and a keyboard and a data glove use to operate the virtual objects and interact with virtual characters in the system. The data glove designs to grab a virtual object and interact with virtual characters in the system to practice social etiquettes skills. The users can choose the answer when the question is appeared in the screen, and the system is able to give an appropriate feedback with text, animation and praise of applause immediately. Otherwise, if the user’s answer is inappropriate, the system will appear the hint and its explanation immediately.

- *The content of system*

The 3D virtual amusement park system is designed on a desktop computer (HP xw9400 workstation, Intel Core 2 Duo 2.00 GHZ, Processor2212, 3.50 GB RAM, NIDIA Quadro FX1600M and Window XP). The system presented in 120-inch 3D stereoscopic screen by the dual stereoscopic projector. The 3D model and characters are formed by the 3Ds Max, and the kernel system is designed through Virtools. The 5DT Data Glove 5 (five sensors) device produced in the 5DT (Fifth Dimension Technologies) company launched. The data gloves can detect each finger joints of a user and show the true extent of curved fingers (X-axis and Z axis, two degrees of freedom).

Method

Participants

Three participants with ASCs were recruited in special education of the local school. According to the participants verbal IQ (VIQ), performance IQ(PIQ), and full-scale IQ(FSIQ) as the prerequisites, as evaluated by Wechsler Abbreviated Scale of Intelligence III [15] >70 (WASI) [16]. The participants were aged from 9-11 years old, all are boys. They had basic literacy and reading abilities, and generally disorder of Social etiquettes.

Experimental design

A single-subject, multiple-probe design across subjects was utilized for this study to observe and measure their social etiquettes behaviors. They came to a virtual reality research lab to operate the system. The baseline, treatment, and maintain probes were conducted in the lab. The participant attended the experiment for 1 day per week and 40-50min each session. Each session was consisted of one teacher of special education, two researchers.

Measure and data collection

The measure of "social etiquettes checklist (SEC)" was developed to determine the change in understandings of social etiquettes skills for each participant. In order to evaluate social-etiquettes understandings from the participants, all criteria were fully discussed with professionals and experts of ASCs for its validity and suitability. All of experiment was videotaped, which contains the baseline, interaction, follow-up probes sessions.

Procedure

The three participants accompanied with their parent to this experimental study. A brief instruction explains how to use the 3DVP system before starting the experiment, which gives the participants an opportunity to learn operating the system. Each participants attended this experiment throughout baseline, intervention, maintain.

- *Baseline*

It was conducted the measure of SEC, 1 day per week. The participants were asked the questions from the SEC measure regard of understandings of social etiquettes skills. The score was grained from the researchers and a professional observer, they observed from the participant's performance.

- *Intervention*

The intervention was designed to increase appropriate social etiquettes behavior. Prior to the intervention of the 3DVP system guidance, the participants equipped with 3D-glasses and data glove by the instructor. The researcher explained how to operate the 3DVP system, and gave the participants the opportunity to familiar the system. The participants could listen the questions with speaking sounds in reading the text. They then chosen the appropriate answer; whether the answer is right or wrong, the system simultaneously is able to give a feedback with animation. The participants also can use the data glove to interactive with any virtual objects when they like to. Additionally, the score was observed by the researchers and a professional observer.

- *Follow-up*

Three participants involved 3 day treatment to evaluate their learning effects by using the measure of SEC in this stage. And the SEC score was recorded through performance of the participants as the basis for the assessment by the researchers and a profession.

Results and discussion

The scores at baseline, intervention and follow-up sessions were compared to gauge the effectiveness of the 3DVP system to teach social etiquettes skills for each participant. Participant A and B improved quickly during the intervention session, suggesting that the 3DVP system was effectively to learn social etiquettes skills. The experimental study is still ongoing. The primitive results are encouraged; (a) the score of each participant shows considerable increased in the intervention stage after operating the 3DVP system; (b) the usage of data glove was acceptable for these participants with ASCs, and they could use the data glove to grab and interact the virtual objects and virtual characters; (c) all participants were enjoying to operate the 3DVP system, they showed their motivation on learning academic skills. However, this study has investigated changes in the participant's social etiquettes skills after using the 3DVP system and provided the beneficial for social etiquettes skills learning.

[1] American Psychiatric Association. (1994). *Diagnostic and statistical manual of mental disorders, (4th ed)*. Washington, DC: American Psychiatric Association.

[2] Laugeson, E. A., Frankel, F., Gantman, A., Dillon, A. R., & Mogil, C. (2012). Evidence-based social skills training for adolescents with autism spectrum disorders: The UCLA PEERS program. *Journal of autism and developmental disorders, 42*(6), 1025-1036.

[3] Bauminger, N., & Kasari, C. (2000). Loneliness and friendship in high-functioningchildren with autism. *Child Development, 71*, 447–456.

[4] Stewart, M. E., Barnard, L., Pearson, J., Hasan, R., & O'Brien, G. (2006). Presentation of depression in autism and Asperger syndrome A review. *Autism, 10*(1), 103-116.

[5] Ladd, G. W., Birch, S. H., & Buhs, E. S. (1999). Children's social and scholastic lives in kindergarten: Related spheres of influence?. *Child development, 70*(6), 1373-1400.

[6] Tse, J., Strulovitch, J., Tagalakis, V., Meng, L., & Fombonne, E.(2007). Social skills training for adolescents with asperger syndrome and high-functioning autism. *Journal of Autism and Developmental Disorders,* 37(10), 1960–1968.

[7] Happé, F. G. (1995). The role of age and verbal ability in the theory of mind task performance of subjects with autism. *Child development, 66*(3), 843-855.

[8] Dugan, E., Kamps, D., Leonard, B., Watkins, N., Rheinberger, A., & Stackhaus, J. (1995). Effects of cooperative learning groups during

social studies for students with autism and fourth‐grade peers. Journal of Applied Behavior Analysis, 28(2), 175-188.

[9] Buhrmester, D. (1990). Intimacy of friendship, interpersonal competence, and adjustment during preadolescence and adolescence. *Child development, 61*(4), 1101-1111.

[10] Mitchell, P., Parsons, S., & Leonard, A. (2007). Using virtual environments for teaching social understanding to 6 adolescents with autistic spectrum disorders. *Journal of autism and developmental disorders, 37*(3), 589-600.

[11] Mengue-Topio, H., Courbois, Y., Farran, E. K., & Sockeel, P. (2011). Route learning and shortcut performance in adults with intellectual disability: a study with virtual environments. *Research in developmental disabilities, 32*(1), 345-352.

[12] Kandalaft, M.R., Didehban, I.N., Krawczyk, D.C., Allen, T.T., Chapman, S.B., (2013), Virtual Reality Social Cognition Training for Young Adults with High-Functioning Autism, *Journal of Autism and Developmental Disorders,* 43(1), 34-44

[13] Bruno, F., & Muzzupappa, M. (2010). Product interface design: A participatory approach based on virtual reality. *International journal of human-computer studies, 68*(5), 254-269.

[14] Pabon, S., Sotgiu, E., Leonardi, R., Brancolini, C., Portillo-Rodriguez, O., Frisoli, A., & Bergamasco, M. (2007, October). A data-glove with vibro-tactile stimulators for virtual social interaction and rehabilitation. In *10th Annual Intl Workshop on Presence*.

[15] Cheng, Y., & Huang, R. (2012). Using virtual reality environment to improve joint attention associated with pervasive developmental disorder. *Research in Developmental Disabilities, 33*(6), 2141-2152.

[16] Wechsler, D. (1999). *Wechsler Abbreviated Scale of Intelligence (WASI).* New York, NY: The Psychological Corporation: Harcourt Brace & Company.

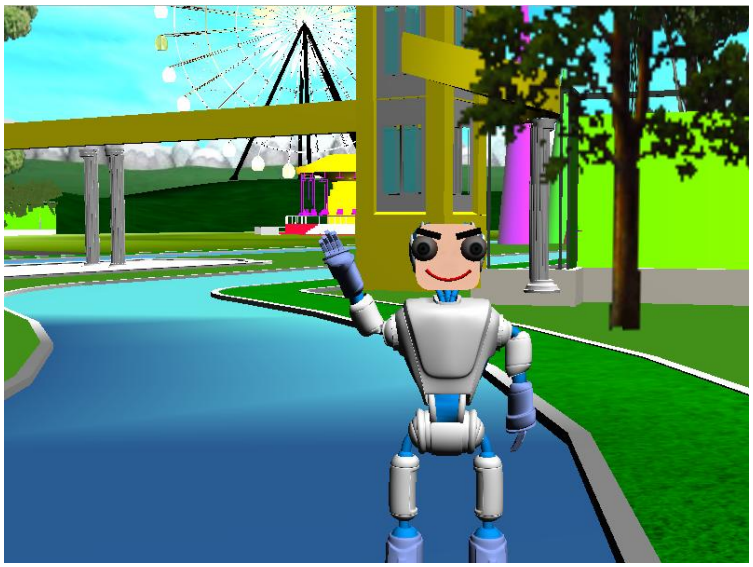

Figure 1. Example of the interface of the 3DVP system

Figure 2. The participant was using a data glove in the 3DVP system operation