# Assessment of Rehabilitative Effects of Motion Sensing Game on Mentally Retarded Children

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***Abstract*—This study explored the rehabilitative effects of motion sensing game("rehabilitative training game system V1.0") on training mentally retarded children. 112 children were chosen as participants in the experimental group from 187 mentally retarded children while the other children in the control group. By using Pediatric Evaluation of Disability Inventory (PEDI), these children are pretested and posttested the ability in daily activities, locomotivity and communication. The experimental data was analyzed with RMANOVA and Independent-Sample T Test, which revealed a significant difference between the experimental group and control group. This suggests that motion sensing game makes significant rehabilitative effects on mentally retarded children training.**

***Keywords-motion sensing game; mental retardation; rehabilitative training***

## I. INTRODUCTION

Mentally retarded children, who are defective in cognition, unclear in verbal expression and even disabled in body movement, undoubtedly impact their whole family. For the arrested development in most areas, the children can hardly adapt to social environment. Thus, it must cost much time for the children to get trained. Up to Apr. 1st in 2006, the amount of the disabled were 82'940 thousand, among which the mentally retarded occupied 6.68% [1]. Viewing the individual amount, it seems tiny. While regarding the number of whole effected family, the severity cannot be ignored. The children determine the destiny of family. Therefore, the crux of the matter is how early education is carried out and how the children get intervened.

Now, the education of mentally retarded children is mainly from family, special school and some institutions, to train the children to grasp some prime skills, such as using the spoon, and express their emotion accurately, so that they can gradually fit into where they live. However, the most difficulty derives from the unwillingness of cooperation from the children. Not only the iterative tasks make the children bored, but once the task they can hardly complete, their emotion could be out of control, which further impede the improvement of their training. The same as the average children, what can attract them are games. Recently, a widely extended game named motion sensing game has caught our eyes. Based on motion sensing technique, users play with body movement instead of mouse and keyboard, experiencing the virtual reality world in games. Children in games can reflect all their movement on the role. Entertaining and attractive as normal games, motion sensing game is also a kind of all-around training, reinforcing their cognition and exercising the motion. When compared to daily tasks, there is no pressure in the virtual situation. Guiding by the games, it's more soft for the children to develop abilities on cognition, thought and movement. Through shifting games and the difficulty level, the children adopt reinforcement repetitively, avoiding the stiffness of traditional training pattern.

Recent years, motion sensing game has been widely applied into many fields such as medical treatment, fitness exercise and special education. Also many studies and experiments have been carried out from 2011 to 2016, mainly aimed at two kinds of objects, paralytic and children with autism. Some Chinese researches show significant rehabilitation effect of paralytic in execution and motoricity [2][3]. Some abroad studies proposed the promotion of the game on selectivity of attention and imitation ability [4][5]. On the fundamental of the conclusion of these researches, our group decided to follow the formal experiment to explore the effect when applied to training mentally retarded children. For remedying the defect of the formal, the games ("rehabilitative training game system V1.0") modified by Zhejiang University of Technology were adopted. With the space more capacious and comfortable, the children could choose and enjoy games from what we had selected based on the weakness of pretest. In the process, the children were given proper assist and reward so that it could meet our expectation, the best rehabilitation effect.

## II. RESEARCH METHODS

### A. Subjects

The subjects of our experiment are from special education schools and rehabilitation institutions in Hang Zhou, including Hang Zhou Hu Shu primary school (an special education school), Hang Zhou children welfare school and Xiao Shan special rehabilitation center. The rules we chose subjects included:

- having been identified as mentally retarded children by DSM-IV;
- receiving scheduled training and learning tasks in special education schools or rehabilitation institutions;
- having a certain ability of cognition and independent ambulation;
- children and their guardians volunteered to participate in this experiment .

We finally found 187 subjects who conformed to our rules.

They were divided into two groups: one group was experimental group, who would receive the intervention of motion sensing game (i.e the rehabilitation game training system, V1.0) as well as the training of special education school or rehabilitation institution as usual; the other group was control group, who would only receive the training of special education school or rehabilitation institution without the intervention of motion sensing game. There were 112 subjects in the experimental group, and 75 subjects in the control group. Sex and age of the two groups' subjects were matched, and there was no significant difference between them except the intervention of the experiment.

### *B. Research Tools*

We used the rehabilitation game training system V1.0 to carry out the motion sensing game training. The system was developed by the national technology supporting project, which depended on the characteristic and ability level of low-ability level children. Mentally retarded children could use Kinect(the external system of motion sensing game) to play games by body movement. This system has 5 periods, including intellectual rehabilitation program, basic perceptive and cognitive rehabilitation program, upper limb rehabilitation program, lower limb rehabilitation program, leisure and healthcare program. Each program has 2 to 5 game parts which differ both in content and form, and each game has 3 levels of difficulty(easy, normal and difficult). Those games cover the training of exceptional children's perception, attention, action and other abilities.

The tool we used to filtrate and measure was Pediatric Evaluation of Disability Inventory (PEDI). The period of "functional activities" is to measure children's present functional ability level. It has 177 items, and all items should be marked as "0" or "1". "0" means children couldn't complete the task or are restricted in many cases; "1" means children have mastered the skill and could complete it well in general. The scale includes 3 dimensions(daily activity, locomotivity and communication skill), which fits the children who age from 6 months to 7.5 years, and children or teenagers whose ability level is below 7.5 years old. PEDI has been used widely and got good results on reliability and validity in correlative researches.

### *C. Research Process*

Got the permission of guardians and teachers. Used PEDI to measure the children chose in the special education schools and rehabilitation institutions. Chose the children who met our requirements. Divided the subjects into experimental group and control group randomly. Made sure the sex and ages of subjects in the two groups are matched. Recorded data of the subjects.

The experimental group received the motion sensing game training which lasted for at least 8 weeks, twice a week and two hours each time. We trained children in activities rooms of the schools and institutions. Before training, the experimenter would introduce and demonstrate the content and the rules of the games. Then the experimenter chose the proper game for each subject, and supervised them to play games correctly and orderly. After training, the experimenter gave subjects some reinforcers (e.g. encouragement and reward).

During the training process, experimenters controlled training time, difficulty and intensity properly for each subject based on their characteristics. Of course, the training had little impact on their daily life, neither would it increase extra variable between compared groups.

Used PEDI to measure subjects again after the whole training had been over. All subjects finished the training and we got 187 data. We regarded the intervention of motion sensing game as independent variable, and regard the scores subjects got on PEDI as dependent variable. We used SPSS19.0 to analyze the data results by descriptive analysis and variance analysis of repeated measure.

## III. RESULTS

The pre-post test scores of the subjects who have been trained by motion sensing game (the experimental group) or not (control group) on the three dimensions(daily activity, locomotivity and communication skill) of PEDI are shown as table I.

We used the scores of the three dimensions(daily activity, locomotivity and communication skill) of PEDI as dependent variables. And the data were analysis with 2(pretest/posttest)×2(experimental group/control group)RMANOVA, and the results were presented in table II

TABLE I. THE SCORE OF THE TWO GROUP ON PEDI

| **Dimension** | **Pre-post test** | **Experimental group （n =112） M ± SD** | **Control group （n =75） M ± SD** | **t** | **P** |
|---|---|---|---|---|---|
| ***Daily activity*** | ***Pretest*** | 44.68 ±9.778 | 47.12±11.428 | 8.816 | <0.01 |
| | ***Posttest*** | 50.80±7.459 | 47.91±11.364 | | |
| ***Locomotivity*** | ***Pretest*** | 49.81±5.462 | 44.99±9.567 | 5.025 | <0.01 |
| | ***Posttest*** | 52.16±3.355 | 45.49±9.443 | | |
| ***Communication skill*** | ***Pretest*** | 34.69±16.122 | 32.64±16.524 | 7.066 | <0.01 |
| | ***Posttest*** | 44.58±13.141 | 34.75±17.443 | | |

TABLE II. RESULTS OF RMANOVA

| Dimension | Variable | Mean square | F | P | η2 |
|---|---|---|---|---|---|
| ***Daily activity*** | ***Pre-post test*** | 1072.935 | 130.294 | <0.01 | 0.413 |
| | ***Group*** | 4.659 | 0.025 | 0.875 | 0.000 |
| | ***Pre-post test * Group*** | 640.058 | 77.727 | <0.01 | 0.296 |
| ***Locomotivity*** | ***Pre-post test*** | 183.056 | 60.682 | <0.01 | 0.247 |
| | ***Group*** | 2966.817 | 31.591 | <0.01 | 0.146 |
| | ***Pre-post test * Group*** | 76.168 | 25.249 | <0.01 | 0.13 |
| ***Communication skill*** | ***Pre-post test*** | 3233.968 | 150.704 | <0.01 | 0.449 |
| | ***Group*** | 3170.499 | 6.760 | 0.01 | 0.035 |
| | ***Pre-post test * Group*** | 1361.626 | 63.452 | <0.01 | 0.255 |

### *A. Daily Activity*

As shown in the results, pre-post test has an significant main effect, F(1,185)= 130.294, P<0.01, η2=0.413;group has an indistinctive main effect, F(1,185)= 0.025, P=0.875, η2=0.000; there exists an interaction effect of pre-post test and group, F(1,185)= 77.727, P<0.01, η2=0.296. The data were analyzed further with simple effect analysis, and the results show that the posttest score is significantly higher than the pretest's in the experimental group, F(1,185)=171.201, P<0.01; there also exists a significant difference between the scores of pretest and posttest in the control group, F(1,185)=10.647, P<0.01. The difference of pre-post test in the two groups were analyzed further with Independent-Sample T Test, t=8.816, df=185, p<0.01. The results indicates motion sensing game makes significant rehabilitative effects on daily activity intervention of mentally retarded children.

### *B. Locomotivity*

As shown in the results, pre-post test has an significant main effect, F(1,185)= 60.682, P<0.01, η2=0.247; group has an indistinctive main effect, F(1,185)= 31.591, P<0.01, η2=0.146; there exists an interaction effect of pre-post test and group, F(1,85)= 77.727, P<0.01, η2=0.296. The data were analyzed further with simple effect analysis, and the results show that the posttest score is significantly higher than the pretest's in the experimental group, F(1,185)=65.573, P<0.01; there also exists a significant difference between the scores of pretest and posttest in the control group, F(1,185)=10.647, P<0.01. The difference of pre-post test in the two groups were analyzed further with Independent-Sample T Test, t=5.025, df=185, p<0.01. The results indicates motion sensing game makes significant rehabilitative effects on locomotivity intervention of mentally retarded children.

### *C. Communication Skill*

As shown in the results, pre-post test has an significant main effect, F(1,185)= 150.704, P<0.01, η2=0.449; groups has an indistinctive main effect, F(1,185)= 6.760, P<0.05, η2=0.035; there exists an interaction effect of pre-post test and group, F(1,85)= 63.452, P<0.01, η2=0.255. The data were analyzed further with simple effect analysis, and the results show that the posttest score is significantly higher than the pretest's in the experimental group, F(1,185)=175.85, P<0.01; there also exists a significant difference between the scores of pretest and posttest in the control group, F(1,185)=24.121, P<0.01. The difference of pre-post test in the two groups were analyzed further with Independent-Sample T Test, t=7.066, df=185, p<0.01. The results indicates motion sensing game makes significant rehabilitative effects on communication skill intervention of mentally retarded children .

## IV. DISCUSSION

As a multimedia game, motion sensing game has a strong appeal to children, it can help mentally retarded children receive rehabilitation training better.

Before training, the most essential preparation is to create relaxing atmosphere for subjects to adjust to training quickly. In the process of training, in addition to giving favorite fortifier(e.g. snacks), it's also important to take care of subjects' emotion. The trainer should give feedback in time for their performance, like some assistance and encouragement, in order to make subjects keep good mentality and emotion. It can also help subjects correct their mistakes.

There are some deficiencies of the system:

- This training requires that subjects have to reach the underlying level of intelligence including cognition and attention. There remains only little improvement for the severely mentally retarded children.

- The time children get trained needs further ascertainment. Time too long may cause tiredness, while too short cannot meet our expectation.

- The content of training should be on the basis of the retarded level of children.

## V. CONCLUSION

As a result, motion sensing game has a significant rehabilitative effect on mentally retarded children's intelligence and body movements. After some period of direction, the action competence of subjects were strengthened observably, from guiding by us to operating the machine to choosing the difficulty level by themselves.

As a new way of rehabilitation training, rehabilitative training game system V1.0, with its easy tasks and convenient operation, unlike other motion sensing games in the markets aiming at profit, is extremely suitable for mentally retarded children education. Although there remains some deficiencies, the data still show it makes effect. Now the application only exists in some special schools and institutions. It's better to extend it to families, so that children can be trained by their parents, and it will be more convenient and efficient.

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