COMPUTER-MEDIATED INTERVENTION: CAN COGNITIVE FLEXIBILITY OF AUTISTIC CHILDREN BE IMPROVED?

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Abstract

Among individuals with Autism Spectrum Disorder (ASD) some executive functions were found to be deficient, in particular cognitive flexibility (De Vries & Geurts, 2012; Wang, 2010). Various studies have shown that difficulties in cognitive flexibility affect the social functioning of children with ASD (Bauminger, 2002; Hill, 2004). Studies also shows that technology enhance the ability of children with ASD to learn (Battocchi et al., 2008; Ploog et al., 2013), and effective in promoting cognitive flexibility (Panerai et al., 2014) and social problem solving (Parsons & Mitchell, 2002; Wainer & Ingersoll, 2011).

The purpose of the study was to examine the effect of a computer-mediated intervention program on the cognitive flexibility of children with high-functioning autism (HFASD). The study concludes 44 children ages 5-7 which were divided to three groups: (1) 15 HFASD who experienced a computer-mediated intervention, (2) 14 HFASD who had a traditional pictures-mediated intervention, and (3) 15 typical development that served as a control group and did not undergo any intervention.

Pre-intervention the parents completed a demographic questionnaire and the SCQ questionnaire which provided information on the child's functioning in language, communication, and social networking. In addition, all participants underwent language assessment using the PPVT-III test to determine the level of verbal IQ, and a test for the evaluation of cognitive flexibility. The participants with HFASD underwent the cognitive flexibility assessment after the intervention. The intervention concludes five 45-min sessions of individual intervention.

Results indicated that pre-intervention children with HFASD presented a lower level of cognitive flexibility than children with typical development. After the intervention, children with HFASD presented a higher level of cognitive flexibility following the computer-mediated intervention, compared to the picture mediated intervention.

The results of this study may contribute to early intervention programs aimed at improving the social and cognitive functioning of children with ASD

Keywords: Autism, HFASD, cognitive flexibility, computer-mediated intervention.

1 INTRODUCTION

Autism spectrum disorder (ASD) is a developmental disability that can cause significant social, communication and behavioral challenges. It is a neurodevelopmental disorder, whose symptoms are expressed in two central categories: persistent deficits in social communication and interaction, and repetitive patterns of behavior with limited interests and activities [1]. The children who participated in this study are high-functioning (HF) and characterized with appropriate cognition alongside other characters including social difficulties.

Among individuals with ASD, some executive functions were found to be deficient, in particular—cognitive flexibility [2, 3]. Various studies have shown that difficulties in cognitive flexibility affect the social functioning of children with ASD [4, 5]. Compared to typical developed children, ASD are less cognitive flexible and more repetitive in their responses [6, 7].

Over the years there is a substantial increase in technology-based intervention programs, especially among people with special needs. Computer-mediated intervention has been found as a sufficient teaching and learning method for children with ASD [8, 9], and effective in promoting cognitive flexibility [6]. Various studies indicate the advantages of learning with computers among ASD children that tend to prefer predicted and structured environment. They also tend to think and learn visually, and the visual and auditory illustration and support that the computer supply might answer the children needs. Another aspect is the repetitiveness that children with ASD mostly needs, a fetcher that exists precisely in computers. The computer also provides controlled environment that children with ASD can learn independently.
Despite of the importance of early intervention, therapists and parents consider cognitive flexibility a difficult area to intervene. Due to this, the need arose to develop appropriate interventions.

The aim of this study was to examine whether a computer mediated intervention program, including the presentation of social problems, will affect the cognitive flexibility in children with high-functioning autism (HFASD).

2 METHODOLOGY

2.1 Participants
The study concludes 44 children ages 5-7 (M=69.7 month, SD=7.62), most of them boys (n=34). The participants were divided to three groups: (1) 15 HFASD who experienced a computer mediated intervention program, (2) 14 HFASD who had a traditional picture mediated intervention program, and (3) 15 typical development that served as a control group and did not undergo any intervention.

2.2 Instruments
Demographic questionnaire. Personal data about the participants.
Peabody Picture Vocabulary Test – Third Edition (PPVT-III). This assessment determines the level of verbal IQ. It has 20 categories and 204 items. Reliability $\alpha = 0.97$ [10].
The Social Communication Questionnaire (SCQ). This assessment gives information on the child's functioning in language, communication, and social networking. It has 40 questions. Reliability $\alpha = 0.80$ [11].
Torrance Tests of Creative Thinking (TTCT). This assessment evaluates the cognitive flexibility. It contains 36 circles, and the participant has to create different ideas from each circle. Reliability $\alpha = 0.90$ [12].

2.3 Interventions

2.3.1 Computer-mediated Intervention
The study uses an individual intervention program based on the principles of Cognitive-Behavioral Therapy (CBT), which includes cognitive learning and experimentation. The intervention program included four situations with social problems (playmate invitation, help request, joint activity and conversation initiation), whose solution focused on social initiative behaviors. The problems were presented in three different environments: in the home environment, in the garden environment and in the playground environment. The computer program included a stage of learning and a phase of experience, according to the CBT theory. Every social problem was presented in a video clip, in a spoken voice and written text. The child was asked to think of as many solutions as possible to the problem. After the child completed offering solutions, he was asked to choose one solution that he said aloud and recorded it to the computer. The experimenter then revealed to the child the three solutions proposed by the computer: adaptive solution, avoidance solution, and unrelated solution, in addition to his solution. Afterwards, the child was presented with all the solutions offered by him and by the software, and the best solution was decided upon. During the trial stage, a child role-play was conducted with the experimenter, in which the chosen solution was videotaped by a web camera attached to the computer, after which the child and the experimenter watched the recorded video. The experimenter gave the child feedback, mediation and assistance.

2.3.2 Picture-mediated Intervention
The non-computerized intervention program included the same problems and solutions, presented in the same order, only in color photographs and without recording a selected solution and without taking the role playing.

2.4 Procedure
The procedure was divided into four stages:

a) In the first pre-intervention stage, all children were individually tested to assess their cognitive verbal ability (PPVT) and their social communication (SCQ) in order to determine their suitability for the research;
b) In the second pre-intervention stage, the selected children were administered the cognitive flexibility test;

c) In the intervention stage, children in the experimental groups (computer-mediated/picture-mediated intervention) participated in five 45-min sessions of individual intervention program.

d) In the post-intervention stage, children were re-assessed with the cognitive flexibility test.

3 RESULTS

Overall, before any intervention, we compared the participants' cognitive flexibility of typical development and HFASD. Results shown in Table 1.

<table>
<thead>
<tr>
<th></th>
<th>HFASD</th>
<th>Typical Development</th>
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<tbody>
<tr>
<td>M</td>
<td>5.48</td>
<td>7.53</td>
</tr>
<tr>
<td>SD</td>
<td>3.03</td>
<td>3.72</td>
</tr>
<tr>
<td>Adj. M</td>
<td>4.77</td>
<td>8.92</td>
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</tbody>
</table>

Findings indicate that in the pre-intervention stage, children with HFASD presented a lower level of cognitive flexibility than children with typical development.

We also compared the cognitive flexibility of the two groups of HFASD children in both intervention groups pre-intervention. No difference was found ($F(1,27)=.78$, $p=.384$, $\eta^2=.0$)

Table 2 shows the results of the HFASD children pre- post-intervention.

<table>
<thead>
<tr>
<th></th>
<th>Computer-mediated intervention</th>
<th>Picture-mediated intervention</th>
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<tbody>
<tr>
<td>Pre</td>
<td>5.00</td>
<td>6.00</td>
</tr>
<tr>
<td>Post</td>
<td>6.00</td>
<td>5.00</td>
</tr>
<tr>
<td>Ws</td>
<td>54.00</td>
<td>2.50</td>
</tr>
<tr>
<td>Z</td>
<td>1.90*</td>
<td>0.52</td>
</tr>
</tbody>
</table>

*p<.05

As can be seen in Table 2, post-intervention children with HFASD presented a higher level of cognitive flexibility following the computer-mediated intervention compared to the picture-mediated intervention.

4 CONCLUSIONS

In conclusion, the study points to the advantage and effectiveness of using a computer-mediated intervention program, based on the CBT model, to promote cognitive flexibility in preschool age children with HFASD.

The results of this study may contribute to early intervention programs aimed at improving the cognitive functioning of children with ASD. To determine how these findings may be applied to new groups, and expand and develop the computer program, it is recommended to further examine the impact of the intervention.

REFERENCES


