COMPUTER MEDIATED INTERVENTION FOR INDIVIDUALS WITH AUTISM SPECTRUM DISORDER (ASD): A PILOT STUDY USING COMPUTER GAMES

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Abstract

Insistence of the child on sameness is a core feature of autism spectrum disorder. Structured computer programs help autistic children to overcome their over stimulation selectiveness through practice or sufficient experience. In recent years there is an increase of High-Tech Alternative and Augmentative Communication (AAC) devices. In order to use these devices efficiently an individual with autism must develop sufficient skills like pressing space bar or enter button, visual tracking, scrolling, making choices etc. These skills maybe taught and practiced with computer games. Nowadays computer games have become a tool to communicate, teach, and influence attitudes and behaviour. In this present investigation 3 (three) computer games were used to develop basic computer skills among individuals with autism over a six (6) month study period. It was observed that by using computer games most of the participants developed considerable computer operating skills. Even though the pace of learning differed among the participants it was apparent that all they enjoyed the computer mediated intervention sessions.

Keywords: Computer mediated intervention, ASD, AAC, computer games, ASWB

Introduction

Computers have a positive effect on the comparative performances of the autistic children in the domains of attention and other education methods [1]. Autism spectrum disorder (ASD) is a complex neurodevelopmental disorder characterized by persistent deficits in social communication and interaction and stereotyped behaviors, interests, and activities as

mentioned in DSM-5 [2]. Insistence of the child on sameness is a core feature of autism. In comparison to people, computers are tools that tend to provide for such kind of sameness. Computer mediated intervention provide consistency, regularity, usefulness and stimulates willingness without exertion of undue pressure and allows the children to control their learning process. Structured computer programs help autistic children to overcome their over stimulation selectiveness through practice or sufficient experience [3].

Computer-assisted instruction was an early application to support learning of individuals with Autism Spectrum Disorder (ASD) and other disabilities [4] and it continues to support a variety of learner outcomes such as academic skills [5] and social competence [6]. Children with ASD process visual information easier than auditory information. Every time assistive technology devices like computers, Smartphone and tablets are used with children with ASD, information is given through their strongest processing area i.e. visual area. Various types of technology from "low" tech to "high" tech when incorporated into every aspect of daily living can improve the functional capabilities of children with autism.

Computer games as a learning tool:

Computer games have become a tool to communicate, teach, and influence attitudes and behaviour. Numerous studies have suggested that these computer games have positive effects on problem solving, achievement as well as creating interest and commitment in learning [7, 8]. Contrary to conventional beliefs that playing video games is intellectually lazy and sedating, it turns out that playing these games promotes a wide range of cognitive skills [9]. A computer game offers players different forms of feedbacks, including visual, audio and tactile, which are revealed through computer / TV monitor and speaker.

Samuel L. Odom and co workers in 2015 published a comprehensive paper which was a review of the literature from 1990 to the end of 2013 which identified 30 studies that documented efficacy of different forms of technology and their impact on academics, adaptive behavior, challenging behavior, communication, independence, social competence, and vocational skills among adolescents with autism [10]. They concluded that 'technology has been used to provide models or prompts to engage in the behaviors being learned, to provide performance feedback or self-monitoring, to systematically teach skills or concepts through software presented on traditional desktop computers, and in one case to generate speech on iPod technology.'

AAC and ASD

The term Alternative and Augmentative Communication (AAC) describes any means of communication, aside from traditional speech, that allows someone to use language. This can include using pictures, gestures, sign language, visual aids, or speech-output devices like computers. Augmentative and alternative communication (AAC) provides a means of effective communication to individuals with autism spectrum disorder (ASD), many of whom are unable to use conventional speech effectively [11]. Augmentative and Alternative Communication (AAC) is any form of communication that people use if they are unable or unwilling to use standard forms of communication such as speech.. The children with autism who fail to develop sufficient means of communication for their basic needs are at particular risk of developing problem behaviors, limited academic learning, lack of job prospects, poor

social networks, and mental health problems as they move from childhood to adulthood [12, 13].

High-Tech Communication Devices:

In recent years there is AACs which are High-Tech Communication Devices. The more sophisticated communication devices are similar to tablet computers with touch-screens. The child can navigate through pages of icons that represent different things and will communicate different messages when pushed. These range from very easy to use for the child (one button on the screen) up through very complex. With the production of several high tech gadgets for AACs the intervention now needs to address both learning how to use these AAC systems, including the newer technologies of iPods[®] and iPads [14].

Objective of the study:

In recent years there is an increase of AACs which are High-Tech Communication Devices. In order to use these devices efficiently an individual with autism must develop sufficient skills like pressing space bar or enter button, visual tracking, scrolling, making choices etc. These skills maybe taught and practiced with computer games. Nowadays computer games have become a tool to communicate, teach, and influence attitudes and behaviour. Children with ASD find it hard to concentrate for a long period of time, but when they are visually engaged, as while playing a computer game, they are motivated and encouraged to excel.

Material and Methods

Participants: 10 (ten) individuals with moderate to severe autism.

 Age of the participants: age ranged from 5 – 12 years.

 Gender of the participants: 9 (nine) boys and 1 (one) girl

Duration of computer mediated intervention: 30 mins - 1 hour

Device used: Desktops and tablets at the Intervention unit of Autism Society West Bengal (ASWB)

Frequency of computer mediated intervention: Once a week with the special educator. Participants played the computer game at home as per their own need with support from family members.

Period of study: 6 (Six) months

Place of study: Computer-mediated Intervention unit at Autism Society West Bengal (ASWB)

Computer games:

The games that were used in this pilot project were from Shiny Learning (www.shinylearning.co.uk). Shiny Learning is an independent, family-orientated business established by Helen Melhuish in 2008. They sell educational, motivational, fun software designed to include learners with special needs. Shiny Learning online games are designed for learners with special needs, or anyone who uses assistive technology to access the

computer using devices such as switches, touch screens or mouse. There are several games which may be played for free.

Three free computer games were chosen for this pilot study as given in Table 1. The primary learning outcomes are also mentioned.

Sl. No.	Name of the computer game	Primary learning outcome
1	Fireworks	Player learns the use of Enter or space bar
2	Ballon Bang	Player learns the Use of pressing the Enter or space bar
3	Car Crusher	Player learns the use of Enter or space bar at regular intervals to achieve desired effect

Table 1. List of computer games used in this study

Brief description of the computer games used in the study

1. Game I: Fireworks

A switch, mouse, touch screen and keyboard accessible game. Players have to press the Space Bar, Enter or the Left Mouse Button to launch the rocket. There are options viz.:

- press and hold to watch the fireworks
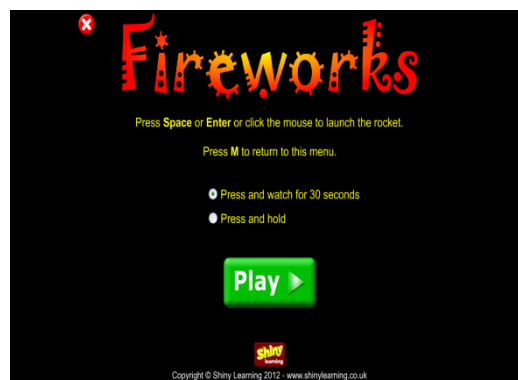- press and watch for 30 seconds
- Press M to return to the menu.

Fig. 1 Fireworks computer game

2. Game II: Balloon Bang -

This is a switch, mouse and keyboard accessible game. Players have to press the Space Bar, Enter or the Left Mouse Button to inflate the balloon. As the player presses the balloon grows larger till it bursts.

There are several options in order to:

- change the background colour
- change the balloon colour.
- The Space Bar and Enter will also activate the Play button within the game so switch users can play independently.
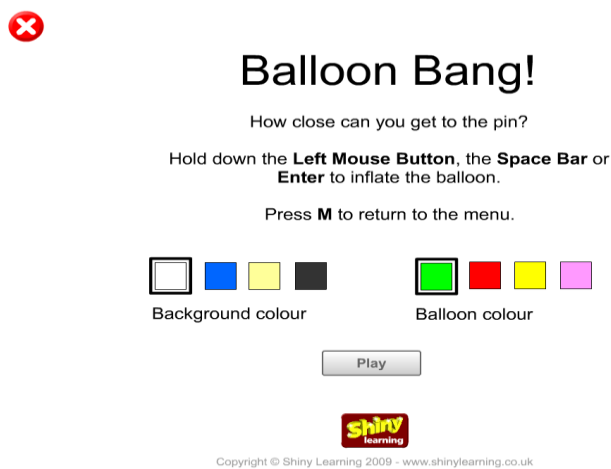- Press M to return to the menu

Fig 2. Balloon Bang Computer game with several options to change colour of the background and the Balloon

3. **Game III: Car Crusher**

A free switch, mouse, touch screen and keyboard accessible game.
Player has to press the Space Bar, Enter or the Left Mouse Button to crush the cars, crush them a second time them with hammers and drop them into a container.
Players could adjust how many times they could play the three step game before earning a reward, which is a picture of an AstroCar!

Several Options present:

- can choose a white, black or scenic background
- can choose the speed
- can turn the tool sounds on or off
- can choose clanking, music or no sound for the conveyor belts

- may choose the number of turns to be earned for the reward.
- The Space Bar and Enter will also activate the Play again button within the game so switch users can play independently.
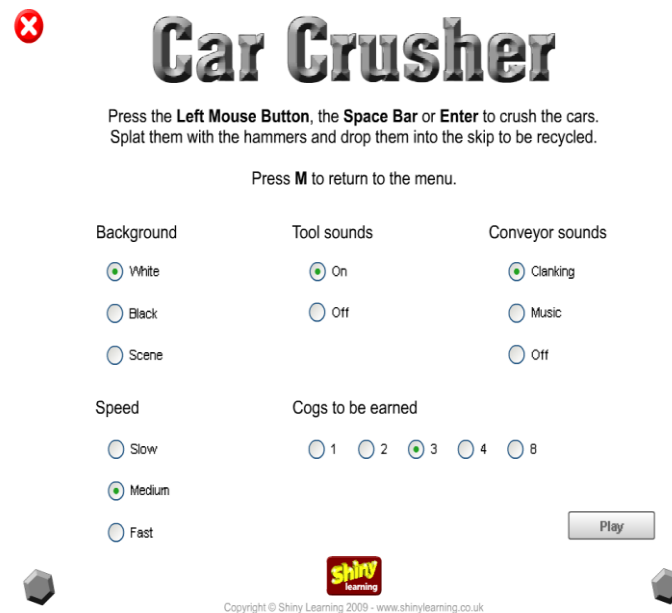- Can press M to return to the menu.

Fig. 3. Car Crusher computer game showing several options

Result and Discussion

The rising popularity of computer/video games has brought about an explosion of research on video game effects [15]. The increasingly large research literature on this topic consistently shows that video game effects are not trivial; significant effects of video game play are found in short-term and long-term contexts, and across a wide range of domains [16]. Computer games can foster motivation among the players by engaging even more deeply the player with the game apart from enhancing certain motor skills [17].

### 1. Computer game 'Fireworks'

The computer game 'Fireworks' allowed the individual with autism understand the utility of pressing the space bar or Enter button. Only one tap on either the Enter button or Space bar started the computer game. The firecracker rocket flew up and burst in a display of lights (Fig 4). The player had the opportunity of watching the display of fireworks for 30 seconds. This computer game allows the player to develop skills for using the space bar and/or enter button. The 30 seconds firework display help in improving attention span and concentration.

Fig 4. Game: Fireworks. The cause and Effect of pressing the either the Enter or Space Bar

2. Computer Game: 'Balloon Bang'

In this game the player learns the skill of pressing the enter button and/or space bar repeatedly. As the player presses the button the balloon grows bigger till it gets pricked with the needle among which it bursts with appropriate sound effects. The different stages are shown below (Fig. 5a-d). The player learns to associate the use of the enter button to increase the balloon size. There are options by which the colour of the balloon and background maybe changed (Fig. 6). So with time the player will know colour concepts and the power of choice making. Sound effects with this computer game attract those individuals who like sound effects.

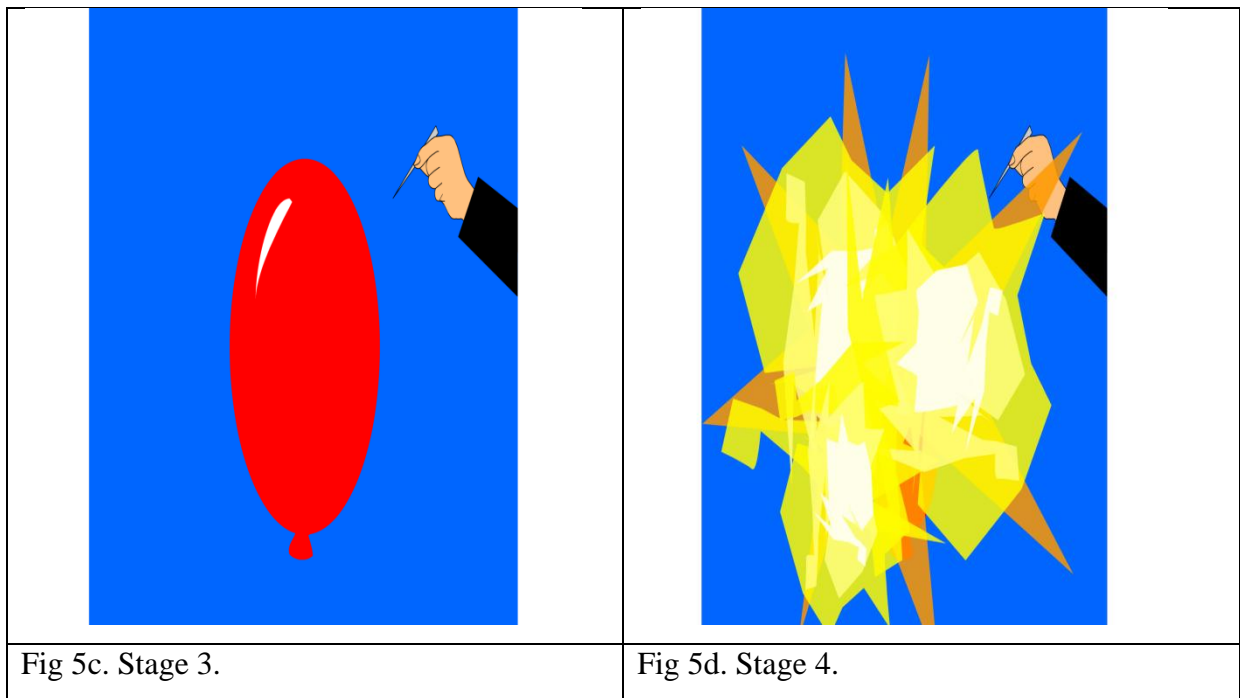| Fig 5a. Stage 1. | Fig 5b.Stage 2. |

| Fig 5c. Stage 3. | Fig 5d. Stage 4. |
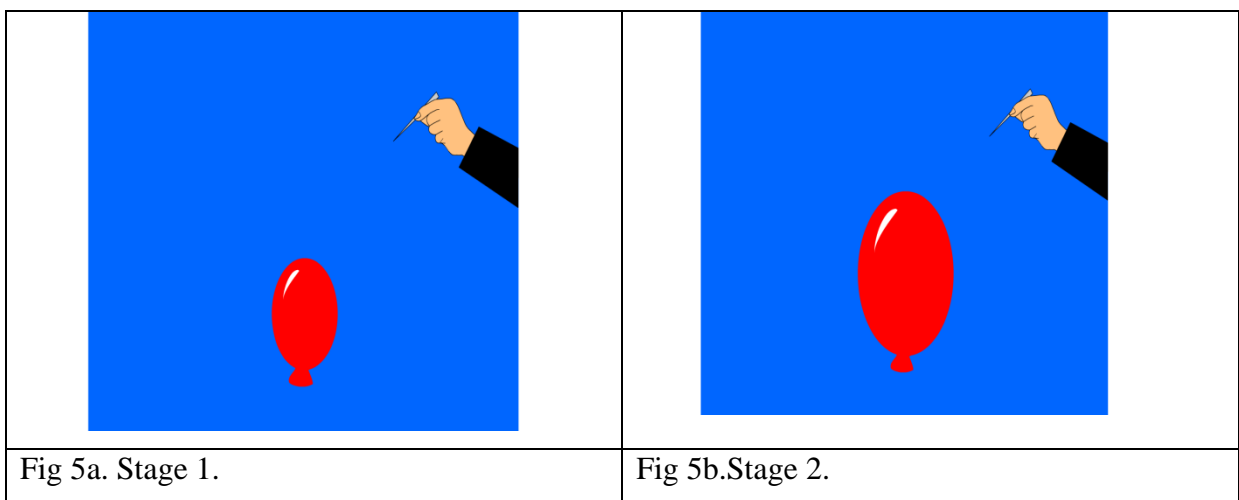
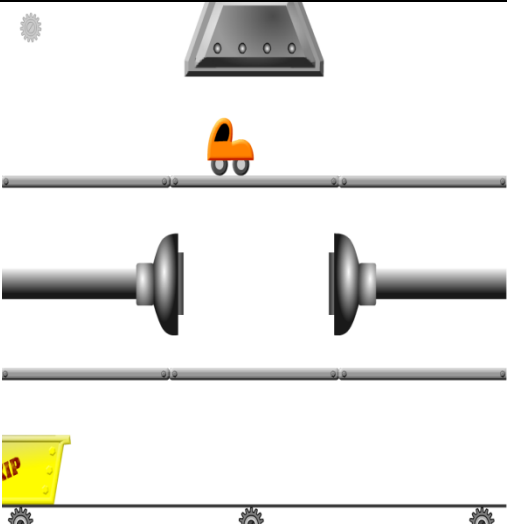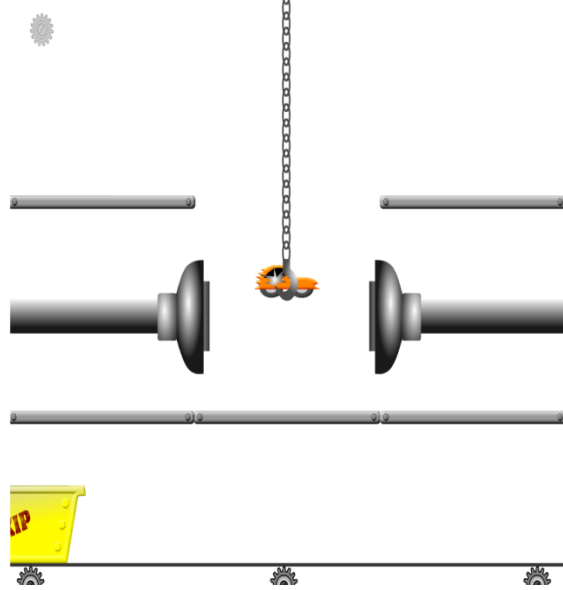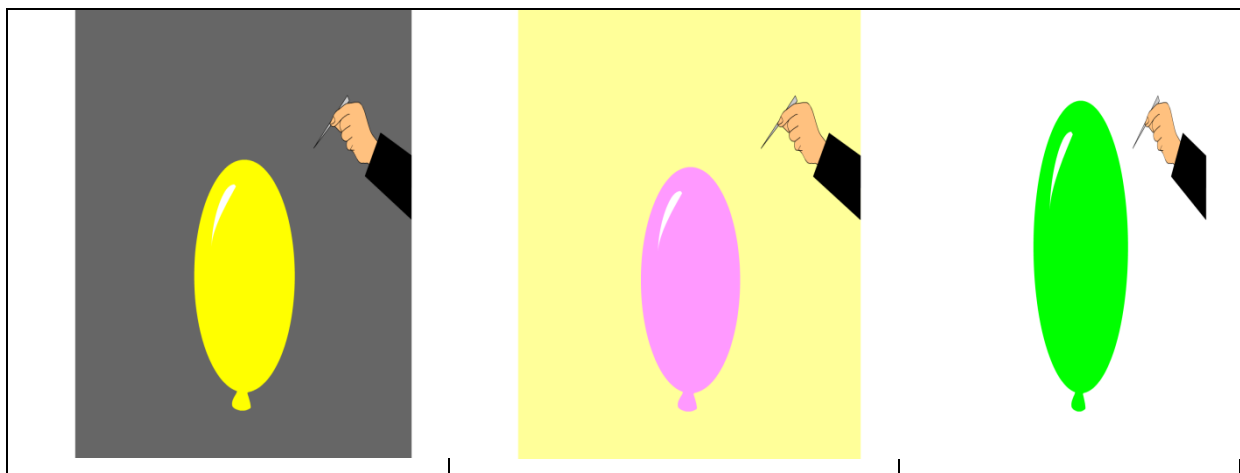Fig 5a-d. Game: Balloon Bang. Different stages of the game

Fig 6. Examples of changing colour of balloon and background during the game Balloon Bang

3. Computer game: 'Car Crusher'

For playing this computer game efficiently the player has to rely on his/her eye hand coordination. Visual tracking is also necessary to play this game. Once the player masters these skills they are also introduced to the concept of reward at the end of the game. There are three stages per turn (Fig. 7). The number of successful turns can be controlled. This game helps in increasing the attention span of the player.

Different stages of the game 'Car Crusher'	Desired outcome

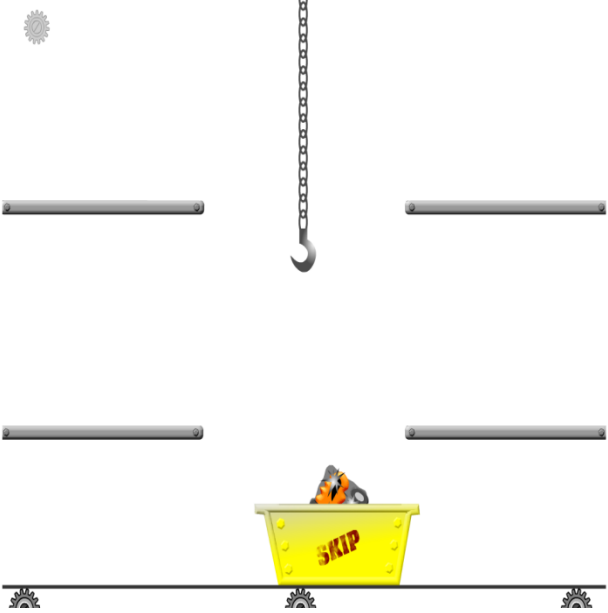| Stage 1.	Stage 1.
	The player has to visually track the movement of the car to press the Enter or Space bar in order to crush the car. Eye hand coordination and visual tracking skills developed.
Stage 2.	Stage 2.
	The player has to wait for the exact moment when the crushed car is in between the hammers before hitting the Enter or Space bar. Develops anticipation and observation skills along with eye hand coordination.
Stage 3.	Stage 3.

	In order to collect the twice crushed car the player will have wait for the precise moment when hitting the required buttons will allow for collection of the crushed car.
Stage 4.	**Stage 4.**
	The reward at the end of the game, an Astro-Car. The number of correct turns needed to view the reward may be set prior to playing the game.

Fig.7. Different stages of the computer game 'Car Crusher' with the desired outcomes,

It must be noted that during the initial months the special educator had to teach step using physical prompts. Later the prompts became verbal, then gestural as the participant developed their skills at each stage. It was noted that all participants responded to the computer mediated intervention with varying pace. The games are designed in such a way that players cannot make errors. There was significant difference among the 10 participants with respect to developing skills. Even after 6 month intervention period the participants are at different levels.

As this intervention is a computer game the participants look forward to the sessions. They develop the skills while playing. These computer games are of the 'Cause and Effect Play' genre. This type of play teaches children that their actions have effects and gives them a sense of control in their play. Once they master these skills it becomes easier for them to use AAC devices, both high tech as well as low tech. They gain more confidence on their fingers and eyes. Scrolling, scanning, choosing on the AAC becomes easier.

More studies are needed to establish this relationship. Teresa Iacono, David Trembath, Shane Erickson have mentioned in their research paper in 2016 that any attempt to evaluate the role of AAC for children with autism and identify future avenues for its efficacious application requires consideration of research from across both AAC and autism fields [18].

Observed differences in play and joint attention skills among children with autism and neurotypical kids are well documented, and recent efforts to teach these skills have yielded positive results [19, 20]. Other complex aspects of play maybe taught using other computer games. It was observed that by using computer games most of the participants developed considerable computer operating skills. Even though the pace of learning differed among the participants it was apparent that all they enjoyed the computer mediated intervention sessions. Participants who played the computer game at home fared better. So consistency is the key to building up these skills.

Conclusion:

Play is an important part of one's life. Yet many individuals with autism have difficulties in playing. Many are restricted to solitary play too. Limited communication is also frustrating for these individuals. The AACs are a boon for communication. But using the AAC, especially the high tech one requires some basic skills. Computer mediated intervention helps the individuals with ASD develop these skills and builds up their confidence levels. When the intervention is by using computer games the result is better. If the individual with autism plays the game regularly he/she hones her skills. Play gives a sense of joy so the individual with autism is happy too.

Conflicts of Interest

The authors declare that there are no conflicts of interest regarding the publication of this work.

Acknowledgement

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