A Review of Interventions to Support the Development of Social Cognition in Children with Autism

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***Abstract*—Autism Spectrum Disorder (ASD) is prevalent in the child population, and is a serious lifelong disease. Social cognition is the main impairment of this group of individuals and this deficit appears very early on in autistic children. To deal with this, tremendous improvements have been made in the treatment of autistic children in recent years, particularly with respect to psychological interventions. The paper analysed the effectiveness of the Transporters, Mind Reading, the Early Intervention Theory and other support interventions, and proposed the implications of these interventions in the areas of educational placements, pedagogic strategies and additional supports. The author aims to attract more attention to the area.**

***Index Terms*—autism spectrum disorder, social cognition, intervention, educational placements, pedagogic strategies, additional supports**

I. Introduction

A. General Information on Autism

As universally acknowledged, the American Leo Kanner was the first one to describe "Autism" in 1943 [1]. He described the details and some features of "early infantile autism" in his paper; the features included: inability to form relationships with others, slow in language acquisition, unable to communicate in spoken language, impairment of echolalia, confusion with pronouns, repeat the same activity, maintain daily lives, good at rote memory and have normal physical appearance [2].

B. Difficulties Children with Autism Have in Social Cognition

From infancy, normally developed children can send emotional signals and understand emotions sent by others as well. By contrast, impairment in emotion recognition is a main feature of children with autism. Hobson designed an experiment and found that autistic children made more mistakes when choosing faces to match videotapes which showed emotional gestures [3]; in Langdell's experiment [4], autistic children were stimulated to show emotions such as "happy" and "sad", but the experimental result was that these children could not distinguish what a happy or sad face looks like. After a few years, Frith suggested that the reason why children with autism find it difficult to figure out emotions is because they are limited in recognising mental states in themselves and other people. Many other experiments and theories support the idea that children with autism have a delay in emotion recognition.

Apart from emotion recognition, children with autism also have difficulties in the Theory of Mind, which means they can neither impute beliefs to other people, nor predict others' behaviour [5]. The Theory of Mind introduced by Premack and Woodruff in 1978, is an innate cognitive module which developed from very early childhood of non-autistic individuals [6]. However, whether the children with autism have this cognition was not tested until 1985. In the experiment by Baron-Cohen et al. they found that 80% of children with autism failed the Belief Question which was significantly different to other groups; all autistic children failed to point to the position of the marble; autistic children answered questions in a different way from non-autistic children and the children with Down's syndrome. The experimental results revealed that the children with autism cannot employ the Theory of Mind, they failed to "impute beliefs to others and are thus at a great disadvantage when having to predict the behaviour of other people". In the following years, there were many more experiments and theories which further the development of the Theory of Mind: in the Enactive Mind, Klin et al. suggested that the mind of the children with autism "is not fully attuned with the social world", and in the Empathizing-systemizing Theory, Baron-Cohen et al. proved that autistic children have impairments in empathising but higher ability in systemising than their peers [6].

All features should be prevalent before autistic children reach three years old, so that analysis of the interventions in childhood is more effective. For a long time, theories and experiments were built to test what problems autistic children faced in social cognition. However, though some autistic children can improve their social cognition and abilities after diagnosis, interventions and special education, for current medical standards, autism cannot be radically cured.

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All of these theories are helpful in understanding the features of autistic children, as well as figuring out their difficulties in emotion recognition, empathy and the Theory of Mind. In summary, all of these cognitive models are under the branch of social cognition. Only after these difficulties were proved, can interventions to help the autistic children to develop their social cognition be undertaken, though some of them are effective and others are disputable.

C. Structure of This Paper

There are five parts to this paper: it starts with a general introduction to autism theories and what difficulties autistic children have in social cognition, then the review themes and results will be discussed. Several experiments which tested the effectiveness of The Transporters, Mind Reading, the Early Intervention Theory and other support interventions will be analysed. After that, the educational implications of these interventions will be included by three aspects, namely, implications to educational placements, pedagogic strategies and additional supports. The conclusion is reached that more experiments should be made to develop more interventions which help the development of social cognition in autistic children.

II. Review Themes

Studies in this review are based on four criteria. Each intervention: (a) included children aged under 13 years with autism as participants; (b) is a theory-based experiment; (c) was published and developed recently; and (d) was either school-based or home-based.

Based on different theories and under the different classifications, transversal comparison seems incomparable and puzzling, as a result the review results will be itemised as (a) The Transporters; (b) Mind Reading; (c) Early Intervention and (d) other interventions. There are several literature items related to each of them, and their experimental processes, interventional effectiveness, existing problems, etc. will be critically analysed.

III. Results

A. The Transporters

In 2009, Golan and his colleagues designed an experiment to test the effectiveness of The Transporters. The Transporters is a 3D animation series created specifically for children with autism, in order to enhance their understanding and recognition of emotions [7]. The series consisted of several episodes and in each of them there is a key emotion or mental state. It obeys the hyper-systemising theory, and aims to create an autism-friendly method in order to teach facial expression and mental states in an easier way for autistic children. Some small quizzes are available in each episode; children can be required to finish tasks such as matching faces to faces, matching faces to emotions, matching situations to faces, etc. Golan's study evaluated whether The Transporters DVD can improve emotion recognition and contextual understanding of emotions and mind states in autistic children between four and seven years old.

One intervention group and two control groups were created. They tested before and after the four-week period and in each test the participants were evaluated in four levels of generalisation including their emotional vocabulary and ability to match a socio-emotional situation to facial expression. During the time, the intervention group watched the DVD every day supported by children's parents; there were two control groups, one consisted of autistic children and another is typically a developing group without any interventions. The experiment showed that the autistic groups were worse in emotion recognition than the typical group initially, while three groups performed better after the period, the intervention group experienced the most significant improvement.

Even though The Transporters DVDs have been prevalently applied in world markets, both pros and cons exist in the software and Golan's experiments should be critically considered. First, all the intervention children and control children were selected from mainstream schools which guarantee similar participants, but the intervention was taking place at home and it is risky that the experimental environments cannot be controlled. Second, the characters in The Transporters are vehicles rather than human beings. On one hand, these cars readily draw the attention of young children, so they children can learn emotions from playing but on the other hand, these vehicles do not represent real human facial emotions, so that the autistic children might be familiar to vehicles' emotions but find it difficult to translate this recognition to real people. Third, the intervention group in the experiment received support from parents who contribute to the children's learning but this makes it hard to establish whether the success was down to parents or the DVDs, so Golan advised at the end of their own experiment that there should be further exploration about the contribution of Transporters and from parental involvement [7]. Fourth, the experiment has shown that during the experimental time the result was optimistic, however, we have no idea and no demonstration shows that whether the result would be sustained after the intervention stops. As ASD cannot be cured, the intervention can only guarantee the promotion of emotion recognition during the period. Thus, parents or caregivers should take more action after intervention. Finally, the vehicles in The Transporters have real faces, the emotions are repeated many times and the narrator keeps talking about characters aiming to draw children's attention to the faces. In all of these ways, children are encouraged to look at faces more frequently than in the non-intervention condition and their attention is drawn to the whole faces of the vehicles rather than anywhere else by the narrator's guide.

In summary, Golan et al. showed that The Transporters significantly helped the emotion and mental state recognition in 4–7 year-old autistic children over the four weeks. The experiment proved The Transporter is

successful.

In the same year, Baron-Cohen, Golan and Ashwin supported the experiment of Golan et al.; they believed The Transporter improves emotion comprehension and recognition skills of autistic children [8]. Their reasons are obvious: firstly, this intervention facilitates generalisation because motivational media has been used – participants enjoy the videos, they would like to learn emotion from real faces and interesting quizzes; secondly, they considered the use of systemising as a method for these children to learn empathy while recognising emotions. Baron-Cohen et al. advised building special classrooms for the interventions in order to ensure the intervention results. As expressed before, my opinion is in keeping with them in this issue; the steady and mutual environment must increase the effectiveness of the intervention.

B. Mind Reading

Designed by Baron-Cohen and his colleagues in 2004, Mind Reading is software for the special needs of individuals with autism, who have defects in emotion recognition in others. Autistic people can learn emotions and mental states from video clips and vocal expressions from audio records. It covers 412 emotions and mental human states, each emotion can be seen and heard by six different people. It is considered a "rich and systematically organized set of educational material" [8], [9].

The inventors (Baron-Cohen and his colleagues) designed two experiments in 2006, aiming to evaluate the effectiveness of Mind Reading. Experiment 1 tested for improvement in autistic individuals in emotion recognition after using Mind Reading independently, the result showed that the intervention improves the close generalisation but not distant generalisation tasks; experiment 2 as designed for the same intervention group and control groups but the interventional children received help from a tutor. They attended group discussion and other cooperative activities as well as watching the videos. This experiment aimed to consolidate their emotion recognition and improve generalisation [9]. In experiment 1, when compared Mind Reading intervention to no intervention ones, intervention group users improved their abilities after 10–15 weeks' interventions, and they also improved on close generalisation measures, though there was no significant improvement on distant generalisation; the results of the experiment showed that autistic children learn recognition skills from both faces and voices from Mind Reading. The experimental result supported Baron-Cohen's previous, and the experimenters suggested the more participants join, the more they get from the distant generalisation tasks. Furthermore, they also advised that a longer intervention period might improve generalisation. At the same time, Baron-Cohen admitted the shortcomings of the experiment. Firstly, the experiment was a "limited short-term intervention"; and secondly, the children's awareness of faces and voices "was not sufficient to cause an improvement on voices". Therefore, we can conclude that more long-term intervention should be used and the emotion recognition and empathy are easier learnt by sight than voice. In terms of experiment 2, the result confirmed the effectiveness of home-based Mind Reading intervention compared to the effect of group activities. The second experiment also suggested that longer application of Mind Reading is helpful for improving generalisation but "caution should be used when interpreting these results due to the small group size". However, as listed after the intervention, there are several problems that should be noted: first, more studies should be taken to evaluate Mind Reading in lower-functioning autistic children; second, receiving different number of hours in different groups might have accounted for the improvement differences; last, operators should be more careful in time and curriculum control, and the more participants, the clearer the generalisation.

In 2007, Baron-Cohen et al. continued a follow-up experiment and they found that those autistic children have progressed in the awareness, expression, understanding and corresponding of emotions. It showed that Mind Reading has long-term functions, though in 2006 they only proved that the intervention was short term, and empathy can be taught to autistic individuals. After achieving successes in the experiments, Baron-Cohen *et al*. [8] thought that Mind Reading offered a simplified context and without disturbing real society, it was easier to operate and without interruption. Baron-Cohen *et al*. admitted that both advantages and disadvantages exist when they reviewed their experiment in 2009. In terms of merits, Mind Reading is a computer-based intervention which means participants can control their times and speed of watching videos and audios, it is beneficial for their memorising. Moreover, in Mind Reading six people act in each emotion and it is helpful for autistic children to recognise and adapt to the real situations. In addition, emotions are assigned by clear labels, including some insincere emotion expressions, because in reality some insincere emotions appear, with this method autistic children can initially identify complicated emotions and lay the groundwork for real communication. Finally, the software contains a "pre-designed classification system" to help users to find out "inherently unpatterned emotional information" in the real society. In terms of drawbacks, Baron-Cohen and his colleagues admitted that this intervention has difficulties in generalisation; besides, Mind Reading applies explicit interventional methods so that the experiment has a "lack of intrinsic motivation".

When evaluating the effectiveness of The Transporters, Golan *et al.* [8] concluded that Mind Reading is a valid software package for the special needs of autistic children who have difficulties in social emotion; it is helpful for them to learn to recognise emotions and mental states from facial and vocal expressions. However, whilst Mind Reading provides a systematic approach to autistic individuals to recognise emotion expression in faces and voices, these expressions are not set in the same context as The Transporters. In this way, children's interest might be less, along with their initiative in learning.

C. Early Intensive Behavioural Intervention (EIBI)

The Early Intensive Behavioural Intervention is based on the principles of Applied Behaviour Analysis. It combines the appropriate behaviour with positive results in order to getting intrinsic motivation. In this intervention, recognition skills of autistic children can be taught and evaluated by small steps and finally several techniques such as "modelling", "shaping" and "prompting" are applied in the interventions [10].

Lovaas *et al.* designed an experiment to test the effectiveness of EIBI in 1987. They set up a two-year intervention for a treatment group and compared the result to the control group. The experiment showed that the 7-year-old autistic children got outstanding IQ gains and the 9-year-olds they can be moved to mainstream school; their recognition of society is similar to the typical development children. However, following studies have showed the drawbacks of this experiment: the social interaction measures and the measurement of families' effects are not enough, further, whether the intervention can be practised in a "non-university-affiliated site" cannot be proved [10].

In 2005, Sallows and Graupner [11] designed an experiment in which the results were consistent with those proved by Lovaas *et al*. Twenty-four autistic children were randomly selected from a group and the parameters of the EIBI developed at UCLA were copied; another group received interventions but without professional supervisors. After the intervention, 48% of autistic children achieved average IQ scores; they also demonstrated average social abilities and social recognition. The result showed that EIBI could be operated in a "clinical setting outside a university with a similar sample". However, the experimenters admitted to several drawbacks: the pre-test and post-test were done by the second author, which might be guided by subjective perspectives; the samples were not equal enough and the number of the samples was limited. They suggested that more parental involvement and more recognition of parents' opinions might be helpful to the effects, furthermore, more supervised play time might benefit autistic children's development of social skills and social recognition.

In 2010, O'Connor and Healy [12] supported the former experiments about EIBI and tested the long-term post-intensive behavioural intervention outcomes for autistic children. This study showed that those autistic children who received EIBI obtained a increased long-time average IQ levels as well as emotional and behavioural abilities. The experiment highlighted the significance of continuing comprehensive intervention for autistic children, as well as additional services. Limitations of this study are: the data was collected by case studies therefore it faces the generalisation issue; and small sample size (only five autistic children) reducing statistical power. Generally speaking, the study is effective since it proved long-term outcomes in IQs level, social recognition and social skills of children with autism who received EIBI.

In 2010, Itzchak and Zachor [13] explored the autistic children's outcomes in adaptive skills and acquisition of cognitive gains after EIBI. All the results of this experiment supported and furthered the effectiveness of EIBI for autistic children.

In summary, many experiments and studies have supported the effectiveness of Early Intensive Behavioural Intervention, even though more attention should be paid to parental roles in this intervention since parents are significant in this intervention. No one can deny that, generally speaking, the EIBI is a valid intervention for IQ gain, and improved social skills and social cognition of children with autism.

D. Other Interventions

The above interventions are examples among the hundreds of interventions to support development of children with autism, especially in their social cognition area. The National Autistic Society [14] sorted the interventions as following: the Behavioural Interventions, methods that alter autistic children's behaviour. The Applied Behavioural Analysis and the Lovaas method are outstanding examples; the Complementary Therapies, which absorb assist from animals; the Diet and Supplement Interventions, which applies vitamins and other diets to help children with autism; the Medical Interventions, based on medical treatments for autistic children; the Physiological Interventions, changing the mechanical, biochemical and physical effects on autistic bodies, Auditory Integration Training is an example of these interventions; the Relationship-based Interventions are those which increase the attachment and the sense of relationships; the Service-based Interventions offer education and parental support services to children with autism; the Skill-based Interventions mean developing and supporting specific skills for autistic individuals, these assist systems include facilitated communication, Makaton, Picture symbol, Social Stories and Comic Strip Conversations; the Standard Therapies are used by the majority of healthcare centres, they provide counselling, music therapy, speech and language therapy to patients; Technology is the last group, applied with computers and carried out at homes. Trevarthen *et al.* [15] claimed that these interventions are classified in another way but whichever the classification is, the various interventions for supporting autistic children in terms of their social cognition have both their own effectiveness and imperfections.

IV. Educational Implications

A. Educational Placement

It is not easy to say where the best place for intervention is. As many interventions are either home-based or school-based, both families and educational institutions are effective and defective. In terms of home-based interventions, since some interventions such as EIBI, social stories, etc require parents' support, homes seem like the right educational place for autistic children, however, this presents more challenges. For instance, home-based interventions lack professional tutors so the efficiency of interventions

might vary from case to case. Besides, a systematic curriculum operated in distant education is not consummate yet, hence home-based intervention faces many difficulties.

In current studies, there are more school-based interventions rather than home-based. However, there is no consensus on whether studying in specialist schools for children with autism or studying in mainstream schools is better for these children. Some children need highly specialised autistic provision whereas others need stimulation from mainstream schools, thus the individual needs vary widely [16]. On one hand in autistic schools the specialist knowledge and expertise of the professors offers a high-quality curriculum, but on the other hand, their limited teaching facilities might hinder the teaching processes, besides, it is better to teach social recognition in a real social environment and the autistic children need social interaction with non-autistic people since this helps with recognition in society. Obviously, the special schools find it difficult to fulfil this task. In mainstream schools, the autistic children can interact with non-autistic peers so that they learn social cognition and social skills more quickly; they have a chance to use various equipment and experience normal education which are beneficial to their social recognition. However, on the other hand, studying in mainstream schools might bring discrimination issues. It would result in more severe symptoms for autistic children. Furthermore, the autistic children might be ignored by teachers since they look similar to others in appearance, and finally mainstream school teachers might be less willing to apply unusual teaching strategies to the autistic children [16], so the intervention result would be impaired.

In summary, Howlin [16] considered that much needs to be done and it should be continually done to improve the educational placement for autistic children. The most significant thing is not to figure out which is the best place for these children, but to build a more perfect educational system which meets their requirements in society recognition, emotion and education.

B. Pedagogic Strategies

It is apparent that many teaching methods are available for teaching children with autism, involving segregation, integration and other mixed methods [16]. Howlin thought that putting autistic children among non-autistic children cannot automatically result in cognition improvements so additional supports from teachers are needed, so teachers should receive special training in pedagogic methods so that they are helpful in providing an optimum environment. Howlin also suggested that teachers need patience and understanding so that they acknowledge and deal with the special needs of children with autism; teachers also should develop their own pedagogic strategies to adapt to those children's development and patterns; finally, equal emphasis should be giving in order to meet both non-autistic students and autistic students' social and emotional requirement. For the whole educational period, it is better to receive interventions before secondary school age.

C. Additional Support Needs

After choosing a certain educational institution and considering pedagogic strategies, the school has an obligation to offer additional support to children with autism. They should work on increasing teachers' knowledge of autism, organising the teaching curriculum, facilities and materials; they should overcome the problems of understanding, avoid undue pressure and make use of additional resources. Finally, schools have responsibilities to build a "parent–teacher co-operation" [16]. No matter how effective each educational placement is, if the teachers and parents work together and further the advantages of both of them, the home–school educational environment must be better for supporting the development of children with autism.

V. Conclusion

In summary, even though autism cannot be totally cured, there are many interventions which are developed to reduce the symptoms in children. As social cognition is a central deficiency of autistic children, interventions are numerous and followed by many experiments to test their feasibility. In this paper, only the experiments of The Transporters, Mind Reading, and the Early Intensive Behavioural Intervention are critically analysed in detail because of words limitations. There is potential for operating more interventions in order to support the development of social cognition in children with autism. In terms of the educational implications, educational placement should be considered carefully for autistic children; teachers should make sure that their pedagogic methods are helpful for giving an optimum environment; further, school and educational institutions should offer additional supports to interventions.

In future studies, researchers should apply themselves to decreasing the indications during the interventions; more effective methods should be researched and developed, so that there are more ways to support the development of social cognition of children with autism. This paper aims to conclude and analyse the existing interventions and raise more attention and consideration for further experiments.

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