

# ***Mindfulness Training for Children with Autism Spectrum Disorder in Cognitive Flexibility***

**Yiheng Dai<sup>1,a,\*</sup>**

*<sup>1</sup>Faculty of Special Education, Central China Normal University, Luoyu Street, Wuhan, China  
a. eswiftmuh85193@student.napavalley.edu*

*\*corresponding author*

**Abstract:** Autism Spectrum Disorder(ASD) is highly prevalent worldwide, and so far incurable, as one of its main symptoms is rigidity in behavior and mind. Cognitive flexibility is considered to be highly relevant to ASD. ASD afflicts individuals and their families severely, which can cause a broad range of social problems. For its incurable nature, alleviating its symptoms or discovering its cures is highly significant. The pathogenic factors of ASD are complex, and the inner differences among individuals with ASD vary a lot. ASD require individualized long-term intervention, including education and rehabilitation training based on wholesome assessments of an individual's psychological development, behavior, demand, and adaptive social capability. An extensive range of interventions is researched and implemented practically. However, the inherent flaws of these interventions are so far unsolved. In this article, mindfulness is discussed as a new intervention to gain a deeper insight into mindfulness's effects on the cognitive flexibility of ASD children. Previous articles are reviewed, and though a relationship between mindfulness and cognitive flexibility in ASD is complex and indirect, the conclusion that mindfulness train is beneficial to the cognitive flexibility of ASD children is drawn eventually. Relevant research directions are recommended according to the conclusion.

**Keywords:** autism spectrum disorder, cognitive flexibility, mindfulness

## **1. Introduction**

Autism Spectrum disorder (ASD) is a kind of disorder that disturbs a family severely when it occurs in children. Also, with a rapidly growing prevalence rate, it draws much attention widely. Rigid behavior and mind are typical syndromes, considered to hold great relevance with cognitive flexibility in previous research as there is no efficient way to cure ASD children. At the same time, mindfulness training effectively improves Rehabilitation education, and training has always been the main intervention method for ASD. Currently, various correction methods are mixed, and evaluating their effectiveness has always been controversial. These methods cannot truly "cure" ASD. Most aim to improve children's symptoms to the greatest extent possible and maximize their potential while helping children with ASD and their families cope with the disease more effectively. In this context, this research is conducted to review a wide range of articles before and after the research that quests about the relevance between cognitive flexibility and rigidity, to gain further insight into the mindfulness training on cognitive flexibility of individuals with ASD furthermore challenge the incurable nature of ASD.

## 2. Literature Review

### 2.1. Definition of ASD

The current definition of Autism Spectrum disorder (ASD) includes those who have social community problems and fixed interest, and restrictive and repetitive behaviour. ASD includes autistic disorder, high functioning autism (HFA), Asperger syndrome and pervasive developmental disorder not otherwise specified (PDD-NOS). Despite the improvement in diagnostic accuracy and another factor, the prevalence of ASD is rising [1]. ASD not only presents a challenge to the individual but also represents a global medical and socioeconomic challenge. Repetitive behaviour Though the causes of ASD is various, genetic factors mainly cause ASD. Could Psychologically, various kinds of development difficulties, including difficulties with emotional understanding and regulation [2], theory of mind and social cognition, executive functioning, weak central coherence, and delayed expressive language development. Children with Autism Spectrum Disorder may exhibit perseveration, characterised by difficulty stopping a task or continuously repeating the same pattern without considering alternative approaches. This behavior is not necessarily observed in all aspects of their lives. Still, it tends to occur more frequently in activities that require making alternative decisions, ultimately impairing their adaptive abilities. These difficulties torment individuals with ASD lifelong, though for some of them, some symptoms alleviate gradually, more or fewer impairments span over life. The author employs ASD to refer to these disorders collectively. Clinically, pervasive cognitive and behavioural rigidity in functional domains is the diagnostic criteria [3].

### 2.2. Limitation of the Existing Intervention

The most frequent and considered most effective intervention is Applied Behaviour Analysis (ABA), according to evidence-base-practice principle, initially applied in epidemiology and is widely accepted in early-age intervention for children with disability nowadays. These 33 intervention theories and methods can be categorized into four types. The first type, science-based practices, proved effective through well-controlled science experiment and practical research, including ABA, discrete trial teaching, etc.; the second type is proven to be effective to some degree but lacks a certain amount of experiment or practical, which is called a more promising practices, such as game-oriented strategies, Teaching, Expanding, Appreciating, Collaborating, Holistic (TEACCH) structured education, picture exchange communication system, social story method, cognitive-behavioural therapy, and sensory integration therapy, etc.; the third type is practices that are effective in some level or proven to be effective in only several individual's cases, which means these practices require further validation, floor time teaching, auditory integration training, and various food therapies can be categorized into this type; the fourth category is not recommended practices, including holding therapy and facilitated communication methods, etc." Due to limited space, this article mainly focuses on ABA, TEACCH program and game therapy.

Individuals with ASD can experience significant improvement in their social interaction through behavioural interventions, mainly through ABA, which has been shown to be more effective than educational interventions in addressing the core symptoms of ASD. However, while ABA can lead to significant behavioural changes, some studies suggest that these changes may only be temporary and not sustainable in the long term. This may be because ABA does not address the cognitive aspects of ASD.

The TEACCH program, developed in the 1970s by Schopler and colleagues in North Carolina, USA, is a widely used educational and treatment approach for ASD. It emphasizes the understanding and compliance of ASD children with the educational and training content and is

centred around structure and individualization. Structuring the physical environment, schedule, and organizational aspects of work and study helps to provide predictability and avoid discomfort from sensory sensitivity. However, no research currently provides evidence of the overall effectiveness of the TEACCH model, and it neglects social skills training. Moreover, the program's high structure level may increase rigid behavior in ASD children and reduce their social interests.

Game therapy holds the inherent advantage as the game is a natural language that children use to communicate, and it is their primary activity during childhood. Children can explore, learn, and understand themselves and the world around them by playing with toys and games, expressing their experiences, feelings, expectations, needs, and desires. This process allows children to utilize their inner resources, strengths, and potentials, leading to personal growth, improved self-regulation, and motivation to achieve their potential. However, the mechanisms of game therapy for children with ASD have not been scientifically revealed, and the related research is not comprehensive. Additionally, game therapy may pose challenges for children with ASD who lack interest in toys or sand.

### 2.3. Cognitive Flexibility in ASD Children

So far, theory suggests that ASD symptom, primarily cognitive and behavioral rigidity, result from impaired executive functions [4]. One executive functions is cognitive flexibility, which refers to the ability to shift thought and behave appropriately according to the environment [5].

Cognitive flexibility is the capacity to adapt efficiently to changes in the environment by modifying our thinking processes. This ability is usually evaluated through tasks like the Trail Making Test, where individuals must respond to numbers and respond to letters alternatively, or the Wisconsin Card Sorting Task, which requires the ability to receive feedback from the experimenter and adapt strategy accordingly [6]. Cognitive flexibility is an essential ability that allows us to adapt to changing situations, think creatively, and solve complex problems. The ability to shift cognitive sets quickly and efficiently is crucial for success in various domains of life.

Cognitive flexibility is the ability to adapt our thoughts and behaviours according to the demands of a particular situation, which is critical for learning and problem-solving. Individuals with solid cognitive flexibility can easily adjust to changes, move between activities, consider different perspectives, and find multiple solutions to a single problem. However, children with Autism Spectrum Disorder (ASD) often struggle with cognitive flexibility. They may find it difficult to tolerate changes and transitions and have challenges adjusting their thinking and behaviour to suit new situations. This lack of cognitive flexibility can create obstacles in their lives, including learning and social interactions. Also, in academics, limited learning range and depth could be caused by impaired cognitive flexibility.

Though the difficulty in clearly demonstrating the inner relation between cognitive flexibility and rigidity in behaviour has been proven, none of the other theories offers a plausible explanation of the rigidity in behaviour. Furthermore, some studies successfully correlate task performance regarding cognitive flexibility and ASD characteristics [7]. Willcutt demonstrated in their meta-analysis that the difference in 'cognitive flexibility' between individuals with ASD and average individuals is less significant than the inner difference among the ASD population itself, which is supported by Recent studies that reveal deficits in cognitive flexibility covering various autism subtypes, ages and cognitive levels [8].

Some potential links between ASD symptoms and cognitive flexibility are shown daily; for example, some children with ASD keep sucking their hands despite the surrounding environment. Many of the relationships between cognitive flexibility and ASD symptoms are pretty acceptable. Also, clinicians widely consider inflexibility as a troubling, consistent symptom, which is hard to intervene.

## 2.4. Mindfulness-Definition and Process

Mindfulness refers to a kind of awareness that arises through deliberate attention in the present moment instead of judging the manifestation of the recent experience of the moment, the positive effect of which on cognitive flexibility and other cognitive functions is well acknowledged.

We unconsciously let our minds wander automatically or suppress negative feelings or thoughts daily. This state of mind is demonstrated to be undesirable. For instance, one study shows that it takes our minds approximately 46% of time in our daily life to predict unhappiness, possibly even that may happen. In contrast to letting our minds wander unwillingly, mindful means we take charge of our thoughts and feelings, leading to a higher level of well-being. The First, the acknowledged definition of mindfulness, is that mindfulness sticks attention and awareness in one's present moment experience. There are many aspects of present experience; Mindfulness involves paying attention to various aspects of one's internal and external experiences, such as body sensations, emotions, mental images, thoughts, and perceptions (e.g., touch). Experts have described this monitoring aspect of mindfulness as "watchfulness" or a "lucid awareness of each experience that presents itself."

Eight accessible mindfulness activities for individual with ASD are as follows: (1) Sound Meditation: Chime Exercises: focus on the voice and discover new things surrounding that we used to ignore. (2) Guided Relaxation: Body Scans and more: Observe sensory input without immediate behavioural output. (3) Conscious Breathing: Feathers and Buddies: using a feather to "see" their breath as it moves the subject through the air. (4) Mindful Walking: stimulate the proprioceptive system while focusing on the sensation of our feet touching the floor. (5) Glitter Jar: name the scenario of the swirling glitter and watch the glitter settle to reach inner stillness. (6) Eye Palming for Eye Health: use the hands heated by rubbing to cover both eyes and feel the color the optic nerve creates. (7) Affirmations and Power Poses: combine the yoga process with affirmation poses. (8) Sensory Breaks: create a sensory space where children can receive physical stimulation and achieve calm.

## 2.5. Relation Between Cognitive Flexibility of ASD Children and Mindfulness

Cognitive flexibility bears a close relationship to mindfulness. Previous research generally suggests that mindfulness training can improve cognitive flexibility Chiesa. However, research suggests mindfulness meditation does not improve cognitive flexibility [9]. Reductions in mind-wandering, for example, could indirectly cause the better result of the measurement of cognitive flexibility. However, the "indirect" issue does not deny its existence. Previous research adopts this view and considers the improvement of cognition as the consequence of mindfulness training.

Practising mindfulness is proven by the earlier study to be effective in improving overall mental well-being, including cognitive function, attention, and neural functioning. As a result, mindfulness-based treatments have been introduced in clinical settings for various groups of individuals. Keng and colleagues conducted research to review 16 randomized controlled experiments that implemented the Mindfulness-Based Stress Reduction (MBSR) program with both clinical and non-clinical populations [10]. Their findings indicated that MBSR reduced symptoms of anxiety, depression, anger, and rumination. Additionally, the MBSR program was associated with significant positive effects, such as enhancing positive emotions, spirituality, empathy, and other aspects of well-being.

In addition to these benefits for general populations, evidence has also proved that mindfulness training is a practical, ecological and sustainable intervention for not only individuals with ASD but also their families. Cachia suggests that future research should aim to gain a further comprehensive understanding of the effectiveness of mindfulness meditation [11]. This includes exploring its

ability to enhance cognitive flexibility and the specific circumstances and populations for which it is most effective. A study that combined mindfulness training for ASD adolescents and their parents showed improvement in those non-core symptoms, such as social responsiveness and numerous comorbid problems, such as rumination and quality of life [12], but not in core ASD symptoms. However, the limitation of the research was that it only tested 23 adolescent subjects, and more focus on children is needed for a comprehensive understanding. The primary method used to examine the effect was a questionnaire, which may have contributed to the finding that mindfulness training mainly improved social responsiveness and comorbid problems. At the same time, improvement in core ASD symptoms was insignificant.

Previous studies have focused on social, language and behavioural characteristics in children with ASD, and research is rarely done on cognitive flexibility. Conducting well-designed studies to investigate the effectiveness of mindfulness meditation in enhancing cognitive flexibility and determining its potential for symptom amelioration or remission is a crucial research challenge. Understanding the clinical relevance of such interventions is essential for improving the daily functioning, learning, and social interactions of specific populations, such as individuals with Autism Spectrum Disorder, who struggle with cognitive inflexibility. Addressing this challenge can lead to evidence-based interventions that improve the lives of those with difficulty with cognitive flexibility.

Although there are some positive results, exploration of the effectiveness of incorporating mindfulness practices in individuals diagnosed with Autism Spectrum Disorder within modern psychology are done in limited research. However, as previous researches prove that it is feasible to implement mindfulness in children with ASD, the gap in the effect of mindfulness on cognition flexibility in children with ASD is still not filled. The high prevalence of ASD calls for selected and specialized intervention with multidisciplinary studies. So future endeavour on the mechanism of mindfulness training on cognitive flexibility in children with ASD and its effect is logical and well-needed. A deeper relationship between cognitive flexibility and ASD symptoms requires further revelation

### 3. Conclusion

According to the research above, mindfulness training will enhance their cognitive flexibility performance. Since ASD cannot be cured, it is an excellent way to study and implement as many effective interventions as possible to help people reduce the symptoms of ASD. Therefore, based on the previous research, current autism-related workers and researchers can consider mindfulness as an intervention to alleviate the pain of autistic people due to their symptoms and help them better integrate into society.

As no existing intervention could cure ASD solely, integration of various methods is proven to be more necessary and efficient than isolated implementation; mindfulness training can also adapt the insight and implement together with other methods or further improve other methods act as part of them. For the uncertainty between cognitive flexibility and rigidity and to exclude more irrelevant variables as possible, behaviour assessment that involves cognitive flexibility is recommended in future research instead of assessing cognitive flexibility via existing measurement methods, which may contribute to the final purpose of all research, to improve the quality of individual with ASD's daily life.

In response to the quest of whether ASD is curable, this research demonstrated that mindfulness training could not be ascertained to cure ASD as it is a relatively new area that requires further investigation.

Although the research of this article can provide valuable help for autistic children, there are still some limitations of previous research. However, according to these limitations, further research

directions can be considered. First of all, the sample size of much relevant research is relatively small, so it is not confident that the predictive effect of these studies on mindfulness training can be applied to the entire population of autistic children. Therefore, to reduce the error of experimental prediction results, the sample size should be increased in subsequent relevant experiments; for example, the number of experimental subjects can be increased to 80–100. Secondly, since the subjects in this experiment were all from developed countries and no evidence or relevant literature has been found that the effects of mindfulness are consistent for people of all populations and cultures, it is reasonable to suspect that the effects of mindfulness are different in groups with different backgrounds. Therefore, in the follow-up experiment, factors such as race and culture can be considered variables to see whether these factors will affect the experimental results.

Additionally, as a kind of intervention, mindfulness training requires the test of evidence-based practice. Finally, people with ASD often suffer from other diseases, such as epilepsy and intellectual disability. For such people with ASD with complications, whether the positive effects of mindfulness on cognitive flexibility are consistent with the expected results in this research also needs further studies.

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