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Using Chaos Theory as a Framework to Understand the Autistic Mind

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Abstract
Children with autism spectrum disorder, whose aetiology and pathogenesis is largely unknown or unidentifiable, is on the rise in Singapore. Parents and educators are concerned about children diagnosed with this disorder as the core deficits of communication (verbal and non-verbal), social interaction, and engagement in repetitive and restricted patterns of behaviours impede their learning. Using the mathematical model of making prediction, the author of this paper used *Chaos Theory* as a framework to understand the autistic mind of children in two core deficits of autism, namely social interaction and engagement in repetitive and restricted patterns of behaviours. Based on the principles of chaos, the framework may help to understand the complex and multidimensional disorder of autism. The implications of practice of using chaos theory as a framework in educational setting are also briefly discussed.

Keywords: Chaos Theory, Children, Autism Spectrum Disorder.

Introduction
The name of Autism Spectrum Disorder (ASD) was derived from the Greek word *autos* meaning "self". It was introduced by Dr Eugen Bleuer, who was a Swiss psychiatrist in 1911 in his paper *Dementia praecox oder Grappe der Schizophrenien*' (cited in Feinstein, 2010, p.4). He described the disorder having symptoms of schizophrenia in which Bluer (1911, cited in Feinstein, 2010) defined as "a form of thinking in which it is manifested in behaviors of an individual who is more drawn towards self and withdraw oneself from other people and the external world" (p.4). In the field of psychology or medicine, this term was never acknowledged when two psychiatrists, Dr Leo Kanner (b.1894-d.1981) who coined the term *early infantile autism* and Dr Hans Asperger (b.1906-d.1980) described individuals who are high functioning as *Asperger syndrome* (high intellectual ability but low social awareness) in 1944 (Feinstein, 2010).
Children with ASD is a worrying trend in Singapore as more of them are being diagnosed due to better awareness and early screening test. The triad of impairments of autism is characterized by communication, social interaction, and engagement and the manifestation of restricted and repetitive behaviours. Those who are more severe on the spectrum of the disorder often have difficulties in emotional regulation, which often lead to tantrums and outburst due to expressive language inability. These impairments are evident in some children as young between 16 and 30 months (Robins *et al.,* 1999) and can be more apparent at the age 3 to 4 years old (Chawarska *et al.,* 2009) [6].

Definitions of Autism Spectrum Disorder
In the research of autism, the most common and widely used definition of ASD is the Diagnostic and Statistical Manual of Mental Disorders (DSM). The new criteria of ASD under DSM-5 stated that an individual must manifest three deficits in, (1) social interaction, (2) communication and (3) at least two repetitive behaviours (American Psychiatric Association, 2013) [1].
While the DSM-5 is used widely, some practitioners used the Educator's Diagnostic Manual of Disabilities and Disorders (EDM) in their practice. According to the EDM, ASD is defined as a neurological disorder which is characterized by a triad of impairments of communication (verbal or non-verbal), social interaction, and repetitive and stereotyped patterns of behaviour (Pierangelo & Giuliani, 2007). ASD usually appears within the first three years of the child's life. The prevailing characteristics will be more evident when the child reaches toddlerhood (Pierangelo & Giuliani, 2007).
Children who are diagnosed with ASD without any expressive language often exhibit behavioural problems such as aggression, tantrums, and self-injury. Such behaviours are not in

the diagnostic criteria for ASD but rather they are secondary symptoms that develop when primary symptoms are not addressed (Koegel, Koegel, Ashbaugh, & Bradshaw, 2014) with unknown or unidentifiable aetiology and pathogenesis.

Prevalence

Globally, the prevalence rate of ASD is estimated to be 60 per 10,000 across all cultures with more boys than girls are being diagnosed with a ratio of 4:1. In the United States, there is an average of 1 in 110 while in United Kingdom the rate is 1 in 100 (Chia, 2012) [7]. In Singapore, there is no exact figure of the prevalence of ASD reported. A recent article by Neik, Lee, Low, Chia and Chua (2014) reported that there is no official record of the total number of young children diagnosed with ASD from both the Singapore Ministries and local autism website. However, the number of children diagnosed with ASD in Singapore is increasing steadily in the last decade due to better awareness of the disorder and early screening. Health records from 2003 to 2004 indicated that ASD is the most common clinical development diagnosis among young children from government hospitals (Lian *et al.*, 2012) [16]. There were 361 ASD cases in 2005 and the number went to 528 ASD cases in 2010, an increase by 46 per cent (The Strait Times, 2012) [25]. Due to the increased prevalence of the disorder, the waiting list for pre-schoolers to be enrolled into intervention is long as the number of early intervention centres in Singapore is insufficient to cater to the rising needs of the children with ASD. A recent paper by Chua (2015) reported that Singapore government is stepping up its effort to set up more early intervention centres within the next few years to meet the projected demand for 2700 places (Ministry of Social and Family Development, 2015).

Chaos Theory

Edward Lorenz, a meteorologist, was the first to recognize chaotic behaviour in the mathematical modelling of predicting weather systems. He realized that small differences in a dynamic system (e.g., atmosphere) could trigger huge and often unsuspected results (e.g., storm and tornado) (Lorenz, 1972). Finally, his observations led him to formulate a theory called "*Butterfly Effect*" in a paper which was presented in 1972 known as "Predictability: does the flap of a butterfly's wings in Brazil set off a tornado in Texas?" In his paper, he observed through computer simulation of the atmosphere, small errors in the courser structures of the weather pattern tend to double in about three days. As the errors become larger the growth rate subsides. Thorough this, it offered hope of better predicting weather forecast several weeks in advance (Lorenz, 1972).

The two most powerful concepts in Mathematics and Science are symmetry and asymmetry. When symmetry is disrupted and/or broken, chaos will follow. In mathematical theory, Chaos Theory (CT) posits initial minute changes in systems can produce chaotic and unpredictable fluctuations in later systems and is used to study the behavior of complex and nonlinear systems (Barker, 1996) [3]. According to Goldberger (1996), not all systems follow a linear cause and thus are considered as complex and nonlinear as it manifests fluctuations. In other words, in a nonlinear system, any small changes can produce striking and unanticipated effects. For example, when chaos occurs in the field of psychiatry, it will be associated with mental illness such as schizophrenia (Andrade, 1995) [2]. In the case of ASD, CT may help to explain why a change in daily routine may cause the individuals with ASD react by withdrawal (refusal to follow instructions, or, for some, have meltdown when having difficulties to express verbally). In other words, when chaos happens to individuals with ASD, disorganization, confusion, and anxiety can ensue.

The applications of CT have been used in several disciplines such as meteorology, physics, engineering, biology, health, psychology, and economics (Cashin & Waters, 2006) [5]. For example, CT has been used as a tool for research in mental health to better understand mood and behaviours in bipolar disorder and thought processes in schizophrenia (Ethlers, 1995; Paulus, Geyer, & Braff, 1996) [11] and nursing (Barker, 1996; Coppa, 1993) [3]. However, there is very limited studies done in autism.

Chaos Theory and Autism

In his paper on "Autistic Disturbances of Affective Contact", Leo Kanner (1943) presented 11 case studies of children from the age of 2 to 8 years that featured a pattern of identical development that differed from typically developing children. He observed that the differences occurred in both the form and content of social interaction and communication skills, which he said "a consideration of fascinating peculiarities" in his observation (Kanner, 1943, p.217).

One of the triad of impairments in ASD is a marked deficit in social interaction (Pierangelo & Giuliani, 2007). When individuals with ASD try attempting to socialise with others, they tend to treat others as objects rather than subjects (Cashin & Waters, 2006) [5]. In one of the case studies by Kanner (1943), he reported that a boy named Paul (a five-year-old boy) as: "there was a marked contrast between his relations to people and to objects. Upon entering the room, he instantly went after objects and used them correctly (Kanner, 1943, p. 227). Such socially isolated behaviour can be explained by the concept of self. According to Moustakas (1998), the term "*monadic*" refers to people with ASD who can gain understanding of their own self where individual needs and wants can be attributed. However, they find difficulties attributing their wants and needs to others, a term called "*intermonadic*". This causes them to be socially unaware when interacting to people and/or the surrounding environment. In today's view, this lack of attributing mental states to others is known as "*theory of mind*" (ToM), an inability to impute beliefs, desires, intents, and knowledge to others (Baron-Cohen, Leslie, & Frith, 1985) [4]. ToM is described as the ability to infer the full range of mental states such as beliefs, desires, intentions, imagination, and emotions that cause action (Baron-Cohen et a., 1985) [4]. The lack of ToM is also termed as mindblindness which creates obstacles for people with ASD to communicate and interact socially (Chia & Chua, 2014). People with ASD prefers routine and they like repetition of activities. However, prolonged repetition creates mindlessness. In fact, the person with an autistic mind can perform the task mindlessly that he/she may not be consciously aware of (Chia & Chua, 2014).

Another deficit in ASD is the engagement in repetitive and stereotyped patterns of behaviour. Why are children with autism so indulged in such behaviours? For example, children with ASD often displayed a limited range of interests and play materials. Their play skills are generally repetitive and often revolved in a persistent preoccupation with parts of play objects (e.g., spinning wheels of toy cars), an attachment to unusual objects (a toy wheelbarrow), or fixation with a narrow interest (e.g., letters or numbers). Such play behaviours make it hard for the child to engage in meaningful play. And it is also difficult for the child to play along and/or with peers. Due

to rigidity in ASD, it is very difficult to adjust to changes in routines or the physical environment around them. When such routines are interrupted, they often displayed socially inappropriate behaviours such as screaming, kicking, or biting (for those who are non-verbal). Using chaos theory to explain this behaviour, and, using the definition mentioned by Barker (1996) [3], the theory posits that any initial minute changes in systems can produce chaotic and unpredictable fluctuations in later systems. Such changes when disturbed by external environment will make people with ASD more disorganized, confused, and anxious and this may explain why it is hard for them to accept changes (no matter how minor it can be) in their daily routines.

The above phenomenon using CT may help to explain why children with ASD often find difficulty in understanding and coping with social environment. Even if they attempt to interact with people and/or environment, there is a tendency of "insistence of sameness". When there is no sameness in their routines, they will get anxious and started to exhibit behavioural outbursts, while some may be socially withdrawn into compulsive and obsessive/ritualistic behaviour patterns, such as body rocking or hand flapping (Cashin & Waters, 2006). Typically developing children are able to adapt to new environment as they find it easy to find sameness in different circumstances. For example, they may play in different playgrounds when exposed. However, children with ASD find it hard to adapt to novel setting. According to Scot, Clark, and Brody (2000), children with ASD possessed a marked impairment in abstraction ability. They will be clueless in a novel setting due to the deficit in their formation of conceptual learning (Scot *et al.*, 2000). This may explain why people with ASD find it comforting and calming to exhibit repetitive behaviours to avoid novel situations which they find anxiety in (Cashin & Waters, 2006).

Implications for Practice

Without predictability (such as visual aids), exposing people with ASD to novel environment and experiences is very stressful. Parents of children with ASD can only rely on behaviours as a form of feedback when their children are stressed. Often, such behaviours are overt such as self-injurious behaviours (e.g., scratching, biting, and hitting oneself and/or others). Chaos theory may provide a rationale and lay a foundation for teaching and therapy that can be communicated to parents and educators that the introduction of any form of novelty should be done gradually with supports, especially using structured teaching where a work system and visual aids are often used in classroom teaching. This form of intervention helps in organization and allows predictability to individuals with ASD to make transition, thereby allaying their fears as they know what is being expected of them. Educators who are new in teaching people with ASD need to be cautious when exposing them to novel situations. Using chaos theory, teachers can be aware that any minute changes in routines will cause big changes in students' behaviours during classroom teaching. Hence, over flooding students with ASD with novelty is discouraged as they are not ready to be exposed to change(s).

Conclusion

This short paper proposes using the lens of chaos theory as a framework to understand the mind of an autistic person by explaining two of the triads of impairment in ASD (i.e., social interaction and engagement in repetitive and stereotyped patterns of behaviour). Understanding the need for making abrupt changes in teaching children with ASD will in no manner justify any therapies when they are unprepared when exposed in novel situations. Hence, it is crucial when designing intervention plan, the need for a more holistic and individualised approach should be taken into consideration. Intervention in classroom management, teaching practices, and transition activities should include moving children with ASD with appropriate supports to reduce their anxieties, help them to organise and work in a less stressful environment. In this way, learning will gradually takes place as they feel calmer with better supports from parents and/or educators. The author hopes that the complex-dynamic systems approach of the chaos theory can help to unfold the complexity and multidimensionality of autism spectrum disorder.

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