

**DOLPHIN ENCOUNTER FOR SPECIAL CHILDREN (DESC) PROGRAM: EFFECTIVENESS OF DOLPHIN-ASSISTED THERAPY FOR CHILDREN WITH AUTISM**

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*Autism is a neuro-developmental syndrome of constitutional origin and whose cause could also be epigenetic, and its onset is usually around first three years of birth, with empathizing deficits that result in a triad of impairments in communication, social interaction, and imagination (or presence of stereotyped behaviors), but may, on the other hand, display or hide a strong systemizing drive that accounts for a distinct triad of strengths in good attention to detail, deep narrow interests, and islets of ability. In this study, 15 children (ten boys and five girls, aged between 9 and 10 years) with high-functioning autistic disorder underwent a 12-month Dolphin Encounter for Special Children (DESC) Program conducted by the Underwater World Singapore at the Dolphin Lagoon in Sentosa. Indo-pacific humpback dolphins were used in this dolphin-assisted therapy. A pre-/post-treatment design was used to determine if the 15 subjects showed significant improvement in the reduction of their autistic symptoms after they had completed the program. The results suggested that the subjects showed a significant reduction in stereotyped behaviors and a significant improvement in communication and social interaction. With a good effect size (d), their mean AQ remained within the average range for typical individuals with autism.*

Autism is often associated with a triad of impairments in communication, social interaction, and imagination resulting in empathizing deficits. Empathizing deficits refer to one's failure to make connection to another individual's experience and to respond appropriately to that person. As a result, social interaction is impaired (Chia, 2008). Functional imaging studies (e.g., Cody, Pelphrey, & Piven, 2002; Di Martino, & Castellanos, 2003) implicate medial prefrontal cortex and posterior superior temporal sulcus as components of this empathizing ability.

However, recent studies (e.g., Lawson, Baron-Cohen, & Wheelwright, 2004; Baron-Cohen et al., 2003) suggest that though individuals with autism display empathizing deficits, they have intact or even superior systemizing ability. Systemizing refers to that ability to analyze and build systems so as to understand and predict the functional behavior or impersonal events or inanimate or abstract entities. Myers, Baron-Cohen and Wheelwright (2004) have identified six systemizing abilities: (1) mechanical systemizing, e.g., machines and tools; (2) natural systemizing, e.g., biological processes and geographical phenomena; (3) abstract systemizing, e.g., mathematical concepts and computer programs; (4) motoric systemizing, e.g., 3D drawing, piano finger technique or a lawn tennis shot; (5) organizable systemizing, e.g., Dewey Classification System used in library cataloging of books or a stamp collection; and (6) social systemizing, e.g., business management or football team.

The way an individual with autism makes sense of any of these systems is not in terms of mental states, but in terms of underlying rules and regularities. Such superior systemizing ability can be seen in those termed as autistic savants, who may have two or more savant abilities (Treffert, 1989). However, there is also another lesser known sub-group of autistic crypto-savants, who, *because of their inability to communicate, have savant skills that are hidden, or secret, and unknown to those around them* (Rimland, 1990, p.3). This aspect is often ignored in the current definition of autism.

As a result, Chia (2008) argues *the need to re-define and expand the term autism as a neuro-developmental syndrome of constitutional origin (genetic) and whose cause could also be epigenetic, and its onset is usually around first three years of birth, with empathizing deficits that result in a triad of impairments in communication, social interaction, and imagination (or presence of stereotyped behaviors), but may, on the other hand, display (especially by autistic savants) or hide (especially by autistic crypto-savants) a strong systemizing drive that accounts for a distinct triad of strengths in good attention to detail, deep narrow interests, and islets of ability* (p.10).

Since autism is a spectrum disorder, there are many subtypes and autism-related anomalies. Hence, it is impossible to have one best treatment approach to address all the different forms of autistic learning and behavioral challenges. Among the many treatments available for children with autism, our interest has brought us to study one particular autism treatment: the dolphin-assisted therapy (DAT).

#### *Dolphin-Assisted Therapy*

Law and Scott (1995) report that children with autism and pervasive developmental disorders have benefited from using domesticated animals such as hamsters, gerbils, rabbits, and fishes in the following areas: (1) their anxiety or fear level associated with animal contact decreased significantly; (2) responsibility through pet-care routines, such as feeding, cleaning and caring for the animals, was inculcated; (3) elevated problem-solving skills related to animal-care activities were developed over time; and (4) improvement in self confidence, social interaction, receptive and expressive language. In addition, these children were reported to become more socially aware of the people in their surrounding environment.

The term *pet therapy* was introduced by Levinson (1969). The principle behind this form of novel therapy is based on 2 premises: (1) *It is easier for an individual to project his/her unacceptable emotions on a pet; and (2) the pet possesses the faculty for supplying some of the individual's need for cuddling, companionship and unconditional acceptance* (Levinson, 1969, p.67). The term soon evolved into animal-assisted therapy (Levinson, 1984), in which an animal is introduced as a companion into a person's life to enhance the emotional well-being. According to Cochrane and Callen (1992), *the experience of human-animal interaction helps in maintaining the equilibrium of human mind and body* (p.31).

Among the many different animals used in animal-assisted therapy, dolphins have been a subject of research interest to help individuals with disabilities to improve their cognitive skills, physical mobility or socio-emotional behaviors as far back in the 1970's (Simpson, 2005, Humphries, 2003). The interaction between humans and dolphins has gradually evolved into what is now known as dolphin-assisted therapy (DAT). Several studies have been done to investigate the effectiveness of DAT with children with pervasive developmental disorders (Lukina, 1999; Nathanson, 1998), other severe disabilities (Nathanson et al., 1997), mental retardation (Nathanson, 1989; Nathanson & de Faria, 1993), and autism (Chia, Kee, Poh, & Watanabe, 2009; Servais, 1999; Smith, 1981). DAT has also gained its popularity in populations of people who have depression, anxiety, or physical pain (Antonioli & Reveli, 2005).

Cochrane and Callen (1992) report one study on how children with autism were relieved of their characteristic anxiety (e.g., vocal and motor self-stimulations) and stress through positive interactions with dolphins, and subsequently, they also improved in their communication and learning. In another study using the single-subject case study method, Smith (1981) reports the use of dolphins to motivate a non-verbal child with autism to communicate. Smith (2003) postulates that the intelligence and spontaneous play behavior of a dolphin could be the distinguishing features that help enhance the therapeutic value of DAT.

In addition, studies done by Nathanson and de Faria (1993), Nathanson et al., (1997), and Nathanson (1998) on the efficacy of dolphin-assisted therapy have suggested that this treatment helps to increase the attention of individuals with disabilities as well as autism because of their desire to be in contact with the dolphins. Findings of these three studies suggest that the human subjects improved in their cognitive performance, increased in motivation and self-confidence.

Servais (1999), in the Autidolfijn project that began in 1991 in Belgium, has found that swimming with dolphins did have a positive effect on children with autism. The effect was probably not because of the

dolphin but as a result of the relationship between the dolphin therapist and the child. Positive changes were only seen when the child and the therapist had bonded well.

However, although findings from previous DAT studies have suggested improvement in emotional regulation (Nathanson et al., 1997) and reduction in stereotyped behavior in children with autism (Chia et al., 2009), *it has failed to show improvement in social and communication skills for children with autism* (Chia et al., 2009, p.75). Chia et al. (2009) have cautioned that the DAT *serves best as a complement to other conventional therapies and should not be used as a sole treatment for children with ASD* (p.82).

Although DAT has been the subject of several scientific investigations (see Marino & Lilienfeld, 1998), there is still a lack of scientific validation regarding its efficacy (Exkorn, 2003). However, anecdotal reports and informal feedbacks from parents and professionals suggest that DAT has been very beneficial for some children with autism (Simpson, 2005).

In Singapore, the Underwater World Singapore, which manages the Dolphin Lagoon, offers the Dolphin Encounter for Special Children (DESC) Program for children with disabilities. It has been introduced to children with autism to develop relevant skills (e.g., hand-signaling to or swimming with a dolphin) needed for the care of specific animals (Ang, 2009).

#### *Description of DAT*

Generally, DAT aims to develop sensory and social skills, manage challenging behavior and improve quality of life (Ang, 2009). It is often regarded as a complementary or alternative treatment to conventional therapies (e.g., speech language, occupational, applied behavioral and cognitive-behavioral therapies) that individuals with autism typically undergo.

There are many different forms of DAT. The simplest form involves swimming with, touching or taking care of dolphins, while the more complex one is based on a structured program designed to meet the needs of the individual concerned. According to Nathanson (1998), the DAT is based on the theory that individuals with disabilities will increase their attention to relevant stimuli in the environment as a result of their desire to interact with dolphins.

The general purpose of DAT is to encourage children with disabilities to engage in desired responses in accordance with their individual education or therapy plan (Nathanson, 1998; Nathanson et al., 1997; Nathanson & de Faria, 1993). It consists of a series of therapeutic sessions that allow participants to interact with the dolphins from the pontoon or in the water after giving a correct motor, cognitive, or language response. Interaction with the dolphins may include touching, kissing, making hand signals to the dolphins to elicit specific behaviors, taking a short ride atop the dolphin while holding its dorsal fin, or dancing in a circular motion with the dolphin (Humphries, 2003). The DAT sessions are specially designed to *jump-start* the participating children with disabilities and to complement or reinforce other conventional therapies (Nathanson, 1998). The duration and frequency of the DAT varies from one providing organization to another, and it can be done in a few hours to several weeks or even months.

According to Humphries (2003), the materials used as adjuncts in the DAT include rubber balls or rings for eliciting motor responses, or big water-proof flash cards depicting objects for language responses.

#### *Research on DAT in Singapore: 2007-2010*

DAT at the Dolphin Lagoon – owned and managed by the Underwater World Singapore – in Sentosa (an island south of the mainland Singapore) began as Dolphin Encounter for Special Children (DESC) Program designed by Watanabe and Lee (2004). The species of dolphins used in the program is the indo-pacific humpback dolphins (*sousa chinensis*).

The first serious study on the effectiveness of DAT based on the DESC Program was carried out as a trial run in November/December 2007. According to Cai and Chia (2011), five DAT studies including the trial were conducted between 2007 and 2010. In the first study (Chia, Wong, & Watanabe, 2008), six non-verbal autistics were involved. One of them was picked up for a further study because of his unique challenging issue of synesthesia besides autism. This subject went on to acquire functional sign language before he was taught Sign Exact English (SEE) to communicate with his parents, siblings, teachers and peers.

The second study (Chia, Kee, Poh, & Watanabe, 2009) captured the attention of a local press (see Ang, 2009) and was reported in *The Straits Times* on 9 May 2009. The study involving five subjects with ASD was published in the *Journal of the American Academy of Special Education Professionals*. Briefly, it reported an overall improvement in the five subjects with autism in terms of a reduction in their stereotyped behaviors was better than their overall improvement in social interaction, which, in turn, was better than that in their communication. The study also reported a better passive joint attention in the subjects once they learnt to do hand-signaling to engage the dolphins. The reduction in the subjects' hand-flapping and hand-leading was also noted.

The third study (Chia, Kee, & Watanabe, 2010) involved six subjects diagnosed with high-functioning autism (HFA) and sensory processing disorder. The findings of this study suggested an increase in joint attention, an improvement in social interaction and better environmental awareness, better visual modeling of social skills and better syllogistic reasoning/thinking, especially in the following three styles as identified by Grandin (2008): visual thinking, associative thinking, and verbal logic thinking.

The fourth study (Chia & Kee, 2010) involved five young Chinese children with severe autism, sensory processing deficits and attention deficit/hyperactivity disorder. The study suggested an increase self-awareness and self-regulation and all the five subjects *awarized* – a term coined by Chia and Kee (2010) to refer to *an action rather than to be aware of, a passive reaction* (p.44). As a result, Chia and Kee (2010) argue that there was an increase in the subjects' level of cognitive consciousness although all of them remained intellectually challenged. The study was based on the hypothesis that a child with ASD manifested hyper-egocentrism which could be reinforced by strong sensory defense mechanism, which could either be hyper-responsivity or hypo-responsivity. *The dolphin served as an excellent psychopomp for a child with ASD to open his/her inner world to the outside world* (Cai & Chia, 2011, slide 22).

#### *Therapeutic Benefits of DAT*

Several theories have been put forward to explain the purported therapeutic benefits of DAT, specifically the physiological and relational effects (Simpson, 2005). McKinney, Dustin and Wolff (2001) suggest that the whistles and clicks emitted by the dolphins can produce changes in an individual's tissue and cell structure, and works in some way similar to music therapy. In addition, because of their natural spontaneity, happiness, and playfulness, dolphins have a profound positive impact on individuals, and it is said to elicit happiness in individuals (McKinney et al., 2001). Moreover, dolphins are said to be particularly perceptive to the needs of individuals with disabilities, and as a result, they respond to such individuals in a very supportive manner (McKinney et al., 2001; Simpson, 2005).

In the recent DAT study, Chia and Kee (2010) report some major behavioral change of their five subjects with autism, aged between five and seven years old, in what they describe as a reduction in hyper-egocentrism. The subjects *have also become more socially aware of themselves, beginning with the somatic awareness of their hands (e.g., performing a hand signal to get the dolphin to respond back) and legs (e.g., waddling their legs in the pool). No longer did they have to hold someone's arms using them as if they were a tool to get something or to do something. These children could do proto-declarative pointing if they wanted something (e.g., pointing to the dolphin, keeping an eye contact with it and beckoning it to come forward). The somatic awareness led them to what we have termed decentring their hyper-egocentrism. To decentring is to break down the walls of hyper-egocentrism, leaving the egocentrism without the hyper part* (Chia & Kee, 2010, p.43-44).

According to the theory that Chia and Kee (2010) propose, the dolphin is like some sort of an *awareness initiator* to these children with autism: a point of a social contact. They use the term *psychopomp* to describe the role of the dolphin in DAT. A psychopomp is like a portal or middle-person that serves as the link between the child with autism and the other people surrounding him/her.

During the process of DAT, the dolphin becomes an *awareness mediator* between the child and his/her surrounding (superimposed with the dolphin = child, and its pool = child's surrounding). By the end of the therapy, the child becomes very aware of the surrounding, i.e., the dolphin pool with at least one dolphin swimming in it at any one time. The dolphin pool is like a photo-frame encapsulating the dolphin within it. It can represent the psycho-space in the mind of a child: simple and clear, without any other distractions. It has its unique hypnotic effect on the child's mind. The dolphin now plays the role of an *awareness reinforcer* in the child. From the somatic awareness, the child develops a psycho-spatial awareness that is gradually transforming into environmental awareness. Chia and Kee (2010) have termed this meta-psychological transformation or process *awarizing*, i.e., *awarize is an action rather*

*than to be aware of, a passive reaction* (p.44). The transforming of awareness to be integrated into the new mental schemes so as to take into account the particularities of the objects, persons or events the child with autism is interacting with.

Finally, Dobbs (1990) suggests that dolphin-assisted therapy is effective in a mystical rather than medical way due to the unconditional love and caring advanced by the dolphin. You will have to add one more sentence.

#### *The DESC Program*

While the DAT for children with special needs is not something new in the west, it is a novel form of treatment for children with autism in Singapore. Here, the parents with such children are more than willing to try anything new that they hope will benefit their children. The Underwater World which manages the Dolphin Lagoon offers its unique DESC Program that allows children with autism or other learning disabilities to interact with its indo-pacific humpback dolphins, also known as pink dolphins (Chia et al., 2009).

As the DAT is a wholly unaccredited and unregulated industry, i.e., there are no regulations or operational standards to decide which form of dolphin therapy is the *true* or *real* professional one (Brakes & Williamson, 2007). Hence, the DESC Program, which has been offered to children with autism, Down syndrome and physical disability since 2004, can be recognized as a unique form of dolphin therapy in this part of the world. According to Watanabe and Lee (2004), the main aim of the DESC Program is threefold: (1) to educate children with special needs on dolphins and their habits; (2) to provide these children a chance to interact with these marine creatures; and (3) to boost the self-confidence of these children when they physically encounter the dolphins in the lagoon.

#### **The Method**

##### *Aim of the Study*

In aim of this study was to find out the effectiveness of DAT for children with autism to improve in terms of reduction in their stereotyped behavioral traits and progress observed in their attempts to communicate and socialize with others.

##### *Design and Data Collection*

Our quasi-experimental study used a small group-based pre-/post-treatment design adapted from Campbell and Stanley (1966) and was considered most suitable to determine the effectiveness of DESC Program as a treatment. This research design was chosen when randomisation of subjects selected to participate in the study is impractical and/or unethical (Gribbons & Herman, 1997). Additionally, utilising the quasi-experimental design minimises threats to external validity as the natural or open environment does not suffer the same problems of artificiality as compared to a well-controlled laboratory setting (Shadish et al., 2002).

In brief, three steps were taken when employing this design:

- Pre-treatment baseline data were taken (before undergoing a 12-month treatment was instituted) on three types of autistic symptoms/traits (i.e., stereotyped behaviors, communication, and social interaction observed, recorded and measured as well as the autism quotient of each subject being taken.
- The treatment involved a 12-month DESC Program.
- Post-treatment baseline data were re-taken (after completing the 12-month treatment) on the same types of autistic symptoms/traits observed, recorded and measured as well as the autism quotients being re-measured.

##### *Participating Subjects*

The participants consisted of ten boys and five girls diagnosed with autism by clinical psychologists from public hospitals when they were aged between three and five years old. Three boys (i.e., subject M1, M2 and M3) and two girls (i.e., the subjects F1 and F2) were home-schooled by their parents who had also employed therapists to come to their home to do intervention. The remaining 10 subjects are still attending regular primary schools today.

Before the start of the study, we assessed all 15 subjects on the Test of Non-verbal Intelligence-3<sup>rd</sup> Edition (TONI-3) (Brown, Sherberson, & Johnsen, 1982) to determine their nonverbal intelligence quotients (NVIQs) in order to find out if any of them had mental retardation, which is often associated

with autism (Exkorn, 2003; Siegel, 1996). The results of TONI-3 (see Table 1) showed that since the NVIQs of the majority of the subjects except F1 (with a slightly low average NVIQ of 89) were between 90 and 110, i.e., within the intellectually average range, and therefore, strictly speaking, they did not manifest any mental retardation (Brown, Sherberson, & Johnsen, 1982; Exkorn, 2003; Siegel, 1996). In other words, the subjects were quite homogeneous in terms of their non-verbal intelligence.

**Table 1. Subjects' Background Information**

Subject No.	Gender	Chronological Age at the beginning of the study	NVIQ at the beginning of the study
1	M	10:06	94
2	M	10:08	93
3	M	10:04	102
1	F	10:00	89
2	F	9:09	96
4	M	9:10	108
3	F	9:07	98
5	M	10:05	104
6	M	9:06	95
7	M	9:11	99
4	F	9:04	101
5	F	10:02	107
8	M	10:03	97
9	M	10:07	103
10	M	9:07	92

#### *Instrumentation*

We used the Gilliam Autism Rating Scale (GARS) (Gilliam, 1995) as the instrument to measure the performance of the 15 subjects before and after the DAT. It is a highly standardized, norm-referenced behavioral checklist used to identify persons ages 3 through 22 who are autistic. It consists of 42 items, which are categorized under three core subtests: (1) Stereotyped Behaviors; (2) Communication; and (3) Social Interaction. There is a supplemental subtest – Developmental Disturbances – about child development during the first three years, but it was not used in this study.

Gilliam (1995) provides the reliabilities and validity of GARS as follows: Internal consistency reliability using Cronbach's coefficient alpha (Cronbach, 1951) is .96 with a standard error of measurement (SEM) at 3.0; test-retest reliability coefficient is .88 with  $p < .01$  as test of significance; inter-rater reliability coefficients are .94 (teacher to teacher), .83 (parent to teacher), and .99 (teacher to parent) respectively; median coefficients in term of content reliability are as follow: stereotyped behaviors .61; communication .65; and social interaction .69; and median coefficients for the subtests were all statistically significant ( $p < .01$ ).

We administered GARS in consultation with the subjects' parents, before the start of the DAT and re-administered it at the end of the program. The purpose of the assessment was to obtain the subjects' Autism Quotients (AQs), standard scores and percentile ranks based on the three core subtests (Stereotyped Behaviors, Communication, and Social Interaction), excluding the supplemental subtest on Developmental Disturbances, at pre- and post-treatment phases. With pre- and post-treatment results, a comparison could be made to determine if the subjects had benefited from the DAT (see Table 2 for pre-treatment GARS results).

#### *Treatment*

One form of DAT is the dolphin swim program used as a possible assistance for children with autism (Chandler, 2005). The DESC Program is the only one such program available in Singapore. A qualified dolphin trainer with one/two of her assistants conducted the DESC Program every Wednesday morning between 9.30am and 10.45am for a period of 12 months, which began on September 17, 2009, and ended on September 18, 2010. The program was divided into the following two parts:

**Table 2. GARS Subtest Scaled Scores and Autism Quotients (Pre-Treatment Phase)**

Subject No.	SB	COM	SI	AQ
1	14	10	10	105
M2	12	10	9	98
M3	13	11	10	105
F1	12	9	11	98
F2	15	13	12	115
M4	11	9	11	97
F3	14	12	12	107
M5	13	10	9	100
M6	12	10	8	95
M7	14	11	12	108
F4	16	13	11	115
F5	14	12	10	107
M8	12	9	10	95
M9	13	12	11	103
M10	15	13	11	112

Key: M = Male; F = Female; SB = Stereotyped Behaviors; COM = Communication; SI = Social Interaction; AQ = Autism Quotient

### *Part 1: Classroom sessions*

The classroom sessions consisted of several activities that were repeatedly taught and revised over again each time the subjects came for the program. The subjects were introduced to the different body parts of a dolphin, which is close to a life-size one, for them to touch. Through some hands-on activities and games, they learnt to differentiate the dolphin from fish and other marine animals (e.g., using marine animal shapes and manipulatives) and also learnt about the habitat of dolphins. They were taught how to stroke a toy dolphin before they do it on a real dolphin. In addition, the subjects were also shown video tapes how a dolphin swims.

The materials used during each classroom session included a huge vanguard with Velcro labels were used to teach body parts of a dolphin, plastic dolphins and fish were used to show how a dolphin (up-and-down motion) and a fish (side-to-side motion) swim differently, and 3-D wooden or foam marine animal shaped puzzles and manipulatives were used to teach the subjects how to differentiate or recognize dolphins from other marine animals. Environment cards (e.g., ocean, forest, sky) were used to teach the different environments and the natural habitat where the dolphins live. In addition, a dolphin float or soft toy dolphin was used to demonstrate how the subjects should touch the dolphin and everyone was given an opportunity to practice stroking the dolphin float or soft toy dolphin before actual water experience could commence. At the end of each classroom session, worksheets and crayons were provided for individual participation of the subjects to observe how much they had learnt and understood what was taught. Certificates and colorful stickers were given to the subjects as a form of incentive to reinforce their classroom learning.

### *Part 2: Water sessions*

At the beginning of each water session, the subjects were introduced to three indo-pacific humpback dolphins and learnt their christened names: Jumbo, Han, and Euang. During the water sessions, the subjects were brought into the Dolphin Lagoon, where they were taught to adopt an interaction position at different water levels (done gradually, beginning at the shallow knee level, then the waist level and finally, the chest level). While in the lagoon, the dolphin trainer and her assistants demonstrated to the subjects how to stroke a real dolphin and to count the number of strokes. The subjects were also given an opportunity to feed the dolphin. After six months of water sessions, the subjects were taught how to make some hand signals to cue the dolphins to perform some tasks in response. They were led to walk up the pontoon in the Dolphin Lagoon by the dolphin trainer and her assistants to do some hand signals to interact with the dolphins. By the ninth month, the subjects were supervised by the dolphin trainer and/or her assistants to perform dorsal tow or deep-water contact and interaction with the dolphins.

The key materials used during each water session were the arm floats (instead of life jackets) were used by the subjects when they went into the Dolphin Lagoon as they provided better control and promote better attention during the water session. Also, some of the subjects had challenging sensory issues and resisted putting on his/her life jacket. Other adjunct materials (e.g., rubber balls and rings) might be used

as and when needed. At the end of each session, the dolphin trainer and/or her assistants would recapitulate the lesson taught in that morning and rewarded the subjects with stickers for every small achievement made (e.g., responding appropriately to a request made, such as how to stroke a dolphin).

### *Dolphins*

The dolphins used in this study belong to the species known as the indo-pacific humpback dolphins (an endangered species). They have been raised in captivity and are taken care in the Dolphin Lagoon owned and managed by the Underwater World, Singapore. These dolphins were brought in to Singapore from Thailand in November 1999 (Boo, 2001).

The indo-pacific humpback dolphins are also commonly known as pink dolphins because of the pastel pink sheen of their skin. While young, these dolphins are grey and as they grow and mature, they become pink. They are thought to be a unique sub-species of the Chinese white dolphin, also a member of the indo-pacific humpback dolphin family. These dolphins can be found in small populations off the coast of China, Singapore, Thailand and Vietnam.

### *Potential Risks of Treatment*

According to Simpson (2005), while there are no known dangers associated with this form of treatment using dolphins, ethical issues regarding the humane use of dolphins for therapeutic purposes have contributed to this treatment status as a controversial approach. However, guidelines have been developed to look into the welfare of dolphins used in this form of treatment: e.g., decrease in contact time between dolphins and human subjects, use only dolphins born and bred in captivity, and use of natural lagoon settings (Nathanson, 1998).

### **Results**

The GARS is useful for determining specific behavioral strengths and weaknesses for individual children identified with autism. The three core components of autistic behaviors in the GARS are adapted from the criteria for autistic disorder listed in the DSM-IV (American Psychiatric Association, 1994): (1) stereotyped behaviors, (2) communication, and (3) social interaction. The distribution of the scaled scores of the three GARS core subtests and their descriptors given in terms of the degree of severity: 17-19 (very high in severity), 15-16 (high in severity), 13-14 (above average), 8-12 (average), 6-7 (below average), 4-5 (low in severity), and 1-3 (very low in severity).

#### *Stereotyped Behaviors (SB) subtest*

Table 1 shows the mean scaled score for Stereotyped Behaviors (SB) subtest dropped from 13.33 (SD=1.40;  $\sigma^2=1.95$ ) at pre-treatment to 10.27 (SD=1.16;  $\sigma^2=1.35$ ) at post-treatment, after one year of DESC Program. There was indeed an extremely significant improvement in the reduction of stereotyped behaviors in the 15 subjects after having undergone the treatment.

A paired *t*-test was carried out on the pre- and post-treatment scaled scores of the SB subtest of GARS to confirm if the subjects who were matched on this variable were indeed significantly different. By conventional criteria, the results indicated that there was an extremely statistically significant difference between the pre- and post-treatment scaled scores,  $t(28) = 6.5184$ , 2-tailed  $p < 0.0001$ , with a standard error of difference = 0.469. The 95% confidence interval of this difference is from 2.0984 to 4.0216. The effect size ( $d$ ), which measures the magnitude of the treatment effect (Cohen, 1988) on the subjects' stereotyped behaviors, was computed using Ray and Shadish's (1996) Equation II, and  $d$  was 2.38, i.e., the size of effect was considered to have a large effect upon the performance, i.e., a good reduction in stereotyped behaviors.

#### *Communication (COM) subtest*

Table 2 shows the mean scaled score for Communication (COM) subtest dropped from 10.93 (SD=1.49;  $\sigma^2=2.21$ ) at pre-treatment to 8.80 (SD=0.86;  $\sigma^2=0.74$ ) at post-treatment, after one year of DESC Program. There was indeed an extremely significant improvement in the communication of the 15 subjects after having undergone the treatment.

A paired *t*-test was carried out on the pre-treatment and post-treatment scaled scores of the COM subtest of GARS to confirm if the subjects who were matched on this variable were indeed significantly different. By conventional criteria, the results indicated that there was an extremely statistically significant difference between the pre-treatment and post-treatment scaled scores,  $t(28) = 4.7951$ , 2-tailed  $p < 0.0001$ , with a standard error of difference = 0.444. The 95% confidence interval of this difference is

from 1.2201 to 3.0399. The effect size ( $d$ ), which measures the magnitude of the treatment effect (Cohen, 1988) on the subjects' communication, was computed using Ray and Shadish's (1996) Equation II, and  $d$  was 1.75, i.e., the size of effect was considered to have a large effect upon the performance, i.e., a good improvement in communication.

**Table 1. Pre- and Post-Treatment Results of Stereotyped Behaviors (SB) subtest**

	Mean	SD	Variance $\sigma^2$	SEM	95% confidence		$t$ (df)	Sig. (2-tailed $p$ )	Effect size $d$
					interval of the				
					Lower	Upper			
Pre	13.33	1.40	1.95	0.36			6.5184		
Post	10.27	1.16	1.35	0.30	2.0984	4.0216	(28)	<0.0001	2.38

**Table 2. Pre- and Post-Treatment Results of Communication (COM) subtest**

	Mean	SD	Variance $\sigma^2$	SEM	95% confidence		$t$ (df)	Sig. (2-tailed $p$ )	Effect size $d$
					interval of the				
					Lower	Upper			
Pre	10.93	1.49	2.21	0.38			4.7951		
Post	8.80	0.86	0.74	0.22	1.2201	3.0399	(28)	<0.0001	1.75

**Table 3. Pre- and Post-Treatment Results of Social Interaction (SI) subtest**

	Mean	SD	Variance $\sigma^2$	SEM	95% confidence		$t$ (df)	Sig. (2-tailed $p$ )	Effect size $d$
					interval of the				
					Lower	Upper			
Pre	10.47	1.19	1.41	0.31			5.3788		
Post	8.60	0.63	0.40	0.16	1.1579	2.5821	(28)	<0.0001	1.96

#### *Social Interaction (SI) subtest*

The mean scaled score for Social Interaction (SI) subtest dropped from 10.47 (SD=1.19;  $\sigma^2=1.41$ ) at pre-treatment to 8.60 (SD=0.63;  $\sigma^2=0.40$ ) at post-treatment, after one year of DESC Program. There was indeed an extremely significant improvement in social interaction of the 15 subjects after having undergone the treatment.

A paired  $t$ -test was carried out on the pre- and post-treatment scaled scores of the SI subtest of GARS to confirm if the subjects who were matched on this variable were indeed significantly different. By conventional criteria, the results indicated that there was an extremely statistically significant difference between the pre-treatment and post-treatment scaled scores,  $t(28) = 5.3788$ , 2-tailed  $p < 0.0001$ , with a standard error of difference = 0.348. The 95% confidence interval of this difference is from 1.1579 to 2.5821. The effect size ( $d$ ), which measures the magnitude of the treatment effect (Cohen, 1988) on the subjects' social interaction, was computed using Ray and Shadish's (1996) Equation II, and  $d$  was 1.96, i.e., the size of effect was considered to have a large effect upon the performance, i.e., a good improvement in social interaction.

*Autism Quotients*

Gilliam (1995) has categorized Autism Quotients (AQs) into seven ranges: 131 and above at 99+ percentile rank (very high), 121-130 at 92-98 percentile rank (high), 111-120 at 76-91 percentile rank (above average), 90-110 at 25-75 percentile rank (average), 80-89 at 9-24 percentile rank (below average), 70-79 at 2-8 percentile rank (low), and 69 and below at 1 percentile rank or less (very low).

The mean standard score for Autism Quotient (AQ) dropped from 104 (SD=6.77;  $\sigma^2=45.86$ ) at pre-treatment to 92.33 (SD=4.15;  $\sigma^2=17.24$ ) at post-treatment, after one year of DESC Program. There was indeed an extremely significant reduction in the autistic behaviors of the 15 subjects after having undergone the treatment.

**Table 4. Pre- and Post-Treatment Results of Autism Quotients (AQ)**

	Mean	SD	Variance $\sigma^2$	SEM	95% confidence		<i>t</i> (df)	Sig. (2-tailed <i>p</i> )	Effect size <i>d</i>
					interval of the				
					Lower	Upper			
Pre	104.00	6.77	45.86	1.75			5.6919		
Post	92.33	4.15	17.24	1.07	7.4702	15.8698	(28)	<0.0001	2.08

A paired *t*-test was carried out on the pre- and post-treatment standard scores of the AQ of GARS to confirm if the subjects who were matched on this variable were indeed significantly different. The results indicated that there was an extremely statistically significant difference between the pre-treatment and post-treatment scaled scores,  $t(28) = 5.6919$ , 2-tailed  $p < 0.0001$ , with a standard error of difference = 2.050. The 95% confidence interval of this difference is from 7.4702 to 15.8698. The effect size (*d*), which measures the magnitude of the treatment effect (Cohen, 1988) on the subjects' social interaction, was computed using Ray and Shadish's (1996) Equation II, and *d* was 2.08, i.e., the size of effect was considered a large effect upon performance, i.e., a drop in autistic behaviors in terms of AQ.

**Discussion**

The results of the three GARS subtests, i.e., SB, COM and SI, showed a significant reduction in stereotyped behaviors as well as significant improvements in communication and social interaction after the 15 subjects had undergone the DESC Program over a period of 12 months. As a result, their mean AQ fell from 104 to 92 by 12 points, although both pre- and post-treatment AQs remained within the average range for subjects. However, the positive treatment effect of the DESC Program was medium for all the subjects in stereotyped behaviors, communication and social interaction as well as the AQ.

**Conclusion**

Currently, there is very limited scientifically valid or reliable evidence to support the use of DAT for children with autism as well as limited number of anecdotal reports about the use of DAT for these children (Marino & Lilienfeld, 2007). Based on the findings of this study, we feel that more can still be done to fine-tune on its focus, especially in the area of social-communicative interaction and the impact of DESC Program on it, which is what the previous study conducted by Chia et al. (2009) has also recommended.

*Limitations and Interferences of the Study*

We have noted several limitations and interferences in our study:

Firstly, autism is a spectrum disorder in terms of its various subtypes and degree of severity and all the participating subjects with autism are individuals with varied profiles. Hence, not everyone would benefit significantly from the DESC Program.

Secondly, we acknowledge there are four possible effects that might impact our findings. First, there is the Hawthorne effect. This is a form of reactivity whereby subjects improve/modify certain aspects of their behavior that were being experimentally measured simply in response to the fact that they are being studied (Fox, Brennan, & Chasen, 2008; McCarney et al., 2007). The reduction in their stereotyped

behaviors and improvement in their social interaction and communication could be impacted by the motivational effect of the interest being shown in them. Moreover, it was difficult to control other factors (e.g., being in water, swimming in the lagoon, interacting with the dolphin trainers, more attention being paid to the subjects) of the treatment which might influence the results of this study. Second, there is the novelty effect. In the context of human performance, novelty effect refers to the tendency for performance initially improve when something new is instituted, not because of any actual improvement in performance or achievement, but in response to increased interest in the DESC Program. The novelty of the treatment and the excitement (or anxiety) on the part of the 15 subjects for their very first time to have a close physical encounter with dolphins might also influence the 15 subjects' behavior in our study. This is because these dolphins are distinct from the other types of animals that these subjects are likely to encounter in their daily lives, such as dogs, cats and birds. Third, there is the observer/experimenter-expectancy effect. This is a form of reactivity in which an observer's cognitive bias can unconsciously influence the subjects of the study. We did not keep any qualitative case record of each subject's progress based on the observations done by us or the subject's parents. Even if there it were ever done, it could be a very subjective or biased parental viewpoint, since the parents of these subjects were quite aware of the study's purpose and hence, were more likely to have an expectation of improvement than what the GARS data had suggested. Fourth, there is the placebo effect. It refers to a phenomenon of a perceived or actual improvement in a certain condition (i.e., autism) as a result of the treatment, which may or may not benefit the subjects (Moerman & Jonas, 2002). Any informal feedback from parents on their children's progress could be some kind of placebo effect, i.e., a measurable, observable or felt improvement in behavior not attributable to the DESC Program that was administered.

Finally, it was difficult to stop parents from sending their children to other complementary and/or alternative therapies (without informing us as they were not obliged to do so) while the subjects were still undergoing the 12-month DESC Program. Hence, it became difficult to conclude if the DESC Program was the treatment that had helped or failed to help the subjects, and not because of the other therapies that they were undergoing, too.

#### *Limitations of the Research Design*

There are several limitations to the choice of quasi-experimental research study using single group pretest/posttest design (Campbell & Stanley, 1966). There is no assurance that the DESC Program as the treatment in this study is the only or even the major factor in pretest-posttest difference. Next, there are plausible rival hypotheses or probable errors (Campbell & Stanley, 1966; Isaac & Michael, 1997) that can be caused one or more of the following:

1. History: Something other than the DESC Program could be causing the posttest mean to increase.
2. Maturation: Normal growth or maturation of the participants could be causing the increase in posttest mean.
3. Testing effects: The experience of taking the pretest, by itself, might increase motivation, alter attitudes, induce learning sets, or stimulate self-pacing. *It is a learning experience. Participants might become more experienced when the same test was used in the pretest and posttest* (Soh & Tan, 2008, p.39).
4. Changing effects of instrumentation: Any changes in the test, its scoring, the observation or interview techniques could make pretest and posttest different events.
5. Statistical regression: This could be an inevitable effect when an extreme group is being compared on pretest and posttest measures.
6. Selection biases and mortality: If the same participants did not take both pretest and posttest, differences might be due to uncontrolled characteristics or factors related to this difference alone.

#### *Precautions*

The findings of our study showed an overall improvement in terms of reduction in the subjects' stereotyped behaviors (e.g., decreased vocal and motor self-stimulation and rocking motion) and better communication and social interaction as a result of successful engagement between the 15 subjects and the dolphins. The group's mean AQ had also dropped from pre- to post-treatment suggesting that autistic behaviors were reduced in terms of quantity and the degree of severity. However, the DESC Program did not cure or eradicate the autistic symptoms. We want to caution that the DESC Program serves best as a complement to other conventional therapies and should not be used as a sole treatment for children with autism.

### Recommendations

The first recommendation concerns the experimental validity of the study. For it to be valid, it must truly represent what it was intended to represent. Experimental validity refers to the manner variables influence both the results of the study and the generalizability to the population at large. As mentioned earlier, we have identified four possible effects on the results of this study: observer/experimenter expectancy effect, placebo effect, novelty effect and Hawthorne effect. In order to avoid the observer/experimenter expectancy effect, which is a significant threat to the internal validity of the study, we recommend that in any future study, it is better to use a double-blind experimental design for a better control of any influencing factor, which can invalidate the findings. Next, similar to the placebo effect and/or novelty effect, in addressing the issue of avoiding the Hawthorne effect, it will be helpful to employ a control group to measure the effect of those not receiving any treatment in future studies. In this sense, the control group is being observed and to see if those subjects in the group would exhibit similar changes in their behaviors as the experimental group, and, therefore, negating the Hawthorne effect.

Our second recommendation is that while GARS (Gilliam, 1995) is a good measure widely used in Singapore to determine the probability of an individual with ASD and the degree of severity, it is indirect and based on third-party rating done by the subjects' parents in most instances. In a possible future study, we recommend that it will be better to use a more direct dependent measure available for psycho-educational diagnostic assessment and profiling.

### References

- Ang, Y. (2009, May 9). The flipped doctor is IN. *The Straits Times*, D8. Retrieved from: [http://www.autism.org.sg/press/2009/0905-ARCS\\_Senior\\_Consultant\\_VIEWS\\_On\\_Therapies\\_involving\\_Animals%20-%20ST.pdf](http://www.autism.org.sg/press/2009/0905-ARCS_Senior_Consultant_VIEWS_On_Therapies_involving_Animals%20-%20ST.pdf)
- Antonioli, C., & Reveli, M. A. (2005). Randomized control trial or animal facilitated therapy with dolphins in the treatment of depression. *British Medical Journal*, 331, 1231-1234.
- Baron-Cohen, S., Richler, J., Bisarya, D., Gurunathan, N., & Wheelwright, S. (2003). The systemizing quotient (SQ): An investigation of adults with Asperger syndrome or high-functioning autism and normal sex differences. *Philosophical Transactions of the Royal Society, Series B. Special Issue on Autism: Mind and Brain*, 358, 361-374.
- Boo, K. (2001). *Another of Sentosa's pink dolphin dies*. Retrieved from [http://www.ecologyasia.com/news-archives/2001/mar-01/straitstimes.asia1.com.sg\\_singapore\\_story\\_0.1870.31716.00.html](http://www.ecologyasia.com/news-archives/2001/mar-01/straitstimes.asia1.com.sg_singapore_story_0.1870.31716.00.html).
- Brakes, P., & Williamson, C. (2007). *Dolphin-assisted therapy: Can you put your faith in DAT?* Wiltshire, England: Whale and Dolphin Conservation Society.
- Brown, L., Sherberson, R. J., & Johnsen, S. K. (1982). *Test of non-verbal intelligence-3rd edition (TONI-3)*. Austin, TX: Pro-Ed Inc.
- Cai, Y., & Chia, N. K. H. (2011). *3D serious game for autism special education*. Paper presented at the Game-On Asia 2011-Asian Simulation Technology Conference *The Asian Simulation and AI in Games*, March 1-2, Digipen Institute of Technology, Singapore.
- Campbell, D. T., & Stanley, J. C. (1966). *Experimental and quasi-experimental designs for research*. Chicago, IL: Rand McNally & Co.
- Chandler, C. K. (2005). *Animal assisted therapy in counseling*. New York, NY: Routledge.
- Chia, N. K. H. (2008). Autistic savant: A need to re-define autism spectrum disorder (ASD). In *Special Educational Needs Monograph Series (Paper 1)*. Singapore: Cobee Publishing House.
- Chia, N. K. H., & Kee, N. K. N. (2010). Dolphin as a psychopomp: A window into the psycho-space of children with autism. *Unlimited Human! Fall(4)*, 40-44.
- Chia, N. K. H., Kee, N. K. N., Poh, P. T. C., & Watanabe, K. (2009). An Investigation on the Effectiveness of *Dolphin Encounter for Special Children (DESC)* Program for Children with Autism Spectrum Disorders. *Journal of American Academy of Special Education Professionals, Fall(3)*, 57-87.
- Chia, N. K. H., Kee, N. K. N., & Watanabe, K. (2010). *The effect of dolphin-assisted therapy based on Dolphin Encounter for Special Children (DESC) program on young children with high-functioning autistic disorder and sensory processing disorders*. Singapore: The Authors.
- Chia, N. K. H., Wong, M. E., & Watanabe, K. (2008). *The benefits of the Dolphin Encounter for Special Children (DESC) program for an autistic youth with synesthesia*. Singapore: The Authors.
- Cochrane, A., & Callen, K. (1992). *Dolphins and their power to heal*. Rochester, VT: Healing Arts Press.
- Cody, H., Pelphrey, K., & Piven, J. (2002). Structural and functional magnetic resonance imaging of autism. *International Journal of Developmental Neuroscience*, 20, 421-438.

- Cohen, J. (1988). *Statistical power analysis for the behavioral sciences (2nd edition)*. Hillsdale, NJ: Lawrence Earlbaum Associates.
- Cronbach, L. J. (1951). Coefficient alpha and the internal structure of tests. *Psychometrika*, 16(3): 297-334.
- Di Martino, A., & Castellanos, F. X. (2003). Functional neuroimaging of social cognition in pervasive developmental disorders: A brief review. *Annals of New York Academy of Sciences*, 1008, 256-260.
- Dobbs, H. (1990). *The magic of dolphins*. Cambridge, England: Lutterworth Press.
- Exkorn, K. (2003). *The autism sourcebook: Everything you need to know about diagnosis, treatment, coping, and healing*. New York, NY: Regan Books.
- Fox, N. S., Brennan, J. S., & Chasen, S. T. (2008). Clinical estimation of fetal weight and the Hawthorne effect. *European Journal of Obstetrics, Gynecology and Reproductive Biology*, 141, 111-114.
- Gilliam, J. E. (1995). *Gilliam autism rating scale (GARS)*. Leicester, England: Pro-Ed Corporation.
- Grandin, T. (2008). *The way I see it: A personal look at autism and Asperger's*. Arlington: Future Horizons.
- Gribbons, B., & Herman, J. (1997). True and quasi-experimental designs. *Practical Assessment Research and Evaluation*, 5(14). Retrieved from: <http://PAREonline.net/getvn.asp?v=5&n=14>
- Humphries, T. L. (2003). *Effectiveness of dolphin-assisted therapy as a behavioral intervention for young children with disabilities*. Retrieved from: <http://altonweb.cust.he.net/cs/downsyndrome/humphries.html>.
- Isaac, S., & Michael, W. B. (1997). *Handbook in research and evaluation: For education and the behavioural sciences (3<sup>rd</sup> ed.)*. San Diego, CA: Educational and Industrial Testing Services.
- Law, S., & Scott, S. (1995). Pet care: A vehicle for learning. *Focus on Autistic Behavior*, 10(2), 17-18.
- Lawson, J., Baron-Cohen, S., & Wheelwright, S. (2004). Empathizing and systemizing in adults with and without Asperger syndrome. *Journal of Autism and Developmental Disorders*, 34(3), 301-310.
- Levinson, B. M. (1969). *Pet-oriented child psychotherapy*. Springfield, IL: Charles C. Thomas.
- Levinson, B. M. (1984). Human-companion animal therapy. *Journal of Contemporary Psychotherapy*, 14, 131-144.
- Lukina, L. N. (1999). Influence of dolphin-assisted therapy sessions on the functional state of children with psycho-neurological symptoms of diseases. *Human Physiology*, 25(6), 676-679.
- Marino, L., & Lilienfeld, S. O. (1998). Dolphin-assisted therapy: Flawed data, flawed conclusions. *Anthrozoos*, 11(4), 194-200.
- McCarney, R., Warner, J., Iliffe, S., van Haselen, R., Griffin, M., & Fisher, P. (2007). The Hawthorne effect: A randomized, controlled trial. *BMC Medical Research Methodology*, 7, 30-37.
- McKinney, A., Dustin, D., & Wolff, R. (2001). The promise of dolphin-assisted therapy. *Parks and Recreation*, 36(5), 46-50.
- Moerman, D. E., & Jonas, W. B. (2002). Deconstructing the placebo effect and finding the meaning response. *Annals of Internal Medicine*, 136, 471-476.
- Myers, P., Baron-Cohen, S., & Wheelwright, S. (2004). *An exact mind: An artist with Asperger syndrome*. London, England: Jessica Kingsley.
- Nathanson, D. E. (1989). Using Atlantic bottlenose dolphins to increase cognition of mentally retarded children. In P. Lovibond & P. Wilson (Eds.), *Clinical and abnormal psychology* (p.233-242). North Holland, The Netherlands: Elsevier Science Publishers.
- Nathanson, D. E. (1998). Long-term effectiveness of dolphin-assisted therapy for children with severe disabilities. *Anthrozoos*, 11, 22-32.
- Nathanson, D. E., & de Faria, S. (1993). Cognitive improvement of children in water with and without dolphins. *Anthrozoos*, 6(1), 17-29.
- Nathanson, D. E., de Castro, D., Friend, H., & McMahon, M. (1997). Effectiveness of short-term dolphin-assisted therapy for children with severe disabilities. *Anthrozoos*, 10(2/3), 90-100.
- Ray, J. W., & Shadish, W. R. 1996. How interchangeable are different estimators of effect size? *Journal of Consulting and Clinical Psychology*, 64, 1316-1325.
- Rimland, B. (1990). Autistic crypto-savants. *Autism Research Review International*, 4(1) 3.
- Servais, V. (1999). Some comments on context embodiment in zootherapy: The case of Autidolfijn project. *Anthrozoos*, 12, 5-15.
- Shadish, W. R., Cook, T. D., & Campbell, D. T. (2002). *Experimental and quasi-experimental designs for generalized causal inference*. New York, NY: Houghton Mifflin.
- Siegel, B. (1996). *The world of the autistic child: Understanding and treating autistic spectrum disorders*. New York, NY: Oxford University Press.
- Simpson, R. L. (2005). *Autism spectrum disorders: Interventions and treatments for children and youth*. Thousand Oaks, CA: Corwin Press.

- Smith, B. A. (1981). *Using dolphins to elicit communication from an autistic child*. Miami, FL: School of Public Affairs and Services.
- Smith, B. A. (2003). The discovery and development of dolphin-assisted therapy. In T. Frohoff & B. Peterson (Eds.), *Between species: A celebration of the dolphin-human bond* (p.239-246). San Francisco, CA: Sierra Club Books.
- Soh, K. C., & Tan, C. (2008). *Workshop on action research: Transforming teachers to action researchers*. Hong Kong: Educational Leadership 21.
- Tawney, J. W., & Gast, D. L. (1984). *Single-subject research in special education*. Columbus, OH: Merrill.
- Treffert, D. A. (1989). *Extraordinary People: Understanding Idiot Savants*. New York, NY: Harper and Row.
- Watanabe, K., & Lee, J. (2004). *Dolphin Encounter for Special Children (DESC): Proposal for Standard Procedures: Special Dolphin Program for Children with Autism, Down Syndrome, and Physically Disability*. Singapore: Underwater World.