



Crafting a Process to Scale up Verbal Communication Training for Children with Autism Using TRIZ Methodology

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Abstract – “To measure the success of our societies, we should examine how well those with different abilities, including persons with autism, are integrated as full and valued members.” -Secretary General Ban Ki-Moon

Autism is an intricate neurobehavioral condition that comprises impairments in social interaction and communication skills along with rigid, repetitive behaviors. This condition is often referred to as Autism Spectrum Disorder (ASD) since it is not one condition but often a range of symptoms. Most children with autism, encounter difficulties in verbal communication. Some children may develop good speech but may still face trouble knowing how to apply the known vocabulary to communicate with others.

To stay included in the society, communication plays a vital role. Being able to communicate efficiently is a very significant life skill. Without being able to express themselves, children with autism face a lot of challenges in leading a normal life in the society. Major issues they face while communicating are lack of vocabulary and inability to construct sentences. They also struggle to understand the application of the same word for different purpose. For example, when ‘BOOK’ is explained as an object to read from for knowledge, they struggle to understand how the same word can be used when referring to buying tickets. Like nouns, they face difficulty in learning new verbs, pronouns and prepositions. Current intervention techniques to improve verbal communication mainly includes two methodologies – Classical Learning and Reinforcement based Learning. A combination of both of these techniques make a very effective training for Autistic children. However, the process is very slow and given the short time a special educator gets to train a child every day, it may take up to 14 days for a child to learn one new verb and few nouns, pronouns and prepositions associated to the new verb.

We applied a structured innovation methodology – TRIZ to identify the key disadvantage of the current training process and then resolved contradictions that were created while trying to solve the disadvantages. The result is a highly engaging technology-based training program where not only we will be able to scale up the process of verbal communication training but can also ensure that kids learn other key skills at a much faster rate.

Keywords – Autism, Communication training, verbal communication, Autistic, Classical Learning, Reinforcement based Learning

Let's Understand Autism

Autism, also referred to as the Autism Spectrum Disorder (ASD), is an intricate condition that comprises problems in communication and behavior. It involves an extensive range of symptoms. ASD can be a trivial issue or a disability requiring full-time care in a facility. According to the Diagnostic and Statistical Manual of Mental Disorders (DSM-5), a guide created by the American Psychiatric Association used to diagnose mental disorders, people with ASD have:

- Difficulty with communication and interaction with other people
- Restricted interests and repetitive behaviors
- Symptoms that hurt the person's ability to function properly in school, work, and other areas of life

People with autism have trouble understanding what other people think and feel. This makes it hard for them to express themselves, either with words or through gestures, facial expressions, and touch.

The three main areas affected by autism are communication, socialization and behavior. All the developmental areas are interlinked with each other. When a child suffers a deficit in one of the areas it automatically hampers the development of other areas too. In case of Autism, as the part of communication is delayed it shows deficit in the area of socialization as well as in behavior.

Communication – a vital ability

The exchange of info or passing of info, thought or ideas from one individual to other is known as communication. According to Dalton McFarland, meaning of communication is as following - “a

process of meaningful interaction among human beings. More specifically, it is the process by which meanings are perceived and understandings are reached among human beings.”. Whatever an individual wish to communicate to another individual, it should be evidently understood by the individual or else the actual purpose of the process would be beaten. Communication thus aids to comprehend people better removing mix-up and creating lucidity of views and expression. It also edifies people.

Inability to Communicate due to Autism

A child with Autism is often unable to express themselves resulting in lack of ability to mix with others. The child also finds it difficult to express his or her needs leading to mal-adaptive behavior or odd behavior. Many children with Autism are verbal but there are various instances where children are found to be non-verbal. One should understand that those non-verbal children do not have problem in their sensory areas or in the vocal cord. Some neurological problem results in their inability to express. They have problem of repetitive language, echolalia and inability to follow facial expressions.

Few of the problems they face includes problem of using pronouns - they face difficulty in pronoun reversal e.g. if ‘me’ is the correct usage in a sentence they may end up replacing it with ‘I’. Even if they comprehend what to say, they are unable to express it in a proper manner. A child with Autism once saw someone eating something in a sweet shop and throwing the paper on the road thus littering the road. The child wanted to tell the person it is not right to litter the road – he learnt this from a moral story book. The story in the books talks about a character named Jim and it teaches if someone litter the road, the character Jim may step on the thrown object and may fall down. When the child saw the man throwing the paper on the road outside the shop, he

remembered the situation read in the book and said “do not throw the things outside the road. If you do like this Jim will fall down, so use dustbin.” This is an example where we see that though they can relate the situation, they are unable to make the phrase contextually. Sometimes they are unable to follow the proper intonation. The word Autism come from the word 'autus' which means inner world. Children with Autism mostly belong to their inner world - they are unable to follow the pattern of speech others use.

Another problem they face is that of following communication using eye movement or any nonverbal communication in that matter. Through communication training they may overcome such problems. One big reason why they fail to follow facial expressions is their inability to make eye contacts. Once they are trained to follow eye contact, they start comprehending nonverbal communication helping them to understand various situations. They also start following the pattern of communication.

Children who are verbal, uses language in their own way. They can be trained to improve their ability to use language meaningfully. For nonverbal children we may try to improve their ability to make eye contacts and then use it to help them follow facial expressions of others and respond.

Classical Conditioning and Reinforcement Learning

There is a process of learning called Classical Conditioning – in this process we practice something for long to make it a habit. We often use Classical Conditioning as an intervention methodology for children with Autism. Special educators use picture cards in different contexts to generate habit in children. This helps them to follow particular pattern of a type of communication. For example, when they are taught to say 'good morning' to all in the morning, they learnt the usage of the phrase. Same way we may teach them to say 'thank you' when they receive something from others.

Reinforcement Training, on the other hand, asks for different kinds of reinforcement in every step. An example – trainer gives the child a reward once he / she uses the right phrase to express his / her feelings. By this they tend to remember the things been taught. It helps to modify the behavior. But it is very difficult to provide abundant exposure of communication to the child using this technique.

But both classical conditioning technique and reinforcement-based technique takes lot of time to train a child with autism and help him / her to communicate better. Unfortunately, a special educator has only limited time for a particular child and that is not enough. Also, there is a level of breadth in communication that a trainer may plan to train a child – that is not enough for improving the overall communication in a child within a stipulated time. Long hours of training make a child feel bored – more so for a child with autism.

Systematic Problem-Solving method – TRIZ

A good analysis of the shortcomings of existing the system should help to bring out the underlying problem. For this we have applied a systematic innovation methodology known as TRIZ. Using TRIZ, we will formulate solutions that are going to scale up the training for multiple kids at a stipulated time with high effectiveness.

The TRIZ methodology follows an orderly structure: -

Stage 1 - We do Root Cause Analysis of the main disadvantage(s) in question. This process is essentially a Multi-WHY Analysis.

Stage 2 - Once the main disadvantage(s) is defined we start formulating the contradiction statements. Contradiction arises when improving one parameter of the system results in deteriorating another parameter of the same system. Here we assume that both the parameters

are equally important to the system. Another way contradiction arises is when the same parameter is required to have contradictory values at different situations. For a system to be inventive it is very important to identify the contradictions and resolve them. In TRIZ, there are mostly two types of contradictions - technical contradiction and physical contradiction. Technical contradictions are the ones that sees one parameter improving at the cost of another parameter. Physical contradictions, on the other hand, are situations where the same parameter of the system is required to have contradicting values at different situations.

There is a reason why it is important to formulate contradiction statements and resolve them using TRIZ methodology to come up with inventive solutions. The problems that we encounter in our daily life often leads to a lot of contradictions. When we encounter a contradiction, we tend to optimize the solution – thus, we compromise with our expected results. Resolving contradictions using TRIZ methodology, an inventor comes up with novel solutions while fulfilling the requirements of both the contradicting situations. The not-been-tried-out solution thus becomes inventive.

Stage 3 - There are 40 inventive principles framed by Genrich Altshuller, the creator of TRIZ methodology. After the Stage 2, once we have formulated the contradictory requirements, we apply these Inventive Principles to come up with solutions. Contradicting requirements are formulated in such a way that they lead to generic problem statements. TRIZ inventive principles then provide generic solutions to those generic problem statements. An inventor should then convert the generic solutions into domain-specific solutions while considering the generic solutions as triggers to coming up with the novel ideas.

Applying TRIZ to scale up Communication Training for Children with Autism

We do the Root Cause Analysis of the main disadvantage – The Communication training for children with Autism is time consuming and thus non-scalable.

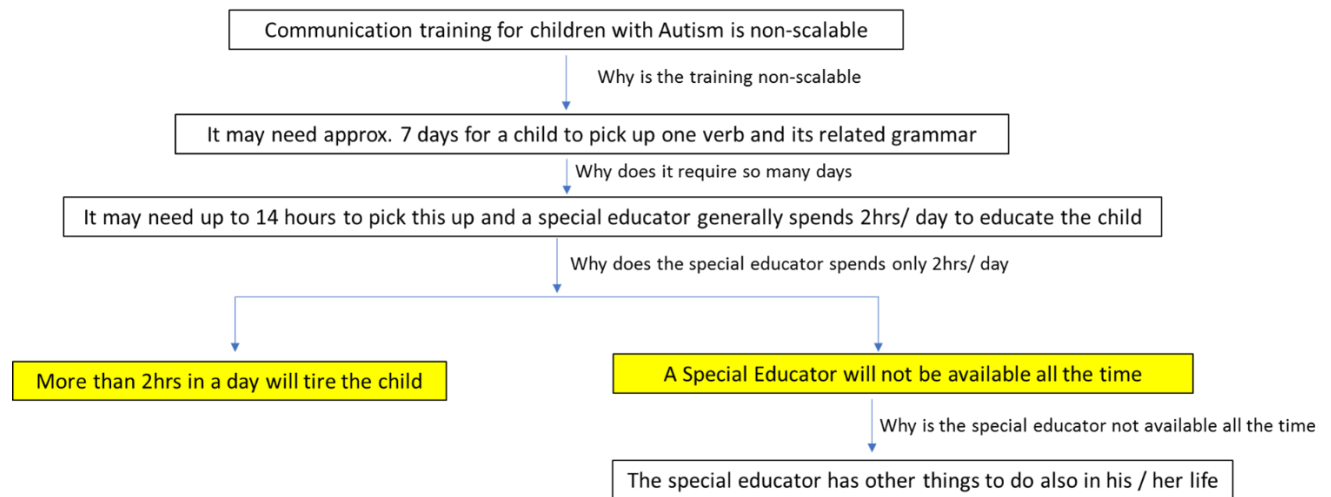


Fig 1. Root Cause Analysis of the Main disadvantage identified. The highlighted ones are the Key Disadvantages to be solved

With the defined Key Disadvantages, we formulate the contradiction statements.

Technical Contradiction formulated for the first problem –

If the Special Educator trains the child for long hours

Then, he / she will learn more words

But, he / she will get tired

We generalize the problem to find that the contradiction lies in **improving the Volume of a moving object** (knowledge is fluid) and **worsening the Energy of the system** (fatigue for the child). We find the following inventive principles to trigger ideas:

- a) Nesting – one within another
- b) Inversion - Turn the object upside-down
- c) Prior Action - Carry out all or part of the required action in advance
- d) Periodic Action - Replace a continuous action with a periodic (pulsed) one

Physical Contradiction formulated for the second problem –

The Special Educator should always be available to guide the student

But, the Special Educator should be unavailable to do his / her other work

The Physical contradiction requires the Special Educator to be available with the child for a longer period of time till when the child is mentally available to get trained. This is a classic case where the contradiction can be resolved by Separation in Time i.e. at the time, when the child is mentally available the Special Educator must be available too but the trainer at other times can be unavailable.

There are few inventive principles that can trigger some ideas to help resolve contradictions using Separation in Time: -

- a) Rejecting and regenerating parts – Remove portions of an object that have fulfilled their function
- b) Cushion in advance – Compensate for the relatively low reliability of an object by countermeasures taken in advance

Based on these available triggers and using various exponential technologies at our disposal, we could come up with a unique methodology to train children with Autism in developing their communication and successfully scale up the process:

We crafted a unique gamified communication training methodology for the children called 'I SEE' (as in, I Understand!). This will include a display screen, headphone with a mic, a camera along with keyboard, mouse or joystick. Various games will be displayed on the screen based on the level of training the child requires. For example, a child requiring ability to identify a certain color will be shown different colours of ball. The screen will display what color to identify while the same will be pronounced over the headphone. The child may use joystick or eye gesture (captured by the camera) to point out the colour (in case of non-verbal child) or pronounce the correct ball's number (for a verbal child). They collect points as they keep on answering correctly. They may collect gifts based on the amount of points they could score at the end of the day's session (combining reinforcement training). This kind of training will be situation based where the Special Educator is not teaching unique words every time, but new words just keep popping up based on the requirements of the game. This will help the child to learn multiple words and contexts of when these words are used (using Inventive principle: Nesting). To ensure that the child applies the knowledge in real world than just getting stuck into the virtual world, there will be another incentive-based system in place. Whatever they could learn in a session, if they apply in real world, they would collect more points. The validation of how they are applying this knowledge will be done by parents and shadow teachers. Since this is a machine – child interaction (using the inventive principle: cushion in advance) the number of words that can be taught is more than when done manually. With this arrangement, the Special Educator should concentrate on creating content for games to be used to train the children - the main delivery happens through the machine.

This TRIZ based novel method 'I SEE' should drastically reduce the time required to effectively train a child and can be scaled up to train multiple children at the same time.

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