

Story narratives and theory of mind: an intervention for children with high functioning autism

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ABSTRACT

This study aimed at reducing ToM deficits through mental state attributes, using story narratives that deploy long-term potentiation through a cognitive intervention among children with high functioning autism. Adopting non-concurrent multiple-baseline experimental design spanning across 25 session days, the hypotheses were: 1) Use of story narratives will reduce ToM deficits and will increase mental state attribution. 2) Use of story narratives will increase creativity and reduce functional fixedness. Post-intervention, both participants displayed an increase in verbalization and a reduced functional fixedness with resultant increase in creativity. However, only one of the participants was able to complete the Sally Ann Task indicating emergent ability to attribute false beliefs to others. Story narratives hold promise as an effective tool in ToM training.

Keywords: *Theory of Mind, High-functioning autism, Long-term potentiation, Creativity, Functional fixedness, Story narratives*

Theory of Mind (ToM) enables an individual's knowledge, beliefs, perspectives, and emotions, which appropriately help them predict, reason, and differentiate the behaviors of others and their own, thereby ascribing mental states (Premack & Woodruff, 1978). Individuals diagnosed with autism spectrum disorder (ASD) are characterized by impaired social skills (Lord, 1984; Baron-Cohen, Leslie & Frith., 1986), "tend not to use mental-state terms in their spontaneous speech, and exhibit difficulty distinguishing mental from physical entities" (Leekam, 1993), thereby failing to ascribe beliefs to others- leading to deficits in ToM (Meltzoff, Gopnik, Baron-Cohen, Tager-Flusberg & Cohen, 1993).

Individuals with ASD lack the ability to attribute mental states (Happe, 2003), and this was a key reason to identify a definitive neural system backing the mechanism. Vogeley et al (2001), through their research, identified that the "self" condition activated the same neural networks with only a slight difference in the activating pattern to that of the neural networks in the ToM condition. In line with this study, Happe (2003), indicated that individuals with

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Story narratives and theory of mind: an intervention for children with high functioning autism

ASD may also have impairments in knowing their own minds. Brothers (1990), while researching social intelligence deficits in ASD, reviewed the neural network regions of the “social brain” to find reduced activation in several components of the frontal regions of the brain and observed little or no activation in the amygdala.

Language is an important component of social communication that allows narration through verbalization. De Villiers (2007), aimed to understand the relationship between ToM and language among children with ASD as against neurotypical children. Their research indicates when individuals with ASD possess knowledge of specific complement clauses they may use it as a privileged means of 'hacking out' solutions for verbal false belief tasks (de Villiers, 2007). In a more recent article by the authors (de Villiers, 2014) they emphasize the value of narratives and state “that the information about minds conveyed through conversation is richer than that conveyed through behaviour, eye gaze, or gestural expression of feelings and desires”. Of the existing interventions used in improving social communication, the use of social stories has been preeminent and an important tool for training and analyzing mental state perspectives (Gray, 2010). Story narratives have also proven to be a successful tool to study language in the ASD population, as the syntactic complexity in their narratives is lesser, often with omitted morphemes and heightened coordination rates (Roberts, Rice, Tager-Flusberg & Helen, 2004; Eigsti, Bennetto & Dadlani, 2007; Marinis, Terzi, Kotsopoulou & Francis, 2013 & Norbury, Gemmell & Paul, 2014). Research has found positive relationships between storytelling, language abilities, and creativity; ascribing to improvement in play and social development (Holmes et al., 2019).

Creativity, often a challenge for children with ASD, is fundamental in engaging in the process of story narration. Halle, Ninness, Ninness & Lawson (2016), assessed the intervention designed by Gray (2010) and the outcomes of using social stories. They found consistent improvements in social responses among participants and prosocial greeting responses even during follow-up. There is ample research that has highlighted the potential of storytelling in creativity and enhancing imagination (Raines & Isbell, 1994), extending children's social lives (Britsch, 1994), developing and improving cognitive skills (Britsch, 1994; Nicolopoulou, Cates, De Sá Barbosa & Ilgaz, 2012), and contributing significantly to language development (Cooper, Collins & Saxby, 1994).

Creativity is an individual's ability to generate something authentic and purposeful, thereby benefiting society at large (Zhu, Zhang, Qiu, 2013; Fink et al., 2010). Often constituting a generation of novel ideas, creativity is largely dependent on divergent thinking and the ability to break away from fixedness. Functional fixedness is when one experiences difficulty in thinking of multiple functions for a single object inhibited by previous learning or experiences (German & Barrett, 2005; Jansson & Smith, 1991) - an attribute that poses a significant challenge amongst children with ASD (Biro & Russel, 2001). Ward's Theory of Structural Imagination and Path of Least Resistance (Ward, 1995) suggests that within the neurological system, spreading activation patterns and their resultant strength determine how creative or novel an idea can be. Often these limited sets of stimuli dominate a specific neural network and disable the brain's ability to activate newer nodes disallowing newer ideas and associations to form (Hallihan & Shu, 2011). Best, Arora, Porter and Doherty (2015) indicated in their study that higher the severity of autism, lower their achievement on divergent thinking tasks. Cohen and Scott (1996), also allude that for creativity directed tasks such as storytelling, executive function impairments extend into “persistent imaginative impairments”.

Story narratives and theory of mind: an intervention for children with high functioning autism

Evidence of physiological processes that enable one to engage in creativity (Hallihan & Shu, 2011), largely depends on learning (Selvi, 2007). While engaging in learning, a specific set of synapses responsible for particular action gets activated, creating a long-lasting pattern over multiple activations, thereby efficiently strengthening neural connections (Sweatt, 2009; Bliss & Cooke, 2011; Hallihan & Shu, 2011). There is well-established evidence that long-term potentiation (LTP) plays a critical role in memory formation (Bliss, Collingridge & Morris, 2003) and information storage in learning (Van Pragg, Christie, Sejnowski & Gage, 1999; Cooke & Bliss, 2006). Deriving from both these theories, the role of LTP is ubiquitous in creative thinking (Hallihan & Shu, 2011).

Within the ASD population, children with HFA show significant levels of impairment in LTP-like plasticity in comparison to their neurotypical counterparts (Jung et al., 2013). Hallihan and Shu (2011), however, propose that LTP as a process emphasises the brain to be malleable enough to rewire itself, especially when exposed to repeated patterns of neural activation; the strength of which would determine propriety of creative thoughts (Gabora, 2010), thereby providing scope for the proposed intervention in this study.

While research has established the importance of ToM in human cognition, and the lack thereof in children with ASD, very little has been addressed through broad scope intervention studies aimed at training these children and their perceived deficits. Most of these were restricted and narrow in their approach which questions the generalizability of treatment. Intervention studies that target ToM in isolation are bound to be less effective than when combined with precursor skills such as language, creativity, and executive functions. Several studies have found targeting ToM in conjunction with social communication components to be more effective with higher success in generalizability, when compared to intervention studies that singularly target ToM skills (Kimhi, 2014; Gould, Tarbox, O'Hara, Noone, & Bergstrom, 2011; Paynter & Peterson, 2013).

In this study we propose an intervention aimed to reduce ToM deficits and functional fixedness while increasing creativity, through a cognitive intervention protocol that engages and strengthens LTP, which in turn requires language. Our objective was to establish the following premises - first, the use of story narratives as an intervention reduces ToM deficits while simultaneously increasing mental state attributes, and second that these story narratives because of their inherent qualities increase language, creativity and reduce functional fixedness thereby leading to the overall improvement in ToM attributes. The hypothesis set for the study were 1) Use of story narratives will reduce ToM deficits and will increase mental state attribution. 2) Use of story narratives will increase creativity and reduce functional fixedness.

Materials and Methods

The present study was conducted at a child development institute, in Chennai, India, incorporating a nonconcurrent multiple baseline experimental design across participants. Dependent variables for the study were mental state attribution (ToM) and creativity.

Participants, Setting, and Definitions

Participants were chosen on the basis of set inclusion criteria being, a) the participant must be clinically diagnosed with autism with emergent/ moderate capacity to communicate verbally b) the participant comprehends and communicates in English and c) the participant has previous exposure to therapy. A "Consent to Participate" was issued and signed by the parents of the participants.

Table 1. Demographic Details of Participants

Criteria	Ivan	Kate
Grade	3rd	2nd
Gender	Boy	Girl
Spoken Language	English	English
Clinical diagnosis	HFA	HFA
Functional communication	Simple sentences	Phrases
Expressive communication	Beyond functional communication	Expresses needs/wants
Expressiveness - structure and syntax	Adequate	Emergent
Expressiveness - mental state attribution	Emergent	Yet to emerge
Functional fixedness	High	High
Received Therapy	Cognitive Training, Behavioural and Expressive Arts Therapies	Cognitive Training, Speech-language, Occupational, Behavioural and Expressive Arts Therapies

Two children of Indian origin diagnosed with HFA participated in this study. Both participants were verbal and could communicate their functional needs but had reduced ability to use elements creatively indicative of high functional fixedness. Table 1 further details each participant's age, functionality and therapies they were receiving. Pseudonyms have been assigned in order to maintain anonymity and discretion of the participants true identity, indicated as "Ivan" and "Kate".

For this study, we drew inspiration from the works of Trabasso and Sperry (1985), Trabasso and Van Den Broek (1985), and Baron-Cohen, Leslie and Frith (1986). Mental state attribution, an important element utilizing ToM is the ability to contemplate beliefs, knowledge, intention, desire and emotions of others (Baron-Cohen, 2001; Brune, Abdel-Hamid, Lehkamper & Sonntag, 2007).

Table 2 Definitions of Mental State Attributes

Causal Connection- Sentences that consist of elements with a clearly defined connection and identify a causal relationship among each-other.

Type 1 Mechanical Statements	Any statement that connects elements on the basis of a definitive cause-effect relationship which may be conveying a fact or describing observations of things as one sees. E.g. "cat in the house".
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Causal Chain- Any statement that connects elements on the basis of a definitive cause-effect relationship which may be conveying a fact or describing observations of things as one sees.

Type 1	Sentences that consist of descriptions of a task, routine activity or a
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Story narratives and theory of mind: an intervention for children with high functioning autism

Behavioural Statements	situation between two or more elements that indicate a motivation driven by one element over another to reach a goal.
Type 2 Intentional Statements	application of abstract thought/reasoning, provide attributes such as wishes, desires, intents, feelings, thoughts and beliefs of characters/elements in description i.e., these will indicate presence of perspective-taking (ToM).

Table 2 enumerates how mental state attributes were coded and measured through sentences that depict a relationship between the given categories, from factual information and/or mere descriptions of observations (causal connections) to applying mental states such as beliefs, intention, desire, knowledge, emotions to a character in the context of a situation (causal chain), thus enabling perspective taking. Causal connections and causal chains are perceived as part of a continuum, indicative of how far the child was able to progress; from the absence of mental states to employing them appropriately in their sentences.

Psychologists have offered numerous definitions of creativity (Plucker, Beghetto, & Dow, 2004; Runco & Jaeger, 2012). Creativity is believed to involve the production of novel, useful products (Mumford, 2003), of "something original and worthwhile" (Sternberg, 2011). There is a general consensus that the most acceptable definition was given by Torrance (1966) who defined creativity as a process of becoming sensitive to problems, deficiencies, gaps in knowledge, missing elements, disharmonies, and so on; identifying the difficulty; searching for solutions, making guesses, or formulating hypotheses about the deficiencies; testing and retesting these hypotheses and possibly modifying and reevaluating them; and finally communicating the results. Beyond being a single process, several different cognitive processes have been linked to creativity (Damian & Simonton, 2015). Guilford (1956, 1959, 1960, 1986) elucidates creative thinking to involve divergent thinking, which emphasizes fluency, flexibility, originality, and elaboration. In line with Guilford's theorization, this study measures creativity based on 5 facets, as defined in Table 3, that fulfil the criteria rather than a singular creative process that is difficult to measure.

Experiment Design

For this study, we employed a nonconcurrent multiple-baseline design (also referred to as a 'natural' multiple-baseline design), one of the several variations of single-subject research designs, which allowed participants to be naturally evaluated at different points in time (i.e., consecutively rather than concurrently). The nonconcurrent multiple-baseline design (Watson & Workman, 1981) essentially is a series of A–B replications. We chose this design in favor of a concurrent multiple baseline design owing to participant availability, as they were only available in succession, thus making concurrent observations impossible. Besides, when it comes to intervention for individuals with autism, single-subject research designs are highly favored due to the flexibility in accounting for the uniqueness in the presentation of autism and aids understanding aspects pertaining to the individual participant across treatment sessions (Morgan & Morgan, 2001). For each participant, the intervention spanned across 15 sessions in addition to baseline and assessment sessions of 60-minutes each.

Phase A: Baseline and Assessment.

We used the Sally-Anne task (Wimmer & Perner, 1983) to explore the presence of ToM among the participants through the false-belief question. Successively, we utilized Rory's Story Cubes, a dice-based game with six-pictorial representations in each cube to enable

Story narratives and theory of mind: an intervention for children with high functioning autism

story narration for evaluating creativity and the narrative ability of the participants. These tasks were used during baseline sessions and the assessment, post-intervention.

Phase B: Intervention.

The intervention was designed to identify if the participants were able to make causal connections (mechanical statements) and to identify if the narrative content follows causal chains (behavioural sentences/intentional sentences). The mental state attributes were operationally defined (Table 2) based on causal connections and causal chains that were emergent from the sentences formed by each participant. The intervention involved alternating between Phase B1 (3 days) and Phase B2 (2 days) alternating 3 times, adding to 15 intervention days in all.

Intervention (Phase B1).

There were two activities within a session in this phase - A story narration followed by a board game. For the story narration, we chose 5 classic fairy tales and adapted their content incorporating the social story rules by Gray (2010) and established content validity. Each story had 5 integral aspects that were established through the narrative - character, emotion, elements (objects that were imperative to the story), setting, and a theme. For e.g. Jack (character 1), Beauty (character 2), sad (emotion), oven (element), valley (setting event), celebration (theme). We narrated these stories as per the script, to the participants along with visual support (black and white pictures), followed by the board game "Terrific Tales Teller" for 30 minutes. We carefully and creatively developed this board game to promote story narration among the participants. As in any board game, it had dice to roll and move forward, cards based on the 5 categories, a specific point system to progress successively within the board, and achieve the Terrific Tales Teller Crown (reward) if they reached the end. We read out a set of instructions to the participants prior to beginning each component in all sessions. For each turn, participants were randomly assigned cards from the categories mentioned above and the child had to narrate his/her own story.

To ensure activation of the right and left-brain hemisphere and enable LTP, we provided participants with drawing sheets, art supplies and ten minutes to draw anything they liked without any instructions or restrictions. This enabled the integration of right and left-brain neural networks in the participants, where the left was activated linguistically and right activated visually. To keep participants on task we employed a least-to-most prompt system. We established the prompt hierarchy upon predefined criteria of what type of prompt was warranted and when.

Intervention (Phase B2).

Cognizant of the demands story narration has on language, we designed phase B2 to improve language and verbal creativity. In addition to the Terrific Tales Teller game, we added a supplemental activity in which participants had to make sentences using visual prompts that were provided. The activity was presented with visuals in three conditions of increasing difficulty, wherein the number of stimuli presented also increased. In each of the conditions, participants were expected to make a sentence, connecting each set of visual stimuli provided, by creating a relationship between them.

Data Collection

The research assistants primarily recorded the number of occurrences based on the previously defined variables. A second coder also recorded occurrences to ensure interobserver agreement (IOA) on the coded data. The frequency of occurrences indicated the presence of

Story narratives and theory of mind: an intervention for children with high functioning autism

causal connections (mechanical sentences) and causal chains (behavioral/intentional sentences), while how they were connected indicated the presence of abstract thinking, lending towards coding for the presence of creativity. We calculated the mean number of sentences for each trial.

Given the lack of a definition in measurable and/or quantifiable terms, we created a rubric to measure creativity; with a scoring method allowing for empirical support as to whether or not a narration was creative. Rubrics are criteria-based scoring schemes that help researchers make decisions needed to evaluate and assess data (Quinlan, 2012), especially when research data to be recorded needs to be monitored for its quality (Boettger, 2010). Maggin, Briesch, Chafouleas, Ferguson, & Clark, (2014), in their study, elaborate on how rubrics can be useful as scoring procedures used to evaluate primary research reports in single-subject research studies.

Table 3 Facets of Creativity

	Facet	Definition
I.	Insight	defined as ability to evaluate thoughts and beliefs
II.	Divergent thinking	defined as the ability to think away from the context
III.	Generating ideas	defined as the ability to form or connect categories in a novel way
IV.	Originality of ideas	defined as the participant's ability to use the categories provided in a new way, i.e. thinking out of the box
V.	Flexibility	defined as the ability to use an element in a different context

Table 3 describes the rubric designed for this study based on six criteria along with the 5 facets of creativity previously described including self-reflection, where a score of 3 was the highest and 1 the lowest for each criterion.

Prior to beginning this study, we documented and clearly outlined the variables and recording measures. We meticulously audio recorded each session and subsequently scored the data for trials, duration, the types of responses, and their occurrences on the basis of the transcribed data. A member of the research team always served as the second independent observer for IOA purposes. IOA was assessed across baseline, intervention phases, and assessments for a minimum of 30% of sessions for each participant. IOA was evaluated using Cohen's kappa (Cohen, 1960). The mean IOA scores for each participant were calculated where kappa values of 0.81–1.0 indicated very good agreement, kappa values of 0.61–0.80 good agreement, and kappa values of 0.41–0.60 moderate agreement (Brennan, & Silman, 1992).

RESULTS

Our study aimed at Improving mental state attribution with an increase in creativity to bring about a reduction in ToM deficits training, which was evaluated using nonconcurrent multiple baseline design. Presented below are the effects of the intervention for each participant in a graphical format and also the means and ranges in tables.

Table 4. Sally Ann Task

Evaluation Criteria	Participant I		Participant K	
	Baseline	Assessment	Baseline	Assessment
ToM question Where will Sally find the ball?	Fail	Fail	Fail	Pass

Table 4 highlights the performance of both participants on the Sally Ann Task during baseline and assessment. While Ivan showed implicit awareness, he could not adequately answer the ToM question to pass the task. On the other hand, Kate was unable to answer the ToM question in the Sally Ann task in the Baseline phase. However, Kate was able to take Sally’s perspective and respond appropriately and passed the task in the assessment phase.

Table 5 Rory's Story Cubes

Evaluation Criteria	Ivan		Kate	
	Baseline	Assessment	Baseline	Assessment
Causal Connections	20	15	0	34
Causal Chains	17	10	0	26
Creativity	8.2/18	12.2/18	6/18	13.2/18

Table 5, indicates the performance of both participants on the Rory’s Story Cubes Task. Ivan’s performance was positive where his baseline score of 8.2 for creativity increased to 12.2 during the assessment. As set out by the study, this was a task that measured both mental state attributes and creativity. Kate’s scores indicate improved performance across both measures during the assessment. Her assessment scores (causal connections=34, causal chains=26) are higher when compared to her baseline performance which was at nil, and there was a progressive increase in her performance through intervention.

Table 6 Story Narrative and Measurement of Mental State Attributes for Ivan

Phase and Sessions		Causal Connections		Causal Chains	
		Mean	Range	Mean	Range
Phase B1	Session 1	7	3-11	14.5	14-15
	Session 2	4.5	2-7	31	7-55
	Session 3	5	2-8	24.5	24-25
	Session 4	1.33	0-3	12	5-25
	Session 5	3.25	1-6	11	6-18
	Session 6	4	2-7	12.4	4-30
	Session 7	3	2-4	2	11-11
	Session 8	1.5	2-3	5.5	5-6
	Session 9	1.6	0-3	4.8	3-7
Phase B2	Session 1	8.3	4-14	15.66	7-31
	Session 2	6	4-10	15	9-31
	Session 3	3.28	2-6	11.86	6-24
	Session 4	4.2	1-7	6.2	3-15
	Session 5	2.8	0-9	5.6	0-15
	Session 6	0.75	0-2	3.62	3-5

Story narratives and theory of mind: an intervention for children with high functioning autism

Table 6 and Figure 1 depict the numeric and visual analysis of causal connections and causal chains produced by Ivan. The graph depicts performance through the intervention phase, indicating an increase in Ivan’s ability to formulate statements with causal connections and chains. Although, Ivan’s narratives saw a reduction in the total number of causal connections and causal chains during the assessment phase (causal connections=15, causal chains=10) when compared to his baseline performance (causal connections=20, causal chains=17), there was an improvement in the quality of statements created due to improved language comprehension and coherence in his statements which is quintessential to story narratives and creativity (Table 7), showing an escalation in performance on creativity measures and a decrease in fixedness of thoughts and ideas.

Table 7 Sample Progression of Story Narrative by Ivan

Phase	Statement
Baseline	"Once upon a time there lived a baby turtle."
3 (B1)	"When they cut the spider web they saw a hiding spot."
9 (B2)	"Once of the soldiers' sent Beauty to jail and she cried."
12 (B1)	"Hansel's cup-friends were trapped in a cage and they said "oh no! someone has the cage!"
14 (B2)	"There was a little pig with an axe and he was teasing all the animals with it."
Assessment	"Once upon a time there was a sheep, having a sad and happy mask and they had the key to open the house and scared- it was Halloween and called their parents on the phone and they had spooky costumes too! and they slept."

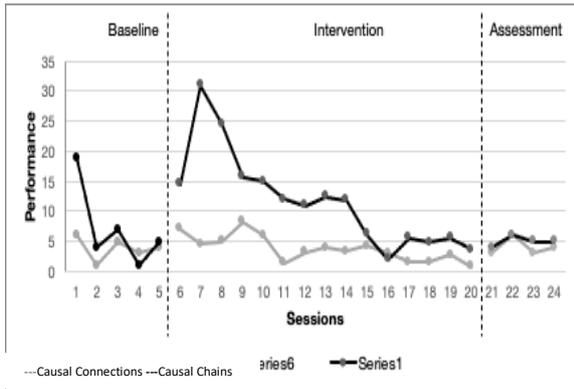


Figure 1. Indicating the causal connections and causal chains constructed by Participant I from baseline, intervention up to assessment session

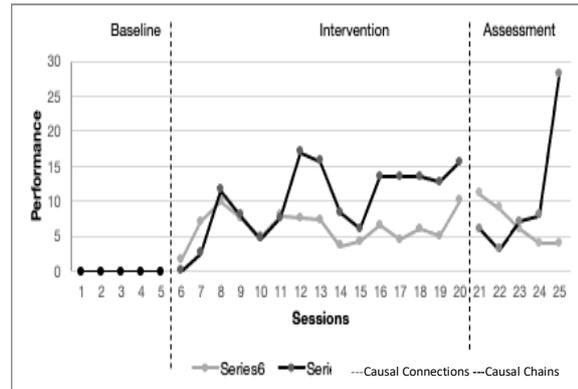


Figure 2. Graph indicating the creativity scores obtained by Participant K during baseline, intervention sessions and assessment, respectively

Table 7 is proof that Ivan’s narratives consisted more of causal chains than causal connections, indicating an increase in mental state attribution. The table also indicates a peak in the number of statements during the initial intervention phase, along with a few examples of these short descriptive sentences that transform to longer, more intricate statements in later sessions, bringing the numbers down but improving the quality of the narrative data.

Table 8 Story Narrative and Measurement of Mental State Attributes for Kate

Phase and Sessions		Causal Connections		Causal Chains	
		Mean	Range	Mean	Range
Phase B1	Session 1	1.5	1-2	0	0
	Session 2	7	2-12	2.5	0-5
	Session 3	10	9-11	11.5	7-16
	Session 4	8	7-9	7.5	5-10
	Session 5	7.5	6-9	17	10-24
	Session 6	7.3	4-9	15.67	7-28
	Session 7	6.5	3-10	13.5	10-17
	Session 8	4.5	4-5	13.5	7-10
	Session 9	6	6-6	13.5	11-16
Phase B2	Session 1	7.5	3-13	8	4-12
	Session 2	4.8	2-9	4.6	1-9
	Session 3	3.6	1-7	8.3	5-12
	Session 4	4.2	1-6	6	1-9
	Session 5	5	3-7	12.67	12-13
	Session 6	10	4-16	15.5	15-16

Table 8 stipulates Kate’s performance with respect to story narratives during the intervention phase. With the graphs indicating "no effect" in the 1st session, steady progress in causal connections, chains was observed despite gradual shifts between peaks through intervention till assessment. As intervention progressed, Kate's ability to construct statements with mental state attributes also improved significantly (Figure 2). On creativity measures, Kate obtained a mean score of 13.2 during the assessment in comparison to a lower mean score of 6 in the baseline phase.

Table 9 Sample Progression of Story Narrative by Kate

Phase	Sentences created
Baseline	"Tortoise. Tortoise. Tortoise"
2 (B1)	"Pig is eat."
5 (B2)	"Simba is going to house. Magic house."
7 (B1)	"Timon Pumbaa is biting Scar, Scar is crying."
12 (B1)	"Gretel have a grape juice, Gretel be a happy."
Assessment	"Girl touching a fire, got burnt, girl crying " I go put a band aid, I call a doctor."

The verbiage and overall standard of Kates’s narratives also showed a qualitative improvement as presented in Table 9, highlighting how she improved from just repeating the given words to stringing words to create meaningful sentences reflective of mental state attributes in her narrative content.

Interobserver Agreement (IOA) Table 10 Interobserver Agreement Scores

Participant	Kappa	IOA Scores		Interpretation
		Agreements Observed %	95% Confidence Interval	
I	0.818	98.19%	0.662 to 0.974	Almost perfect agreement
K	0.975	99.32%	0.941 to 1.000	Almost perfect agreement
Overall	0.937	98.77%	0.891 to 0.983	Almost perfect agreement

Story narratives and theory of mind: an intervention for children with high functioning autism

Our research team observed 30% of all sessions (which constituted baseline (A1), intervention (B1 and B2), and assessment (A2 phases). Cohen's-Kappa was used as a statistical measure for establishing the IOA scores. The IOA scores are listed in Table 10 for each participant as well as averaged across both participants and is interpreted as "almost perfect agreement".

DISCUSSION

During assessment, the participants' ability to be more creative with their narrative as well as produce more meaningful sentences with the presence of causal connections and causal chains, in comparison to the baseline, was indicative of the overall success of the intervention. Within this study, creativity and the production of statements with mental state attributes have been given more emphasis rather than the total number of sentences produced. This increase in causal chains and the resultant increase in the formulation of intentional statements highlight the merits of this study.

In the Sally-Ann task, Ivan showed no change in response between baseline and assessment post-intervention indicating a failure in false-belief reasoning. However, Kate passed the task in the final assessment suggestive of her ability to take Sally's perspective, compared to an inability to do so during the baseline, thus rendering a reduction in ToM deficits. Researchers have claimed that the development of ToM is best understood as being on a continuum through scaled tasks (Wellman & Liu, 2004) rather than depicted by a single task. Based on this premise, children who fail the task could still have an elementary form of ToM (Fodor, 1992) or even parts and/or facets that have developed (Gopnik & Wellman, 1992). The Sally Ann task was primarily used due to the lack of a more comprehensive scaled task developed to the sensitive needs of the ASD population.

In Rory's Story Cubes task, improved narrative quality was recorded in Ivan's performance. Ivan's ability to attribute mental states was developing and was evident in his narratives as they progressively displayed exploration of various themes and elaboration on emotions. This could be attributed to an increase in spreading activation which directly improves the ability to engage in creativity (Gabora, 2010). A significant increase in the number of causal connections (mechanical statements) and causal chains (behavioral and intentional statements) was seen in Kate's narrative content.

Throughout the intervention, in both participants', significant improvements in their ability to engage in story narratives were seen. There was a clear shift from dominantly producing causal connections to causal chain statements with remarkable ability to not only attribute mental states but also successfully characterise roles/inanimate objects/elements and engage in dialogic interaction, thereby taking perspective. This shift was particularly evident in Ivan's narratives, which could be attributed to individual language capacities. An interesting similarity between Ivan and Kate's narratives was that not only did they use the categories provided to them, they also brought in newer ones of their own, thus endorsing the hypothesis that the use of story narratives will increase creativity and reduce functional fixedness.

On a more qualitative note, we observed that Kate engaged in characterization using gestural communication, and Ivan impersonated characters in his stories accompanied by prosody and voicing. Neuropsychological evidence indicates the clear presence of "functional overlap between the neural networks that underlie narrative and ToM abilities" (Mason, Williams, Kana, Minshew & Just, 2008; Spreng, Mar & Kim, 2009; Tager-Flusberg &

Story narratives and theory of mind: an intervention for children with high functioning autism

Sullivan, 1995; Capps, Losh & Thurber., 2000). Similarly, multiple studies investigating the relationship between story narratives and ToM abilities highlight that the act of using cognitive terms corresponds with ToM abilities (Tager-Flusberg & Sullivan, 1995; Capps, Losh, & Thurber, 2000).

The “Make a Sentence” activity was a deconstructed component of the intervention integral to story narration. We believe it laid the foundation for the process of bridging ideas by verbalising thoughts with a structure. Although, children with HFA show deficits in ToM and creativity (Best, Arora, Porter & Doherty, 2015), both participants seemed to inherently form connections between the “Make a Sentence” task and the “Terrific Tales Teller” game. A positive transfer of training was observed, implying it was instrumental in strengthening LTP. Siller, Swanson, Serlin, and Teachworth (2014) stated that interventions focused to support child's ability to serially arrange events, draw inferences of emotions and thoughts including prediction of other's actions would be a good fit for harnessing ToM capacities, exhibiting the effectiveness of using narratives as a means for increasing children's social understanding. This sequential seriation was witnessed in both participants' narratives. These observations seem to evince our hypothesis that using story narratives will increase mental state attributions and therefore reduce ToM deficits.

Craig & Baron-Cohen (1999) investigated creativity and imagination among children with autism, HFA, who in comparison to the control group generated fewer ideas to animate foam shapes. They noticed that these inadequacies in imaginative and/or divergent thinking tasks contribute to deficits in creativity. Our study showed a noticeable increase in each of the identified facets of creativity, leading to an overall positive trend for creativity and a subsequent reduction in functional fixedness. Ivan and Kate not only connected categories to weave stories but towards the end also began to add their own elements to the story narrative. Unfortunately, this level of progress was not anticipated and hence can only be reported from a qualitative point of view. Adding their own elements to their narrative was indicative of intrinsic motivation that went beyond extrinsic motivators that initially gave them the thrust.

Scholars suggest that a “path of least resistance” (Agogu , Le Masson, Dalmasso, Houd , & Cassotti, 2015; Agogu , Poirel, Pineau, Houd , & Cassotti, 2014) may be adopted to reduce the demand on cognitive effort in parity with a task, as the requisite knowledge to perform the task would require generating newer concepts. As a result, “mental fixation” that inhibits creativity does not stem from creative lacuna but a failure to engage in seeking authentic solutions and as a result of non-inhibition of existing knowledge-based automatic activation. The intervention was designed, thus acted as a catalyst leading to increased neuronal activation and LTP.

Linguistically, children with ASD (HFA) can incorporate terms that indicate desire, emotion, knowledge, etc. functionally in their statements with a probe. However, they lack the element of perceptual attribution to interpret what another person might know, feel or do based on the situation in the external environment. Highlighting the difference between mere use of words and contextual cognitive attribution of mental states to anticipate behavior forms the cornerstone of socialization (Tager-Flusberg, 1992; Hale & Tager-Flusberg, 2003). We also observed individual differences in performances, characteristic of the individual traits within the autism spectrum. For Ivan's narratives, there was a clear movement from dominantly producing mechanical statements to using intentional statements with a resultant increase in content quality. While the number of statements he

Story narratives and theory of mind: an intervention for children with high functioning autism

produced towards the final intervention cycle reduced, his statements reflected increased creativity and coherence (table 8). Data collection and recording target only the number of statements made and not the quality and/or length of the statement. Owing to this the number of statements recorded for Ivan were lower. Table 9 is proof of this shift in quality and length of statements made by Ivan but based on the intervention protocol these had to be recorded as a single statement, lowering the numbers.

During the baseline phase, Kate measured limited language capacity, but with intervention, increased usage of intentional statements was witnessed. She tended to use her episodic memory in her narratives and through sessions, was able to fuse these with the characters and elements to narrate her own story thereby assigning mental state attributes. In recent years, neuropsychological research has suggested an “extensive functional overlap between neuronal networks underlying narrative comprehension, autobiographical memory, and ToM” (Mason, Williams, Kana, Minshew, & Just, 2008; Spreng, Mar, & Kim, 2009) as seen in Table 9.

The task of illustrating on paper, after the story narrative, was primarily to bridge right and left-brain neural activity and not for deliberate quantitative analysis. We witnessed a pattern of increased fixedness interfering with creativity during the initial sessions in both participants, where Ivan repeatedly drew trains and Kate drew princesses. As sessions progressed, both participants began adding newer elements to their visual representations. On occasions, this visual representation of thought helped us understand the ideas and beliefs that the participants otherwise could not verbalize.

Overall results of this study reiterate the effectiveness of using story narratives as a means to explore interventions to address ToM deficits. It elucidates the role of other variables such as language and memory, leading to spreading activation i.e. strengthening of LTP. An interesting aspect of this intervention design is that the participants repeatedly had to steer clear of stimuli stories and use the same characters to create authentic narratives. This exercise of constantly having to break-away from stimulus stories to create original content in itself imbuing spreading activation, in turn, targeted moving away from aspects of “common knowledge” (Agogué, Le Masson, Dalmaso, Houdé, & Cassotti, 2015) and reducing the functional fixedness that is otherwise dominant in children with ASD.

Implications of the Study

Given the paucity of studies that specifically target interventions that mitigate ToM deficits in ASD or their subtypes, this study has, without doubt, created a foundational path to understanding ToM with HFA and its applications, better. The success of this study is pinned on the fact that by the end of the intervention the participants were able to distinguish between emotions of their own and that of the characters in their narratives, assigning corresponding actions and reactions, thereby indicating their ability to attribute mental states. Losh and Capps (2003) established that the ability to use mental state terms (cognitive or affective) depended largely on children’s ability to understand and define their emotions and not on ToM abilities, although it is a precursor skill. Hence, the success of future studies with ASD relies on bringing about increased understanding and recognition for mental state terms and emotions in tandem with ToM training.

There is evidence that associates the ability of children with ASD to produce narratives with more ambiguous referencing (Loveland, McEvoy, Tunali & Kelley, 1990; Tager-Flusberg & Sullivan, 1995; Manolitsi & Botting, 2011; Novogrodsky, 2013; Norbury, Gemmell & Paul,

Story narratives and theory of mind: an intervention for children with high functioning autism

2014), fewer dialogic interactions among story characters (Stirling, Barrington, Douglas & Delves, 2017), fewer references to the emotions of the characters in the story (Siller, Swanson, Serlin & Teachworth, 2014), and with regard to inappropriate use of language within context (Losh & Capps, 2003; Collet-Klingenberg & Franzone, 2008). The results of this preliminary study challenge these notions and deem the intervention to have positive effects in these areas.

The participants included in the study had varying levels of language comprehension yet to develop. Despite this, results indicate that LTP strengthening may have caused enough spreading activation to engage in creativity and is cause for further investigations in the future concerning the precise role of language in ToM deficits. The success of the study could also be attributed to the appeal of the intervention which embedded natural rewards to increase intrinsic motivation, imploring future researchers to consider harnessing intrinsic motivation as an integral part of interventions that targets ToM deficits to achieve holistic success. This study further emphasizes that every therapeutic intervention that addresses ToM deficits must be developed around the central aim of improving a child's functionality while embedding a system for collecting regular feedback on their performance across settings.

Limitations of the Study and Future Study

1. Given the variability that exists within the ASD population, it would be beneficial to sustain this study across participants and settings.
2. Data recording should include not just the number of sentences but also the length and quality of the sentence.
3. While expressive language was emergent in both participants, their language comprehension was at varying levels, and the exact role that it played could not be accounted for.
4. Both participants exhibited pragmatic difficulties throughout the study. Future studies are urged to account for pragmatic difficulties and use a broader approach to help develop the same.
5. In addition to a prompt system, the reward system should take into consideration a way of providing feedback, as it was observed that the participants often seek validation for their performance.
6. The drawing/visualization aspect at the end of the Terrific Tales Teller game provided qualitative insight into the participants' thinking but could not be taken into account as a more rigorous system for collecting and analyzing this data was not in place.
7. Recording and receiving anecdotal data from the participants' caregivers could have contributed to better understanding the benefits and generalizability of the intervention across settings.
8. Both participants chosen for the present study had been receiving training/rehabilitation in other facets of cognition and may limit such effects among those without prior exposure to such therapies.

CONCLUSION

This study shows promise in understanding ToM in HFA, as the results indicate that by virtue of strengthened LTP, story narratives lend to reducing ToM deficits while increasing creativity and simultaneously reducing functional fixedness. Having said that, this is a preliminary study at best, that has made a holistic difference in ToM deficits in two children

with HFA. It provides insight and inspiration to delve deeper into the concept warranting further exploration to confirm the fundamental findings of this study.

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Story narratives and theory of mind: an intervention for children with high functioning autism

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Conflict of Interest

The author declared no conflict of interest.

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