A CORRELATION ANALYSIS BETWEEN INTERVENTION THERAPY METHOD AND THEORY OF MIND DEVELOPMENT

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Word Count: 4921

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Introduction

Autism spectrum condition (ASC) is a developmental condition that contributes to difficulties in social skills, such as processing verbal and nonverbal information (i.e. sensory), as well as difficulties in verbal and emotional expression. This condition is typically displayed in a nonlinear spectrum which involves the presence of specific traits and skills, or lack thereof. The condition of autism being focused on in this study is high-functioning autism spectrum condition (HFASC). Individuals with HFASC are not intellectually compromised, though experience the difficulties stated previously.

Researchers typically say that theory of mind development in children with ASC is either limited or completely nonexistent. Theory of mind is the ability to represent the mental states and processes of others and act in response to them. More current research by Jane R. Conway from MRC Social, Genetic, and Developmental Psychiatry Center, Institute of Psychiatry, Psychology and Neuroscience in King's College London and the Department of Experimental Psychology at the University of Oxford, is suggesting that theory of mind tests, the Sally-Anne test, “tend to test the ability to make accurate mental state *inferences”* and predictions (2019). Additionally, it involves having a basic false belief understanding, or understanding that others can believe or represent something dissimilar to one’s own perceptions and reality. To exemplify, an individual knows that his or her mother keeps chocolate in the cupboard and only takes a piece when she has had a stressful day at work. If the child were to take a chocolate out of the cupboard, eat a piece, and relocate it to an alternate location like a refrigerator without telling their mother, the mother would not know the real location of her chocolates. Someone who understands that the mother will look for her chocolates in the cupboard instead of the refrigerator when she comes back is said to have developed a false belief understanding and theory of mind. They are aware

that they can know something that another does not and are therefore able to infer that the mother will not look in the right location and experience stress and confusion. It is crucial for everyone to continue ameliorating this ability, not just children with ASC. Humans are social creatures and thrive when they can effectively engage in social interactions, maintain them, and learn from them. These abilities also allow humans to better understand and interact with their environment. Additionally, the progression of theory of mind will be fruitful to their own development, as they will be able to recognize their own mental and emotional states and processes. There are many children with ASC who do not receive supplemental therapy outside of their classroom learning, but those who do are typically geared towards occupational skills and behavioral skills rather than being taught about mental and emotional awareness. There are a few substantially different theory of mind based therapies, and it is important to acknowledge and determine the effects of them. A preliminary hypothesis is that an intervention service that improves the participants' false belief understanding via Theory of Mind test scores and Sally-Annes test scores will be most correlated with an enhanced theory of mind in HFASC children.

Social Cognitive Therapy

Social-cognitive therapy focuses on trying to improve social skills by both simulating social interactions and engaging certain qualities such as emotional empathy, perception, irony and humor, etc. For children with autism spectrum conditions, this therapy has been shown to work closely with skills involved in theory of mind development and improve them. Carolien Gevers from the Department of Child and Adolescent Psychiatry, Academic Medical Center in Amsterdam, The Netherlands conducted a study of 18 ASC children aged eight to eleven from

the United States, where the thirteen boys and five girls went through 21 one-hour group therapy sessions with five to six children in a group weekly (2006). After undergoing the social-cognition-based theory of mind program, they were assessed with the Theory of Mind (TOM) Test, which was split into three components: TOM 1, which measured theory of mind precursors, such as perception/imitation, emotion recognition, pretense, and physical-mental distinction, TOM 2, which observed elementary Theory of Mind understanding, including first order belief and false belief understanding, and TOM 3, or advanced Theory of Mind understanding, involving second order belief and irony/humor. The following chart expresses their before and after theory of mind domains and subdomains in mean values.

Table I. Mean Scores (Standard Deviations) for TOM-Domains and Subdomains

Subdomain	Domain	Normgroup*	Pre-treatment	Post-treatment
Perception/imitation		8.2 (1.2)	6.6 (1.5)	8.2 (1.2)
Emotion recognition		4.7 (0.5)	5.0 (0.0)	4.9 (0.2)
Pretense		4.8 (0.5)	4.1 (1.3)	4.8 (0.5)
Distinction physical–mental		2.7 (0.5)	2.8 (0.6)	2.9 (0.2)
	TOM 1	20.3 (1.7)	18.4 (2.4)	20.9 (1.2)
First order belief		29.3 (3.8)	24.3 (4.9)	29.6 (2.6)
False belief		2.7 (0.6)	2.6 (0.6)	2.7 (0.6)
	TOM 2	32.0 (3.9)	27.0 (4.8)	32.3 (3.0)
Second order belief		0.5 (0.5)	0.6 (0.5)	0.8 (0.4)
Irony/humor		7.7 (1.9)	6.9 (2.2)	8.7 (1.6)
	TOM 3	8.1 (1.9)	7.7 (2.4)	9.5 (1.9)
	TOM total	60.4 (5.8)	52.8 (7.8)	62.7 (5.2)

*Non-clinical population of Dutch children attending regular schools; Steerneman, Meesters, & Muris, 2000.

This chart suggests significant improvement in all areas except emotional recognition, and in the study itself, distinction physical–mental, understanding of false belief, the ability to acknowledge that oneself does not share the same knowledge of a situation as another person, and second order belief, the ability to infer someone's beliefs about another person's beliefs, were not said to have progressed.

Thought Bubble Therapy

In contrast to social-cognitive therapy, thought-bubble therapy does not elicit social interaction with others, but interaction with pictorial representations of how people are thinking and feeling instead. Accumulative results from Jessica Paynter from the Menzies Health Institute in Queensland, Gold Coast, Australia and Candida C. Peterson from the School of Psychology at the University of Queensland in Brisbane, Queensland, Australia suggest that children with ASC understand mental and emotional states on a fundamental level, however, it is not clear if scores on False Belief Tests increase because of an enhanced theory of mind or if they increase due to memorization of answers or concepts from the specific situations presented on the tests (2013). They are better typically able to identify but not explain the internal processes of others. She described a study with twenty-four children with ASC, seven in the control group (received no thought-bubble training) and 17 in experimental (received thought-bubble training). After subjecting them to a pre-test, post-test, and three-week follow-up tests, it was concluded that "task-specific" knowledge and "non-ToM-related heuristics (e.g., 'say the wrong answer')" was gained by some ASC children. This can be a reason as to why their scores improved on False Belief tasks. However, Henry Wellman from the Department of Psychology at the University of Michigan, Ann Arbor, United States began to disprove the idea through two studies: one that involved giving the experimental group paper-drawn thought bubbles and another that received cartoon cutouts (2002). The participants of Study 1 were seven male children with ASC aged eight to eighteen, and in Study 2, there were 10 children with ASC total: 9 males and one female, all aged five to seventeen. Everyone received pre-tests and post-tests, which included the Sally-Anne, Smarties, Bears, and Seeing-Knowing tasks. All of the subjects received individual training and testing for up to five sessions for about 30 minutes a day, depending on the child's

rate of progress. The therapy featured six stages, and as the stages progressed, the ASC children were challenged to face more complex concepts and eventually had to absorb and apply their own theory of mind skills without thought bubbles. This source demonstrates that authentic theory of mind understanding can be obtained or further developed by ASC children without them memorizing the test as well. Therefore, thought-bubble therapy can be effective at times, but it depends on the execution and rigor of it.

The Gap

It is known that putting children with ASC in a therapy is beneficial to the development of theory of mind and better than having no therapy. It is not known which therapies are considered most effective, and what components make a therapy successful. To fill the gap of knowledge, the Theory of Mind total scores between two similar social-cognitive treatments will be compared to one another and the Sally-Annes scores between two similar thought-bubble treatments will be compared to one another. This paper aims to answer the following research question: Which intervention therapy in each category (social-cognitive and thought-bubble therapy) is most correlated with an increase in theory of mind development in children with ASC? Whichever therapy helps improve the most theory of mind-understanding related skills will be considered most influential. The pre-therapy and post-therapy scores of the tests will be retrieved from preexisting data and compared within the individual studied via meta-analysis, and then the improvement levels will be compared among the four studies using either means or percent increase. The conclusion obtained from this research will help revolutionize out-of-school therapies for children with ASC, or even push to implement theory of mind based teaching in public schools.

Method

The goal of this research is to identify which social-cognitive therapy and which thought-bubble therapy is most correlated with an increased theory of mind development in children with ASC. By conducting a meta-analysis, unlimited resources about each therapy are granted, and a multitude of aspects of the therapies can be observed more thoroughly. There is also tangible data available for experimentation and interpretation.

Data tables with the mean scores on the Total Theory of Mind Test before and after social-cognition therapy were extracted from Sander Beeger's article "Theory of Mind Training in Children with Autism: A Randomized Controlled Trial" and Gevers' "Brief Report: A Theory-of-Mind-Based Social-Cognition Training Program for School-Aged Children with Pervasive Developmental Disorders: An Open Study of its Effectiveness". Likewise, data tables of the proportion of individuals who passed the Sally-Anne's test before and after thought-bubble therapy were collected for the thought-bubble therapies researched. These tables came from Evelyn McGregory's "Teaching Theory of Mind by Highlighting Intention and Illustrating Thoughts: A Comparison of Their Effectiveness with 3-Year-Olds and Autistic Individuals" and Henry Wellman's "Thought-Bubbles Help Children with Autism Acquire an Alternative to a Theory of Mind". A table of demographics has also been provided, including age, "severity" of the condition, and IQ levels, but only for Beeger's subjects. All available details and information about the therapies themselves have been researched and included in the paper. A statistical analysis involving one 2-sample t-test and one 2-sample z-test were conducted, and this paper will depict the findings from them.

Conducting an experiment on children with ASC was unreasonable and unethical because a specialized license or permit to work with them could not be attained, as well as time

constraints in conducting the experiment. Procedure and data errors are also prevented, as the research done will be by licensed professionals who are credible in their field of work. Therefore, choosing a meta-analysis to compile data was ideal. This meant that compiling different sources about the therapies and their impacts on theory of mind development was crucial to my method. There was also a plethora of papers already that began to link theory of mind development to developmental conditions, but none that connect.

Ethical Considerations

There was no written portion of any of the papers stating that the data provided may not be used, therefore it is reasonable to assume that it can be freely used and interpreted as long as credit is given to the original authors.

Data Tables

Table 1: Demographics Data of Participants in Beeger's Study

	Treatment (n = 19)	No treatment (n = 17)	
Age (years:months)	10:3 (1:3)	10:3 (1:1)	Mean (SD)
	8:5–13:7	8:3–12:7	Range
Gender (female:male)	1:18	2:15	
Autism (number of participants)	2	0	
Asperger (number of participants)	3	7	
PDDNOS (Pervasive Developmental Disorder Not Otherwise Specified) (number of participants)	14	10	
Full scale IQ	100.1 (15.3)	103.3 (12.9)	Mean (SD)
	79–133	82–126	Range
Verbal IQ	101.3 (16.2)	109.1(11.1)	Mean (SD)
	68–123	89–130	Range
Nonverbal IQ	98.4 (16.8)	96.6 (17.9)	Mean (SD)
	73–132	67–125	Range

This data table is from "Theory of Mind Training in Children with Autism: A Randomized Controlled Trial" by Sander Beeger. It splits the total sample size of 36 children with developmental conditions into treatment and no treatment groups. The treatment will be explained under the next data table. It provides the demographics of the 36 children, including their ages, genders, the number of each child with each diagnosis, and their scores on different IQ tests. It provides the means and standard deviations adjacent to the means in parentheses (i.e.

the mean age of the treatment group is ten years and three months with a standard deviation of one year and three months), as well as the ranges for the previously stated demographics.

Table 2: Pre-Therapy and Post-Therapy Theory of Mind Test Total and Breakdown Scores of Control and Treatment Groups

	Means (SD) [95% CI]		Group difference	
	Treatment (n = 19)	Waitlist control (n = 17)	F	p
Theory of Mind total score (max score = 72)				
Time 1	50.89 (5.31)	54.00 (5.93)		
Time 2	58.21 (4.00)	58.00 (5.78)		
Difference score	7.31 [5.20, 9.42]	4.00 [1.69, 6.31]	5.01	0.03
Effect size	1.49	0.79		
Theory of Mind precursors (max score = 22)				
Time 1	18.05 (1.51)	17.94 (1.89)		
Time 2	19.37 (1.38)	19.05 (1.71)	0.11	0.75
Difference score	1.32 [.34, 2.29]	1.11 [.31, 1.93]		
Effect size	0.58	0.63		
Elementary Theory of Mind (max score = 38)				
Time 1	25.10 (3.30)	27.59 (3.12)		
Time 2	29.84 (2.36)	29.24 (3.70)		
Difference score	4.74 [3.44, 6.03]	1.64 [−.14, 3.44]	9	0.005
Effect size	1.58	0.42		
Advanced Theory of Mind scale (max score = 12)				
Time 1	7.44 (1.00)	8.47 (1.91)		
Time 2	9.00 (2.11)	9.71 (1.45)	0	0.95
Difference score	1.26 [.69, 1.83]	1.23 [.52, 1.95]		
Effect size	0.95	0.79		

This data table is from "Theory of Mind Training in Children with Autism: A Randomized Controlled Trial" by Sander Beeger from the Section Clinical Developmental Psychology in Amsterdam, The Netherlands. It shows the means and standard deviations adjacent to the means in parentheses (i.e. the mean Theory of Mind Test total score of the treatment group the second time that participants took it and standard deviation was 58.21 (4.00)). Additionally, difference scores, effect sizes and 95% confidence intervals (CI), and summary statistics for one-way between groups using an Anova test for treatment and waitlist control groups, which in total is 36 children with high-functioning autism aged 8-13, were provided. The treatment group was involved in 16 weekly sessions administered by therapists lasting around an hour and a half each. The following three aspects were taught to the children: 1. Theory of Mind precursors, such as perception, imitation, emotion recognition, and pretense, 2. elementary Theory of Mind understanding, including belief and false belief understanding, and 3. advanced Theory of Mind understanding, involving second order reasoning, irony, and humour. 5 to 6 children with age ranges of three years or less were allotted to a session. In the last 15 minutes of each session, parents joined in and received information on the meeting's progress, future goals for their child, and training for how to encourage social cognition growth by playing games and story-telling. The waitlist control group received experimental treatment after their waitlist period, which was after the active treatment group received it. The data that was used for comparison in this paper was the Total Theory of Mind test score out of 72. Time 1 represents the pre-therapy scores, while Time 2 represents the post-therapy scores. When comparing the total Theory of Mind test scores, the treatment group improved significantly more than the waitlist control group, and scored higher the second time as well.

Table 3: Pre-Therapy and Post-Therapy Theory of Mind Test Total and Breakdown Scores of Control and Treatment Groups

Subdomain	Domain	Normgroup* Mean (SD)	Pre-treatment Mean (SD)	Post-treatment Mean (SD)
Perception/ imitation test score		8.2 (1.2)	6.6 (1.5)	8.2 (1.2)
Emotion recognition test score		4.7 (0.5)	5.0 (0.0)	4.9 (0.2)
Pretense test score		4.8 (0.5)	4.1 (1.3)	4.8 (0.5)
Distinction physical-mental test score		2.7 (0.5)	2.8 (0.6)	2.9 (0.2)
	TOM 1 test score (sum of subdomains)	20.3 (1.7)	18.4 (2.4)	20.9 (1.2)
First order belief test score		29.3 (3.8)	24.3 (4.9)	29.6 (2.6)
False belief test score		2.7 (0.6)	2.6 (0.6)	2.7 (0.6)
	TOM 2 test score (sum of subdomains)	32.0 (3.9)	27.0 (4.8)	32.3 (3.0)
Second order belief test score		0.5 (0.5)	0.6 (0.5)	0.8 (0.4)
Irony/ humor test score		7.7 (1.9)	6.9 (2.2)	8.7 (1.6)
	TOM 3 test score (sub of subdomains)	8.1 (1.9)	7.7 (2.4)	9.5 (1.9)
	TOM total (sum of TOM 1, 2, and 3)	60.4 (5.8)	52.8 (7.8)	62.7 (5.2)

*Non-clinical population of Dutch children attending regular schools; Steerneman, Meesters, & Muris, 2000.

This data table is from “Brief Report: A Theory-of-Mind-Based Social-Cognition Training Program for School-Aged Children with Pervasive Developmental Disorders: An Open Study of its Effectiveness” by Carolien Gevers. It shows the means and standard deviations statistics for the normgroup, which is a group of children attending regular schools without developmental condition, and the pre-treatment and post-treatment test scores of the treatment group, which is comprised of 18 children, 13 boys and 5 girls, with PDD, a subset of the autism spectrum condition, aged 8-11. The treatment group received 21 weeks of one hour training sessions involving materials and pictures to promote perception, imitation, and making acquaintances, with 5 to 6 children to a group. The same pictures and materials used in training were not the same as those used for the theory of mind (TOM) test. Their parents also underwent five monthly sessions where they received psychoeducation and information on the meeting’s progress, future goals for their child, and training for how to encourage social cognition growth by playing games and story-telling. The data that was used for comparison in this paper was the Total Theory of Mind test score out of 72 and the scores of the three subsets of the test, which is TOM 1 (max score = 22), TOM 2 (max score = 38), and TOM 3 (max score = 12). When comparing the total Theory of Mind test scores, the treatment group improved from a score significantly lower than the normgroup, to one higher than the normgroup.

Table 4: Sally-Anne Marble Test Passing Rates for 3-Year-Old Non-Disabled Group and Autistic Group

Test	No. of passes for sample 1 (control) 3-year-old control	No. of passes for sample 2 (exp. effect) 3-year-old experimental	*p*
1. Sally's marble	prop. = 6/16	prop. = 16/16	.001
2. All six post-tests	mean = 1.5	mean = 3.5	.001
3. Five post-tests	mean = 1.1	mean = 2.5	.01
	Autistic group pre-test	Autistic group post-test	
4. Sally's marble	prop. = 0/16	prop. = 10/16	.01
	Autistic control	Autistic experimental	
5. Sally's marble	prop. = 0/8	prop. = 6/8	.01
6. All six post-tests	mean = 0.8	mean = 2.3	.05
7. Five post-tests	mean = 0.25	mean = 1.3	.07*
	Autistic control	Control as experimental	
8. Sally's marble	prop. = 0/8	prop. = 4/8	.05
9. All six post-tests	mean = 0.8	mean = 2.5	.05
10. Five post-tests	mean = 0.25	mean = 2.0	.05

This data table is from "Teaching Theory of Mind by highlighting intention and illustrating thoughts: A comparison of their effectiveness with 3‐year‐olds and autistic individuals" by Evelyn McGregor from University of St Andrews in Scotland. One portion of this study included 32 three-year old children without developmental conditions evenly split into control and treatment groups; another included sixteen total autistic individuals, eight autistic children aged 8-16 and eight autistic adults, which were split evenly into control and treatment groups. Both of the treatment groups went through a program involving three steps: A, B, and A2. This program was run in four five-week blocks with one class of four autistic children and one class of four 3-year old children, both running simultaneously. In programme A, the intention of the task is initially highlighted. Each subject was told Sally's story as follows: Sally has a yellow basket and a blue basket. She does not know which one the marble is in. She tips

the yellow basket and does not find it, but she tips the blue basket and it rolls out. She puts the marble back in the blue basket and goes off to play. Her little brother sneakily comes in and takes the marble out of the blue basket and into the yellow basket. Sally comes back. Participants are then asked where she will look for the marble when she comes back. In programme B, the same story is told, except now there is a physical Sally doll with a thought bubble picture in her head. The participants were asked the same two questions in programme A, as well as "What is the picture in Sally's head?" In programme A2, pictures from programme B were incorporated into teaching with the intention of task highlighted, similar to programme A. As the programme progressed, all pictures and aids were reduced and later eradicated for the participants to perform one more task. The control groups did the same program as the intervention group without the false-belief aspect. Row 1 in the data table above shows the passing rate for the Sally-Anne marble test of 3-year old control and treatment groups. 6 out of the 16 control group 3-year olds passed the Sally's marble test, but all 16 out of 16 treatment 3-year olds passed the same test, signifying that there was a higher passing rate in the 3-year old treatment group. Additionally, row 4 displays the proportion of all autistic individuals who passed the Sally-Anne marble test before and after treatment. Notably, the passing rate for the autistic individuals increased, though it was still lower than that of the non-disabled 3-year old treatment group. Row 5 shows the passing rates of the autistic treatment group before and after treatment, which increased as well. Unlike row 4, row 5 splits the sample of individuals with autism into the autistic control and autistic experimental, which is the autistic treatment group before and after therapy. The subjects of the autistic control group in Row 8 took the Sally-Anne test without any treatment and initially were going to be reassessed after five weeks of no treatment. However, the designers of the experiment hypothesized that the passing rate would not change significantly, thus moving

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the autistic control group into a second therapy group, the “control as experimental”, who received the same treatment as the initial treatment group. The passing rate of this group post-therapy was recorded, which is higher than before their treatment, but lower than that of the first autistic treatment group. The four Sally-Anne Marble Test passing rates from this study will be compared to passing rates in other studies that include thought-bubble therapy. Although the data table explores the results of all six post-tests used in this particular study and their means, they will not be utilized for a statistical test in this meta-analysis; only the Sally's marble test passing rates will be compared between studies because that is the only comparable data in the chart.

Table 5: Pre-Therapy and Post-Therapy Sally-Anne Marble Test Scores of Autistic Children

Subject Number	Age (Years:Months)	Mental Age	Sally-Annes Questions: Pre-Test (out of 2)	Highest Teaching Stage Reached	Sally-Annes Questions: Post-Test (out of 2)
1	11:10	5	1	5	2
2	13:5	8	0	6	2
3	14:3	4.25	0	2	1
4	12:10	5.75	0	6	2
5	5:4	4	0	6	2
6	16:1	4.25	1	5	1
7	17:9	4.5	1	5	2
8	12:0	4.5	1	3	1
9	14:5	4.25	1	2	1
10	5:6	4.5	1	5	2

This is the second data table from "Thought-bubbles help children with autism acquire an alternative to a theory of mind" by Henry M. Wellman. It shows the individual scoring of ten children with autism, nine male and one female, between ages 5 and 17 on the Sally-Anne marble test pre-therapy and post-therapy. The therapy included up to 5 half hour teaching sessions, with a sixth session involving children doing Sally-Anne tasks with the same story as in McGregor's study, and the materials as in teaching, but without any thought bubbles. The materials included cardboard Sally-Anne figures (plus cardboard cut-out objects and thought-bubbles). Pre-therapy, no one answered both Sally-Anne test questions correctly, though six out of ten answered one correctly. On average, most of the children improved from their pre-test to their post-test trials, with ultimately six of the 10 children getting both questions correct, making the passing rate of the test 60%.

Statistical Analysis

Test #1: 2-Sample T-Test

Stated Question: Is there a significant difference between the mean post-therapy TOM Max Score of the treatment groups in Beeger Study ($\mu 1_B$) vs. mean post-therapy TOM Max Score of the treatment groups in Gevers Study ($\mu 1_G$)?

H0: $\mu 1_B = \mu 1_B$

HA: $\mu 1_B \neq \mu 1_B$

$\mu 1_B$ = 58.21

Standard dev= 4.00

n = 18

$\mu 1_G$ = 62.7

Standard dev = 5.2

n = 18

α: 0.05

t = -2.903664682

df = 31.90106584

p value = 0.0066423793; At a p-value less than alpha level 0.05, the mean post-therapy TOM Max Scores of the treatment groups in Beeger's study and the mean post-therapy TOM Max Scores of the treatment groups in Gevers' study are statistically significant, meaning that the social-cognitive therapy conducted in Gevers' study was more influential towards enhancing theory of mind test scores than the social-cognitive therapy conducted in Beeger's study, being that it is associated with higher post-test scores, therefore a more elevated false belief understanding.

Test #2: 2-Sample Z-Test

Stated Question: Is there a significant difference between the passing rate on the Sally-Anne Marble Test of the treatment groups in McGregor's study ($p1_M$) vs passing rate on the Sally-Anne Marble Test of the treatment groups in Wellman's study ($p1_W$)?

H0: $p1_M = p1_W$

HA: $p1_M \neq p1_W$

$p1_M = 0.625$

n = 16

$p1_W = 0.6$

n = 10

α: 0.05

z = 0.1275

p value = .89656; At a p-value greater than alpha level 0.05, the passing rate on the Sally-Anne Marble Test of the treatment groups in McGregor's study and the passing rate on the Sally-Anne Marble Test of the treatment groups in Wellman's study are statistically significant, meaning that the thought-bubble therapy conducted in McGregor's study and the thought-bubble therapy conducted in Wellman's study were equally influential towards enhancing theory of mind test scores.

Discussion

When comparing the two social-cognitive therapies, there was a significant difference between the Total Theory of Mind test scores of Beeger's and Gevers' studies. Since the subjects in Gevers' study had higher mean pre-therapy and post-therapy Theory of Mind Test scores than Beeger's already, it is pivotal to note that the subjects in Gevers' therapy still experienced a ten-point increase in score in comparison to the eight-point increase of Beeger's. In response to the original hypothesis, the treatment executed in Gevers' study is considered more effective

than that of Beeger's due to its ability to enhance theory of mind understanding the most. This can be attributed to the spaced rehearsal effect. Spaced rehearsal, or the process of consuming smaller bits of information over a long period of time, may have enhanced the children's abilities to retain the information that they were taught in the sessions. The sample of autistic children in Beeger's study went through 3 more hours of training than the sample of autisitic children in Gevers', and one would hypothesize that more cumulative hours yields better results. Though Gever's subjects had less hours of training cumulatively, the therapy continued for 21 weeks rather than 16. This provided the subjects more time to learn, process, and practice the material they learned. Contrarily, there was no statistical significance between the passing rates of the treatment groups of McGregor and Wellman's studies, meaning that the therapies were equally effective in their abilities to influence theory of mind development.

Limitations

One of the main limitations in this study was that all of the samples had small sample sizes less than 30. This increases the variability of the data, which could lead to ambiguous or inaccurate results. Furthermore, there were different groups of kids from study to study. Certain groups of children do better to others, but this may be due to predispositions and not to the actual method of training used. Predispositions include biological ones that can influence one's cognition and personality (i.e. age), as well as social ones, such a child's exposure to a theory of mind therapy prior to the experiments conducted in the articles.

Not only are there limitations involving the children being studied, but the studies themselves. The effectiveness of social-cognitive therapy and thought-bubble therapy in enhancing theory of mind development could not be compared to one another because their

method of testing theory of mind development varied. The Total Theory of Mind Test or Sally-Anne Test scores are scaled differently from one another, and measure different components of false belief understanding, therefore being incomparable.

Consequences and Implications

Future studies should observe how time spacing in therapeutic seminars affects memory and learning abilities in children with autism and seek official implementation. For reference, two similar therapies can utilize the same pre-test and post-test and run for 20 hours cumulative, but one does ten hours a week for two weeks and the other does four hours a week for five weeks. Another area of interest should investigate whether biological predispositions, such as age differences, yield different results in memory and learning abilities in these children.

Moreover, researchers should seek out therapies with the same pre-evaluations and post-evaluations in order to make reasonable and more accurate comparisons. An alternative to this would be for researchers to execute their own research and ensure that the method of evaluation is consistent throughout the therapies. Using this method, different therapies can be juxtaposed as well, allowing researchers to hypothesize which specific therapy type is the most effective.

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