Evaluation of the Rethink Autism Program

Paper 2

By Damian Daszynski and Kayla Nelson

Evaluation of the Rethink Autism Program

Objective

The goal of this project/study is to examine the success of the Rethink Autism program by looking at improvements made by participating students. Performance levels based on different skills of individuals on the autism spectrum were compared before and after time spent in the program. We were able come up with and narrow down certain key factors that contributed a major role in the ongoing success of students. Through this, we were able to come up with a mathematical model to assess the successes of the autism programs.

Introduction

Autism is a neurobiological disorder that ranges in symptoms and severity for each individual. Common features of autism include social impairment, such as lack of ability to communicate properly, and adherence to strict routines and repetitive behaviors. One in every 110 children is diagnosed with autism and unfortunately, Nebraska is ranked 49th in the nation for special needs services. Autism Action Partnership (AAP) is a non-profit organization that works for Nebraska families to better service those on the autism spectrum. Due to the generosity of a number of Nebraska foundations, AAP is rewarded grants in order to fund programs to improve the lives of autism spectrum peoples. They also work to raise the awareness and knowledge of the disorder by reaching out to people at conventions, fundraising events, and through social media networks.

This last year AAP funded the Rethink Autism program in a number of schools in Nebraska. Rethink Autism was created in order to provide affordable science-based treatment to children with autism. The program is used to further the performance of individuals with autism in a number of daily-life skills and activities. The program is broken down into eight categories;

each has specific lessons to be mastered by the individuals over the course of a timeframe. The eight categories include, but are not limited to, pre-academic skills, academic skills, daily living skills, expressive language skills, receptive language skills, motor skills, play/leisure skills, and social/emotional skills. Each of these categories includes many sub-factors for analysis. Individuals on the autism spectrum struggle in a number of these areas, if not all.

In order for the program to work, individuals must first be assessed according to their own needs. Students take tests that assess their individual level of performance in the numerous areas of focus. Lesson plans and program goals for each student are then devised. The curriculum is broken into easily manageable step for the teachers and students. This allows for ongoing assessment throughout the program. Student's success is evaluated on the basis of number of steps mastered in each lesson and number of lessons mastered in a given time period.

Methods

Participants

With the help of AAP, we were able to contact two different elementary schools in the Hall and Cumming counties of Nebraska. In the Hall County School, we had three students following the Rethink program whereas in our Cuming County School, we had two students following the program. Each student was given an individualized lesson plan and his or her success in lesson achievement was recorded each month. Both schools sent us each student's progress in lesson achievement. The Hall County School sent us data from four months of using the program and the Cuming County School for six months.

Procedures

In order to assess the quality of the Rethink Autism program in the further development of autism spectrum elementary school students, we identified five factors that contribute to their

success. These factors include: skill development, comfortability/social relations, structured system with trained staff, transition planning, and parent/peer involvement. These categories were rated in importance by four experts in the field. We then took the categories we identified and applied them to the outline of the Rethink Autism program.

One of the categories we identified is having a structured system with a trained staff. This category is the broadest of the five. The program in itself serves as a structured system. Each individual student is given a lesson plan designed for the individual. The lesson plan is a routine that the students follow throughout the program with a particular teacher. The teacher follows guidelines that are also given to them in the Rethink Autism handbook.

With the other four categories, we were able to take the Rethink Autism program outline and break up the general lesson plan into subcategories. Under skill development we put academic, expressive language, receptive language, and motor skills. Under comfortability/social relations we put pre-academic, (having to deal with making eye contact, identifying sounds, and communicating thoughts and feelings), and social/emotional. Under transition planning we put daily living skills, and under parent/peer involvement we put play/leisure.

Results

We assigned the Hall County School the title of "School 1," with students "1a, 1b, and 1c." The Cuming County School was assigned "School 2," with students "2a and 2b." The numbers of steps mastered by student 1a in the four consecutive months of evaluation were 4, 6, 10, and 3. The numbers of lessons mastered by student 1a in the four months were 1, 2, 4, and 1. Student 1b had steps mastered scores of 5, 3, 6, and 0. The lessons mastered scores for student 1b were 2, 1, 2, and 0. Student 1c had steps mastered scores of 8, 5, 6, and 4. Lessons mastered scores for student 1c were 3, 1, 2, and 1. In school 2 they followed the program for six months.

Student 2a had lessons mastered scores for the consecutive six months of 3, 5, 4, 2, 1 and 1. Student 2a's lessons mastered scores were 1, 1, 2, 0, 1, and 0. Student 2b had steps mastered scores of 14, 10, 9, 3, and 1. The lessons mastered scores for student 2b were 6, 7, 2, 7, 1, and 0.

Mathematical Modeling for the Effectiveness of Programs for Children with Autism

Overarching Goal:

- G: Effectiveness of Autism Development Programs

Factors:

- F1: Skill Development
- F2: Comfortability/Social Relations
- F3: Structured System with Trained Staff
- F4: Transition Planning
- F5: Parent/Peer Involvement

Analytical Hierarchy Process:

Given the following matrix W,

Matrix W

	E_1	E_2	E_3	E_4
F_1	.8	.7	.8	.7
F_2	.6	.7	.6	.6
F_3	.9	.8	.8	.8
F_4	.5	.6	.4	.6
F_5	.5	.5	.5	.6

Take the row averages and add them:

- $W_1 = 0.75$
- $W_2 = 0.625$
- $W_3 = 0.825$
- $W_4 = 0.525$
- $W_5 = 0.525$
- $W_{tot} = 3.25$

Let us define the following adjectives for our factors when defining values:

- Poor = 0.1
- Okay = 0.3
- Good = 0.5
- Very Good = 0.7
- Excellent = 0.9

Therefore, the final equation will be:

- $G = W1WF1+ W2WF2+ W3WF3+ W4WF4+ W5WF5$
- $G = .2308F_1 + .1923F_2 + .2538F_3 + .1615F_4 + .1615F_5$

Guiasu Method

Given matrix W (reference above), divide each column by its column total.

	E_1	E_2	E_3	E_4
F_1	*833*	*733*	*831*	*733*
F_2	*633*	*733*	*631*	*633*
F_3	*933*	*833*	*831*	*833*
F_4	*533*	*633*	*431*	*633*
F_5	*533*	*533*	*531*	*633*

Take the row averages and add them (should add up to one):

- $W_1 = 0.231$
- $W_2 = 0.192$
- $W_3 = 0.254$
- $W_4 = 0.161$
- $W_5 = 0.162$
- $W_{tot} = 1.000$

Let us define the following adjectives for our factors when defining values:

- Poor = 0.1
- Okay = 0.3
- Good = 0.5
- Very Good = 0.7
- Excellent = 0.9

Therefore, the final equation will be:

- G = *W1WF1+ W2WF2+ W3WF3+ W4WF4+ W5WF5*
- G = .2312F1 + .1923F2 + .2539F3 + .1610F4 + .1615F5

Yen Method

Given matrix W (reference first matrix), divide each number by the greatest number within the matrix:

	E_1	E_2	E_3	E_4
F_1	*89*	*78*	*88*	*78*
F_2	*69*	*78*	*68*	*68*
F_3	*99*	*88*	*88*	*88*

F_4	*59*	*68*	*48*	*68*
F_5	*59*	*58*	*58*	*68*

Take the row averages and add them:

- $W_1 = 0.910$
- $W_2 = 0.760$
- $W_3 = 1.000$
- $W_4 = 0.639$
- $W_5 = 0.639$
- $W_{tot} = 3.948$

Let us define the following adjectives for our factors when defining values:

- Poor = 0.1
- Okay = 0.3
- Good = 0.5
- Very Good = 0.7
- Excellent = 0.9

Therefore, the final equation will be:

- G = *W1WF1+ W2WF2+ W3WF3+ W4WF4+ W5WF5*
- G = .2304F1 + .1926F2 + .2533F3 + .1618F4 + .1618F5

The average equation for G as a result of all the methods sets out to be as follows:

- G = .2308F1 + .1924F2 + 2537F3 + .1614F4 + .1616F5
- G_{tot} greater than 0.7 is considered very good with minor areas of improvement.

Example 1:

- G = .2308(.9) + .1924(.7) + .2537(.7) + .1614(.5) + .1616(.9) = .7461
- This analysis for a program is very good! As we can see, improvement would be needed in factor 4, but the rest seem to be in great shape.

Example 2:

- G = .2308(.5) + .1924(.9) + .2537(.9) + .1614(.3) + .1616(.5) = .6461
- This analysis for this program is sub-par. Improvement is needed within three factors. Bringing those factors up to a 0.7 would make this program very effective
- G = .2308(.7) + .1924(.9) + .2537(.9) + .1614(.7) + .1616(.7) = .7892
- If those three factors were improved that much, this program would be much more effective model-wise than our first example.

Fuzzy Set Analysis:

Matrix W

	E_1	**E_2**	**E_3**	**E_4**
F_1	.8	.7	.8	.7

F_2	.6	.7	.6	.6
F_3	.9	.8	.8	.8
F_4	.5	.6	.4	.6
F_5	.5	.5	.5	.6

Definition: $\rho_k(F_i,F_j) = (e_{ik} - e_{jk} + 0.5) \wedge 1$ if $e_{ik} \geq e_{jk}$

$1 - [e_{jk} - e_{ik} + 0.5] \wedge 1$ if $e_{jk} > e_{ik}$

Matrix R_1

	F_1	F_2	F_3	F_4	F_5
F_1	.5	.7	.4	.8	.8
F_2	.3	.5	.2	.6	.6
F_3	.6	.8	.5	.9	.9
F_4	.2	.4	.1	.5	.5
F_5	.2	.4	.1	.5	.5

Matrix R_2

	F_1	F_2	F_3	F_4	F_5
F_1	.5	.5	.4	.6	.7
F_2	.5	.5	.4	.6	.7
F_3	.6	.6	.5	.7	.8
F_4	.4	.4	.3	.5	.6
F_5	.3	.3	.2	.4	.5

Matrix R_3

	F_1	F_2	F_3	F_4	F_5
F_1	.5	.7	.5	.9	.8
F_2	.3	.5	.3	.7	.6
F_3	.5	.7	.5	.9	.8
F_4	.1	.3	.1	.5	.4

F_5	.2	.4	.2	.6	.5

Matrix R_4

	F_1	F_2	F_3	F_4	F_5
F_1	.5	.6	.4	.6	.6
F_2	.4	.5	.3	.5	.5
F_3	.6	.7	.5	.7	.7
F_4	.4	.5	.3	.5	.5
F_5	.4	.5	.3	.5	.5

Definition:

Assign value "1" for a number $\rho(F_i,F_j) > 0.5$
Assign value "0" for a number $\rho(F_i,F_j) < 0.5$

Let $A_k = [a_{ij}^k]$; k = 1, 2, 3, 4

Where $a_{ij}^k =$ 1 if $r_{ij}^k > 0.5$
0 otherwise

Matrix A_1

	F_1	F_2	F_3	F_4	F_5
F_1	0	1	0	1	1
F_2	0	0	0	1	1
F_3	1	1	0	1	1
F_4	0	0	0	0	1
F_5	0	0	0	0	0

Matrix A_2

	F_1	F_2	F_3	F_4	F_5
F_1	0	0	0	1	1
F_2	0	0	0	1	1
F_3	1	1	0	1	1
F_4	0	0	0	0	1

F_5	0	0	0	0	0

Matrix A_3

	F_1	F_2	F_3	F_4	F_5
F_1	0	1	0	1	1
F_2	0	0	0	1	1
F_3	0	1	0	1	1
F_4	0	0	0	0	0
F_5	0	0	0	1	0

Matrix A_4

	F_1	F_2	F_3	F_4	F_5
F_1	0	1	0	1	1
F_2	0	0	0	0	0
F_3	1	1	0	1	1
F_4	0	0	0	0	0
F_5	0	0	0	0	0

Definition:

Let r_{ij} = $14k=14g_{ij}^{k}$ if $i \neq j$

0 otherwise

Where i, j = 1, 2, 3, 4

Let $R_{tot} = [r_{ij}]$

Matrix R_{tot}

	F_1	F_2	F_3	F_4	F_5
F_1	0	*34*	0	*1*	*1*
F_2	0	0	0	*34*	*34*
F_3	*34*	1	0	1	1
F_4	*0*	0	0	0	*24*

F_5	*0*	0	0	*14*	0

Let g_{ij} = 1 if $r_{ij} > 0.5$
0 otherwise

Then $g_i = 14k=15g_{ij}$
Let $G = [g_{ij}]$

Matrix G

	F_1	F_2	F_3	F_4	F_5
F_1	0	*1*	0	*1*	*1*
F_2	0	0	0	*1*	*1*
F_3	*1*	1	0	1	1
F_4	*0*	0	0	0	*0*
F_5	*0*	0	0	*0*	0

$g_n = j=15g_{ij}$
$g_1 = 14(0+1+0+1+1) = 34$
$g_2 = 14(0+0+0+1+1) = 24$
$g_3 = 14(1+1+0+1+1) = 44$
$g_4 = 0$
$g_5 = 0$

Let z_q^i = $\mu_q(g_i)$ for I = 1, 2, 3, 4, 5
Q is defines as "most"
then $\mu(_Q)(x)$ = 1 if $0.8 \leq 1$
$2x - 0.6$ if $0.3 < x \leq 0.8$
0 if $x \leq 0.3$

Fuzzy Q is called consensus winner; it is defined to be the fuzzy subset
$W_Q(F_i) = z_Q^i$, i = 1, 2, 3, 4, 5
As the fuzzy subset of the set of F_i that preferred to Q other F_j.

$z_Q^1 = \mu_Q(g_1) = \mu_Q(34) = 2(34) - 0.6 = 0.9$
$z_Q^2 = \mu_Q(g_2) = \mu_Q(24) = 2(24) - 0.6 = 0.4$
$z_Q^3 = \mu_Q(g_3) = \mu_Q(44) = 1$
$z_Q^4 = \mu_Q(g_4) = 0$
$z_Q^5 = \mu_Q(g_5) = 0$

Therefore,

- $W_Q(F_1) = 0.9$

- $W_Q(F_2) = 0.4$
- $W_Q(F_3) = 1.0$
- $W_Q(F_4) = 0.0$
- $W_Q(F_5) = 0.0$

Relations Method:

Let S, I, >, R, ~ be relations on X

- S = outranking = xSy means x is not worse than y
  - Induces from S: ∀ x,yε X
- I = indifference = xIy means x and y are indifferent
  - I(x)(x,y) = S(x,y) ⩓ S(y,x)
- > = preference = x>y means x is preferred to y
  - >(S) = S(x,y) ⩓ (1 – S(y,x))
- R = incompatibility = xRy means x and y are incomparable
  - R(S)(x,y) = ((1 – S(x,y) ⩓ (1 – S(y,x))
- ~ = nonpreference = x~y means x and y cannot be discriminated between
  - ~(S) = (S(x,y) ⩓ S(y,x)) V ((1 – S(x,y)) ⩓ (1 – S(y-x)))

S = XxX → [0,1]
Let S = R where

S = R Matrix

	F_1	**F_2**	**F_3**	**F_4**	**F_5**
F_1	0	*34*	0	*1*	*1*
F_2	0	0	0	*34*	*34*
F_3	*34*	1	0	1	1
F_4	*0*	0	0	0	*24*
F_5	*0*	0	0	*14*	0

Matrix I(S)

	F_1	**F_2**	**F_3**	**F_4**	**F_5**
F_1	0	*0*	0	*0*	*0*
F_2	0	0	0	*0*	*0*
F_3	0	0	0	0	0
F_4	*0*	0	0	0	*14*
F_5	*0*	0	0	*14*	0

Matrix R(S)

	F_1	**F_2**	**F_3**	**F_4**	**F_5**
F_1	1	*14*	*14*	*0*	*0*

F_2	*14*	1	0	*14*	*14*
F_3	*14*	0	1	0	0
F_4	*0*	*14*	0	1	*24*
F_5	*0*	*14*	0	*24*	1

Matrix >(S)

	F_1	**F_2**	**F_3**	**F_4**	**F_5**
F_1	0	*34*	*0*	*1*	*1*
F_2	*0*	0	0	*34*	*34*
F_3	*34*	1	0	1	1
F_4	*0*	*0*	0	0	*24*
F_5	*0*	*0*	0	*14*	0

Matrix ~(S)

	F_1	**F_2**	**F_3**	**F_4**	**F_5**
F_1	1	*14*	*14*	*0*	*0*
F_2	*14*	*1*	*0*	*14*	*14*
F_3	*14*	0	1	*0*	*0*
F_4	*0*	*14*	0	1	*24*
F_5	*0*	*14*	0	*24*	1

Degree of Consensus:

We consider the degree of agreement between the experts m,n = 1, 2, 3, 4

$V_{ij}(m,n) =$ 1 if $|r_{ij}^{m} - r_{ij}^{n}| < 0.1$

0 otherwise

Solve for $[v_{ij}^{12}]$, $[v_{ij}^{13}]$, $[v_{ij}^{14}]$, $[v_{ij}^{23}]$, $[v_{ij}^{24}]$, $[v_{ij}^{34}]$ (refer to R matrices)

Matrix $[v_{ij}^{12}]$

	F_1	**F_2**	**F_3**	**F_4**	**F_5**
F_1	1	*0*	*1*	*0*	*1*
F_2	*0*	*1*	*0*	*1*	*1*

F_3	*1*	0	1	*0*	*1*
F_4	*0*	*1*	0	1	*1*
F_5	*1*	*1*	1	*1*	1

Matrix $[v_{ij}^{13}]$

	F_1	**F_2**	**F_3**	**F_4**	**F_5**
F_1	1	*1*	*1*	*1*	*1*
F_2	*1*	*1*	*1*	*1*	*1*
F_3	*1*	1	1	*1*	*1*
F_4	*1*	*1*	1	1	*1*
F_5	*1*	*1*	1	*1*	1

Matrix $[v_{ij}^{14}]$

	F_1	**F_2**	**F_3**	**F_4**	**F_5**
F_1	1	*1*	*1*	*0*	*0*
F_2	*1*	*1*	*1*	*1*	*1*
F_3	*1*	1	1	*0*	*0*
F_4	*0*	*1*	0	1	*1*
F_5	*0*	*1*	0	*1*	1

Matrix $[v_{ij}^{23}]$

	F_1	**F_2**	**F_3**	**F_4**	**F_5**
F_1	1	*0*	*1*	*0*	*1*
F_2	*0*	*1*	*1*	*1*	*1*
F_3	*1*	1	1	*0*	*1*
F_4	*0*	*1*	0	1	*0*
F_5	*1*	*1*	1	*0*	1

Matrix $[v_{ij}^{24}]$

	F_1	**F_2**	**F_3**	**F_4**	**F_5**

F_1	1	*1*	*1*	*1*	*1*
F_2	*1*	*1*	*1*	*1*	*0*
F_3	*1*	1	1	*1*	*1*
F_4	*1*	*1*	1	1	*1*
F_5	*1*	*1*	1	*1*	1

Matrix $[v_{ij}^{34}]$

	F_1	F_2	F_3	F_4	F_5
F_1	1	*1*	*1*	*0*	*0*
F_2	*1*	*1*	*1*	*0*	*1*
F_3	*1*	1	1	*0*	*1*
F_4	*0*	*0*	0	1	*1*
F_5	*0*	*1*	1	*1*	1

The degree of agreement between experts m, n as to their preference is:

V_B (m,n) = $110i=14j=i+15 where\ m,n=1, 2, 3, 4$

Therefore,

$V_{ij}(1,2) = 110(0+1+0+1+0+1+1+0+1+1) = 610 = 35$
$V_{ij}(1,3) = 110(1+1+1+1+1+1+1+1+1+1) = 1010 = 1$
$V_{ij}(1,4) = 110(1+1+0+0+1+1+1+0+0+1) = 610 = 35$
$V_{ij}(2,3) = 110(0+1+0+1+1+1+1+0+1+0) = 610 = 35$
$V_{ij}(2,4) = 110(1+1+1+1+1+1+0+1+1+1) = 910$
$V_{ij}(3,4) = 110(1+1+0+0+1+0+1+0+1+1) = 610 = 35$

Experts

Sue Baker, M.S. Autism Services Consultant. The University of Iowa. Regional Autism Services Program. Child Health Specialty Clinic.

Debra Schwiesow, EdS, Certified School Psychologist and Adjunct Professor at Creighton University.

Susan Stokes. Autism Consultant. Research Study. Wisconsin Department of Public Instruction.

Statewide Autism Resources and Training. Universal Supports Assessment and Planning Tool.