

Alternate Psychological Therapies to Treat Children with Disturbing Behavior and Mental Illness -A Case Study

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Abstract:- Children with mental challenges, functioning significantly below average, are treated with different kinds of psychological therapies. Data is collected from 145 families with one child each, meeting given qualifying criteria, taking similar psychological therapies for past three months. Likert scale is used to find the response of each therapy. 145 cases include 62.07% (90/145) boys and 37.93% (55/145) girls. Multiple regression models are used to determine effectiveness of these therapies on basic skill /behavior /mental ability. It is concluded that head phone therapy is the most significant contributor for estimating basic skill (BS), Intellectual ability (IA) and Social and Psychological development (SPD). The given psychological therapies are proven effective in 99% of cases.

I. INTRODUCTION

Children with Intellectual Disability show significantly low levels of intellectual functioning. Disorders like mental retardation, hearing impairment, delay or loss of speech, attention-deficit/hyperactivity disorder (ADHD), Autism, and Cerebral Palsy have a significant impact on their behavior. There are problems with the child's intellectual, social and psychological development as a result of the given impact of disorders inherited by birth.

Mental Retardation (MR), the "Intellectual Disability" as per DSM-IV, this disorder reflects the below-average intellectual ability of individuals and an intelligence quotient (IQ) score lies 50–70. MR is a serious and lifelong disability that places heavy demands on society and the health system. It ranks fourth in the list of leading causes of disability [1]. Attention deficit /hyperactivity disorder (ADHD) is one of the most common neurobehavioral disorders, characterized by problems with inattentiveness, over-activity, impulsivity, or a combination. ADHD affects children of all ages, and approximately 5 percent of children worldwide show impaired levels of attention and hyperactivity [2]. Hearing impairment /loss affects delay in the development of receptive and expressive communication skills (speech and language), which in turn delays academic skills [4]. In 2001, WHO estimated that 250 million people worldwide had hearing impairment of which two thirds of the population belonged to developing countries (WHO, 2002). Speech delay/loss in children is associated with increased difficulty with reading, writing, attention, and socialization. Autism Spectrum Disorders (ASD), the Centers for Disease Control describes ASDs as, "developmental disabilities that cause substantial impairments in social interaction and communication and the presence of unusual behaviors and interests and an ASD begins before the age of 3 and lasts throughout a person's life" [5]. Although ASD is seen to occur in almost all socioeconomic groups affecting every age group varying significantly in character and severity, yet experts estimate that 1 out of 68 children aged less than 8 will have an ASD (Centers for Disease Control and Prevention: Morbidity and Mortality Weekly Report, 2014). Cerebral palsy (CP) comprises several more or less distinct subtypes with a wide spectrum of severity of motor disability, often accompanied by visual impairment, intellectual deficit, or epilepsy. As per centre of disease control and prevention, CP is more common among boys than among girls. Many of the children with CP also have at least one co-occurring condition, 41% co-occurring epilepsy and 6.9% co-occurring ASD. As per World Health Organization, 50 percent of mental illnesses appear by age of 14.

To correct disturbing behavior and improve mental ability, different kinds of psychological therapies are adopted. Children with severe mental challenges, where they function significantly below average, are treated with operant conditioning. This approach is a specific psychological intervention (individual cognitive behaviour therapy (CBT), interpersonal therapy or short-term family therapy, reinforcing a desired behavior in increments. Play therapy involves a non-threatening form of communication in which toys represent words. Concepts such as displacement (redirecting feelings from an original target to someone else) and projection (attributing one's own thoughts and feelings toward someone else) are used as part of the games. Specifically, children engage in storytelling followed by identifying feelings of the characters in a story; role-playing with puppets as a form of feeling projection; and blowing bubbles to improve deep and controlled breathing. Art therapy is used to treat children where family/relationship struggles. Children draw a story of their life events

expressing their feelings in a playful manner. Therapists may connect a color to certain emotions such as black symbolizing fear. The music therapy with individuals with ASD that have been the topics of published research, evidence-based practice, and/or clinical observations as music holds universal appeal. It captures and helps maintain attention and is highly motivating and may be used as a natural tool to improve a very young child's reasoning skills, language skills, and ability to adapt in some groups. Noise reduction headphones are one of the tools that have been very helpful and effective. These headphones are without earphones, provide a way to reduce overall exposure to individuals with sensitivity to loud noise. These headphones do not provide complete silence but the sound is just reduced making it less disturbing and disruptive. The Picture Exchange Communication System (PECS) is among the most commonly used with children who have little or no verbal ability. Therapists, teachers and parents help the child or adult build a vocabulary and consistently articulate desires, observations and feelings through pictures. The Sensory Integration Therapy is a type of occupational therapy that places a child in a room specifically designed to stimulate and challenge all of the senses. During the session, the therapist works closely with the child to encourage movement within the room. Sensory integration therapy is driven by just right challenge, adaptive response, active engagement. The multi-system is an approach that involves intervention in multiple settings including family, schools, and peer environments. Family members are trained to respond to children with mental illnesses, inviting desirable behavior by using positive reinforcement. Psychosocial and pharmacological multimodal therapies are also used simultaneously.

Previous works reveal that multiple regression and logistic regression are efficient models to estimate response variable through independent predictors. 245 families were approached through various schools. Data from 145 families, meeting qualifying criteria, with one child each, taking similar therapies for past three months minimum, was collected. In order to replace disturbing behavior and improve intellectual abilities of their children, these families were taking similar therapies for a previous 3 months. In order to analyze effective resultant of the given Psychological Therapies, Multiple linear regression (MLR) models are applied. Whereas, Basic Skill /Psychological and Social Development/Intellectual ability is taken as response variable, age Group, disorder Group and different Therapies are taken as predictors. Affected Families provided information through questionnaire is used to determine effect of these therapies on sitting, eye to eye contact, awareness, concentration, discrimination, identification, comprehension and expression, understanding and cognition defined in terms of Basic skill / Intellectual ability/ Social and Psychological Development. Firstly, multiple regression models are used to determine effect of these therapies on basic skill /behavior /mental ability. Secondly, model is applied to estimate overall improvement in performing a given task. Besides introduction the course of this paper is as follows. In section 2 model is discussed. The models are then applied to the disorder data and their adequacy critically assessed in section 3. We conclude this paper in section 4.

II. METHODOLOGY

Multiple linear regression models:

Multiple linear regression (MLR) model is used to estimate response variables with independent predictors which is defined as follows:

$$Y_i = \beta_0 + \beta_1 X_{i,1} + \beta_2 X_{i,2} + \dots + \beta_j X_{i,j} + e_i \quad (1)$$

where Y_i , a response variable and $X_{i,1}, X_{i,2}, X_{i,3}, X_{i,4}, X_{i,5}, X_{i,6}, \dots$ are independent predictors for the i^{th} ($i = 1, 2, \dots, n$) case. The parameter β_0 is the intercept and parameter β_j 's ($j = 1, 2, \dots$) are referred to as partial regression coefficients to be estimated by the method of least square; and e_i is a random error assumed to be normally distributed with expectation 0 and constant variance. MLR models are based on the assumptions: Linearity of relationship, homoscedasticity, no autocorrelation and the independence of predictors [6,7]. The overall goodness of fit of the regression model (*i.e.* whether the regression model is at all helpful in predicting the values of Y) can be evaluated using an F -test. To test the null hypothesis: $H_0: \beta_1 = \beta_2 = \dots = \beta_j = 0$ the statistic F is defined as follows:

$$F = \frac{(R^2 / j)}{(1 - R^2) / (n - j - 1)} \quad (2)$$

where R^2 is the coefficient of determination and is described as the proportion of variance "accounted for", "explained", or "described" by regression. Further, whether a particular variable contributes significantly to the regression equation can be tested through t -test as follows. For any specific variable $X_{i,j}$, we can test the null hypothesis $H_0: \beta_j = 0$ by computing the statistic as:

$$t = \frac{\hat{\beta}_j}{S_{\hat{\beta}_j}} \tag{3}$$

and statistic follows t - distribution with $(n - (j + 1))$ degrees of freedom.

III. APPLICATIONS

Data from 145 children suffering from either of the disorder autism, neurological disorder(ADHD, MR, CP),speech loss(DL,DSL,SL), hearing impairment were collected from different families, whom we approached through schools. These families were using similar therapies on their children from minimum period of 3 months The children below 18 age years were included for this study.According to DSM-IV disorder description children are divided into four groups: autism, Neurological disorder, Speech loss/delay and Hearing impairment. Gender wise count and age wise count with respect to disorder are depicted in Table 1 and Table 2. It can be observed from table 1 that out of 145 cases, 62.07% (90/145) are boys and 37.93% (55/145) are girls. Also, it can be observed from table 2 that out of 145 cases, 31.03% (45/145) are below 5 years of age, 42.76% (62/145) are between 5 to 10 years of age and 26.21% are more than or equal to 10 years of age. Likert scale is used to find the response of each therapy. Also, time to completing the task with or without the therapy is also recorded to find the effectiveness of therapy for each disorder.

Table 1. Distribution of 145 cases in accordance to gender with disorder groups

Count		Disorder group				Total
		Autism	Neurological	Speech loss/delay	Hearing impairment	
Gender	Boy	16	13	40	21	90
	Girl	8	12	15	20	55
Total		24	25	55	41	145

Table 2. Distribution of 145 cases in accordance to Age groups with disorder groups

Count		Disorder group				Total
		Autism	Neurological	Speech loss/delay	Hearing impairment	
Age groups	<5yrs	12	6	14	13	45
	5-10yrs	10	13	19	20	62
	≥10 yrs	2	6	22	8	38
Total		24	25	55	41	145

3.1. Regression models:

Regression models have been applied, to estimate mean(sitting, eye to eye contact, awareness), mean(Concentration, Discrimination, Identification, Comprehension), and mean(Expression, understanding and cognition) defining as basic skill (BS), Intellectual ability (IA) and Social and Psychological development (SPD) respectively with independent predictors; age group (AG), disorder group(DG), speaker output (SO), picture usage (PS), light simulation (LS), head phone(HP), live output (LO) and repetitive and recordable speech (RRS).

3.1.1. Estimating the basic skill using multiple linear regression model to assess the role of therapies:

The MLR model used to estimate the basic skill (BS) for all cases ($i = 1, 2, \dots, 145$) with the predictors and is defined as follows:

$$(BS)_i = \beta_0 + \beta_1(LO)_i + \beta_2(RSS)_i + \beta_3(PS)_i + \beta_4(LS)_i + \beta_5(SO)_i + \beta_6(HP)_i + \beta_7(DG)_i + \beta_8(AG)_i + \varepsilon_i \tag{4}$$

The fitting of the model (4) is tested through R^2 , which came out to be, 0.634. Thus about 63.4% of the variance of BS can be explained by independent predictors. The fitted model is found to be statistically significant, as $p < .001$. We have applied t - test to find the independent contribution of each predictor in estimating the mean (sitting, eye to eye contact, awareness) for each case to assess the overall effect of therapy. It has been found LO, LS, SO, HP and DG are significant contributors for estimating BS, as $p < .05$. The factors RSS, PS and AG are not significant factors for estimating BS. Thus, basic skill is significantly affected by live output, light simulation, speaker output and headphone. Also, it can be concluded from the result that disorder group is associated with BS. Detailed results are given in Table 3. Fitted MLR model (4) on the basis of our data is given as follows:

Table 3. Multiple linear regression model for estimating mean(sitting, eye to eye contact , awareness) in terms of BS with independent predictors: live output (LO), repetitive and recordable speech (RRS), picture usage (PS), light simulation (LS), speaker output (SO), head phone(HP), age group (AG) and disorder group (DG).

Model	Un standardized Coefficients		T	Sig.
	B	Std. Error		
(Constant)	1.574	.395	3.984	.000
LO	.130	.059	2.222	.027
RSS	-.023	.058	-.405	.686
PS	-.024	.076	-.320	.749
LS	.112	.051	2.222	.028
SO	.126	.051	2.469	.015
HP	.182	.055	3.329	.001
DG	.119	.041	2.915	.004
AG	.002	.052	.033	.974

Dependent Variable: mean(sitting, eye to eye contact , awareness)=BS
Fitted Model
 $(BS)_i = 1.574 + 0.0130(LO)_i - 0.023(RSS)_i - 0.024(PS)_i - 0.112(LS)_i + 0.126(SO)_i + 0.182(HP)_i + 0.119(DG)_i + .002$

3.2.2. Estimating the Intellectual ability using multiple linear regression model to assess the role of therapies:

A multiple linear regression model is applied to estimate the Intellectual ability (IA) with independent predictors is defined as follows:

$$(IA)_i = \beta_0 + \beta_1(LO)_i + \beta_2(RSS)_i + \beta_3(PS)_i + \beta_4(LS)_i + \beta_5(SO)_i + \beta_6(HP)_i + \beta_7(DG)_i + \beta_8(AG)_i + \epsilon_i \quad (5)$$

The fitting of the model (5) is tested using R^2 , which came out to be 0.521. Thus, about 52.1 % of the variance of IA can be explained by independent predictors. The fitted model is found to be statistically significant, with $p < .001$. We have applied t - test to find the independent contribution of each predictor in estimating the mean(Concentration, Discrimination, Identification, Comprehension) defined as IA for each case to assess the overall effect of therapy. It has been found LO, LS, HP and DG are significant contributors for estimating IA, as $p < .05$. The factors RSS, PS, SO and AG are not significant factors for estimating IA. Thus, live output, light simulation and headphone therapies are significant predictors for estimating intellectual ability. Also, disorder group is also a significant factor for estimating intellectual ability. Detailed results are given in Table 4. Fitted MLR model (5) on the basis of our data is given as follows:

Table 4 Multiple linear regression model for estimating mean(Concentration, Discrimination, Identification, Comprehension) in terms of IA with independent predictors: live output (LO), repetitive and recordable speech (RRS), picture usage (PS), light simulation (LS), speaker output (SO), head phone(HP), age group (AG) and disorder group (DG).

Model	Un standardized Coefficients		T	Sig.
	B	Std. Error		
(Constant)	1.619	.361	4.488	.000
LO	.284	.067	4.238	.000
RSS	.055	.053	1.045	.298
PS	.010	.070	.147	.883
LS	.101	.046	2.198	.031
SO	.033	.047	.700	.485
HP	.134	.050	2.677	.008
DG	.075	.037	2.023	.045
AG	-.005	.048	-.096	.924

Dependent Variable: mean(Concentration, Discrimination, Identification, Comprehension)
Fitted Model:
 $(IA)_i = 1.619 + 0.284(LO)_i + 0.055(RSS)_i + 0.010(PS)_i + 0.101(LS)_i + 0.033(SO)_i + 0.134(HP)_i + 0.075(DG)_i - 0.005(DG)_i$

3.2.3. Estimating the Social and Psychological development using multiple linear regression model to assess the role of therapies:

A multiple linear regression model is applied to estimate the Social and Psychological development (SPD) with independent predictors is defined as follows:

$$(SPD)_i = \beta_0 + \beta_1(LO)_i + \beta_2(DG)_i + \beta_3(RSS)_i + \beta_4(LS)_i + \beta_5(SO)_i + \beta_6(HP)_i + \beta_7(DG)_i + \beta_8(AG)_i + \varepsilon_i$$

(6)

The fitting of the model (6) is tested using R^2 , which came out to be 0.563. Thus, about 56.3 % of the variance of SPD can be explained by independent predictors. The fitted model is found to be statistically significant, with $p < .001$. We have applied t - test to find the independent contribution of each predictor in estimating the mean(Expression, understanding and cognition) defined as SPD for each case to assess the overall effect of therapy. It has been found RSS, LS and HP are significant contributors for estimating SPD, as $p < .05$. The factors LO, PS, SO, DG and AG are not significant factors for estimating SPD. Thus, repetitive and recordable speech, light simulation and headphone therapies are significant predictors for estimating Social and Psychological development. Detailed results are given in Table 5. Fitted MLR model (6) on the basis of our data is given as follows:

Table 5. Multiple linear regression model for estimating mean(Expression, understanding and cognition)in terms of SPD with independent predictors: live output (LO), repetitive and recordable speech (RRS), picture usage (PS), light simulation (LS), speaker output (SO), head phone(HP), age group (AG) and disorder group (DG).

Model	Un standardized Coefficients		T	Sig.	
	B	Std. Error			
1	(Constant)	1.951	.354	5.511	.000
	LO	.088	.066	1.344	.181
	RSS	.115	.052	2.212	.029
	PS	.009	.069	.126	.900
	LS	.166	.045	3.665	.000
	SO	.039	.046	.857	.393
	HP	.109	.049	2.211	.029
	DG	.036	.036	.984	.327
	AG	-.011	.047	-.230	.818

Dependent Variable: mean(Expression, understanding and cognition)
 $(SPD)_i = 1.951 + 0.088(LO)_i + 0.115(RSS)_i + 0.009(PS)_i + 0.166(LS)_i + 0.039(SO)_i + 0.109(HP)_i + 0.036(DG)_i - 0.011(DG)_i$

IV. CONCLUSION

Regression models are used as powerful tools, predicting, past, present, or future events to be made with information about past or present events. The main objective in many biomedical studies is to understand and exploit relationship between lifetime and covariates [7]. It is concluded that head phone therapy is significant contributor for estimating basic skill (BS), Intellectual ability (IA) and Social and Psychological development (SPD). It provides a way to reduce the overall sound exposure to anyone with sensitivity to sound. It has been found basic skill i.e. eye to eye contact, sitting and awareness affected by live output, light simulation, speaker output, and head phone therapies. Our case study concluded live output, light simulation along with head phone are useful therapies for estimating IA. Also, found that repetitive and recordable speech, light simulation and headphone therapies are significant predictors for estimating Social and Psychological development. As disorder group is one of the significant predictor, so it can be explored in the next study that these therapies are disorder specific.

Table 6: Data is divided into two groups Group 0 (no change in completing the task after the therapies) and Group1 (change in completing the task after the therapies) with respect to disorder.

Disorder group	Effective		Total
	0	1	
Autism	2	22	24
Neurological	2	23	25
Speech loss/delay	4	51	55
Hearing impairment	3	38	41
Total	11	134	145

It is clear from our results given in Table 6 that only for cases 11/145 i.e. less than 1% these therapies are not helpful else it is effective (improvement in performing task) for all the other cases. Further, from our data it can be concluded that these therapies is effective alternatives to improve disability.

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