© Journal of the Indian Academy of Applied Psychology,
January 2008, Vol. 34, No.1, 101-106.

Creating Opportunities for Improving Problem Solving Skills in Infants with Developmental Delays

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The study lays emphasis on improving problem solving skills in children with developmental delays by designing a model called as Problem solving Interactive model. The model was tested on 45 children with developmental delays. The efficacy of the Problem Solving Interactive Model (PSIM) was determined from Mental Age (MA), Mental Development Index (MDI) and Deviation Mental Quotient (DMeQ) derived from Bayleys Scale of Infant Development. The pre and post test differences on all the intervention outcome indicators were highly significant in experimental group MA (t=5.70), MDI (t=4.099), Dmeq (t=2.64) and Battery of Problem Solving Tasks (t=27.93), indicating the efficacy of the Problem Solving Interactive Model. The variations in intervention outcomes with respect to chronological age of infants and toddlers with developmental delays showed that children in age group of 24-33 months showed the highest rate of gain of 0.99 in experimental group and 0.76 in control group. Lowest rate of gain of 0.77 and 0.24 in experimental and control group was seen in children from 4-13 months chronological age. These variations in intervention outcomes indicate the need to plan and implement specialized early interventions targeting specific child characteristics.

The day to day activities of children involve finding strategies to solve the problems that they encounter. So, the basic requirements of problem solving – goals, obstacles, strategies for overcoming obstacles and evaluation of results – appear as early as infancy. Children's problem solving is marked by flexibility and opportunism from an early age, but their performances are limited by the strategies they have access to, resources available for problem solving, their ability to manage the process of solving problems, and the social contexts in which problems are presented and vanquished (DeLoache, Miller & Pierroutsakos, 1998. These problems involve people, as solution strategies and as obstacles for attaining a goal. The development of problem solving can be characterized as a process of overcoming cognitive limitations to make problem solving more reliable, systematic, and efficient ((DeLoache., et al., 1998).This leads to developmental changes in problem solving skills in children. But children with cognitive delays engage in concrete strategic behavior leading to poor performance. According to Vygotsky (1978), one of the reasons for concrete and rigid problem solving nature of retarded children is that their environment is deficit in modeling effective strategies for a variety of problem solving situations.

The utility of Triarchic theory in understanding problem solving performance in mentally retarded has been attributed probably due to inferior use of all three information processing components (Sternberg,1984).The inferior use of meta-components lead to three scenarios: the inadequate choice of which performance component and what knowledge acquisition component to use on a particular task, faulty coordination of controlled and automatic problem solving strategies and making corrections in mid-stream.

Evidence from studies of children with cognitive delays or mental retardation report that they appear to be persistent on challenging tasks as other children with similar mental age during the infant and toddler period (Hauser-Cram, 2001; MacTurk., Vietze, McCarthy, McQuinston, & Yarrow, 1985; Ruskin, Mundy, Kasari, & Sigman, 1994). Robert White (1959) maintained that as children come to perceive their action as producing effects on the environment, they develop a sense of efficacy, accompanied by feeling of pleasure. He further proposed that this sense of efficacy leads to iterative series of transactions between the child and the environment that result in increasingly competent behaviour. Thus, the learning process is facilitated by the participation of young children with developmental delays, which helps in cognitive growth. Problem solving is an important "functional" cognitive skill that results in important achievement for infants and toddlers.

According to Shari & Siegler (1994), "It is not that social phenomena are being investigated that is new in the study of children's problem solving. What is new is the increasingly widespread realization of how deeply the social world is implicated in the development of problem solving, a broadened vision of what the development of problem solving entails, and a growing commitment to explicating the mechanisms through which cognitive and social processes jointly contribute to children's developing ability to solve problems".

It is against this background that the present study lays emphasis on improving problem solving skills in children with developmental delays by designing and implementing the intervention model called as Problem solving Interactive model. Apart from determining the efficacy of the model the study will also focus on studying intervention outcomes with respect to chronological age of infants and toddlers. The interaction between the program features and child characteristics provides a research framework for evaluating and understanding the mechanisms through which interventions operate (Guralnick, 2000). It is this issue of specificity that ultimately informs practice. Therefore, the intervention outcomes with respect to age of the child were also studied.

Objectives

1. To improve problem solving skills in children with developmental delays by designing a model called as problem solving interactive model(PSIM).
2. To determine the efficacy of PSIM.
3. Assess the intervention outcomes with specific reference to chronological age of infants and toddlers.

Method

Sample:

The sample comprised 45 children in experimental and 30 children in control group with developmental delays in the age range of 4 to 33 months. The children attending early intervention services at National Institute for the Mentally Handicapped, Secunderabad were selected for the purpose of the study. Only children with borderline to mild developmental delays for whom the severity of developmental delay was determined by administering the Developmental Screening Tool (DST) by Bharath Raj (1993) were included in the sample. The other criteria for inclusion in the sample was children showing variation with respect to chronological age, children of mothers with higher secondary education and children staying with their parents residing in twin cities of Hyderabad and Secunderabad

Tools:

Development Screening Tool (DST)- As standardized by Bharath Raj (1993), the DST was administered by the psychologist to determine the level of developmental delay in the child.

Bayley's Scale of Infant Development (BSID)- As an outcome measure, the BSID was used to assess the intervention gains. The mental scale of the BSID was used for all the subjects. The research form of Bayley scale (1961) of Infant Development (BSID) as used in Baroda studies consisted of two sections: the motor development scales and the mental development scales. Both the scales are point scales and express the child's performance in terms of number of items passed by the child. These numbers are further expressed as motor age, mental age and DMoQs (deviation motor quotient) and DmeQs (deviation mental quotients).For the present study only mental development scale was taken. The mental scale consists of 163 items, covering different expressions of mental growth.

Battery of Problem Solving Tasks (BPST): The researcher developed and validated assessment-linked intervention, which has been designated as Battery of Problem Solving Tasks (BPST): It consists of 30 problem-solving tasks. The selected tasks on BPST address higher mental processes specifically for enhancing problem-solving skills. The tasks were constructed as familiar domains of content that are most commonly confronted by infants and toddlers in day to day activities. The tasks were constructed as per Piagets sensorimotor stages where purposeful problem solving /means ends behaviour is an important functional cognitive skill. The process comprises of testing, teaching and retesting. The change occurring between the initial testing and retesting reflects the individual's cognitive and structural modifiability. The theory of structural cognitive modifiability and mediated learning experience of Feureistein, Jensen, Kaniel, & Tzuriel (1987), as an approach to dynamic assessment formed the basis for the designing and validation of BPST.

Procedure:

The study was undertaken in two stages. The first stage consisted of devising the Problem solving interactive model and then implementing the model. It may be noted here that children in control group received the general cognitive stimulation given as part of early intervention program at NIMH while children in experimental group also received the PSIM.

Devising the problem solving interactive model: The intervention devised for the present study was problem solving interactive model which emphasizes both on psychological and environmental attributes which influences both, the child and the mother. The tridirectional influence of child on mother, mother on child and the influence of environment on both is an important aspect of this strategy. These aspects are essential for facilitating the process of learning. The problem solving interactive model therefore comprised of the following three components.

Components:

Task analysis**:** For each of the targets which consisted of problem solving tasks a procedural manual entitled "Strategies to Enhance Problem solving skills-STEPSS" was prepared specifically for the purpose of intervention. This manual gives guidelines on task analysis, which consists of 4-6 steps for each of the problem solving task.

Target related interaction: The training for the mothers included teaching specified problem solving targets and modification of interactions and verbalizations to help child achieve the target. Therefore, training of mothers formed an essential facet of the present study**.** Task specific instructional material: In the present study, instructional material has been exclusively prepared to suit the needs of mother and child. The task specific material enabled teaching of the problem solving task to the child. The problem solving interactive model was implemented on each child by selecting four problem solving tasks.

Procedure for selection of target items for each subject: For each subject in the sample four target items consisting of problem solving tasks were selected. The targets for each child were determined by administering the Battery of problem solving tasks (BPST) which was prepared and validated by the researcher. The item from where the child does not complete the task on BPST is taken as the first target and the following three tasks on BPST were the total four targets given for each subject. Therefore, the targets varied from subject to subject depending on the level of performance.

Implementation of the problem solving tasks: One target was introduced for each subject at a time. No specific time frame was allotted for achieving the task. The above mentioned components of Problem solving interactive model were used by the researcher to train the mothers in helping the child to learn the problem solving task.

Results and Discussion

For determining the efficacy of the psycho-ecological intervention strategy the Bayleys Scale of infant development was administered to determine cognitive outcomes which give the mental age (MA) and mental development index (MDI) and deviation mental quotients (DMeq).The mean performance of child outcomes is given below in the table 1 and 2.

Table 1. Mean performance of child outcome before and after Intervention in experimental group

Performance measure	N	Pretest		Post test		
		Mean	SD	Mean	S.D	t-value
Mental age	45	8.23	4.29	11.81	5.6	5.70**
MDI	45	54.88	14.36	59.91	16.29	4.09**
Dmeq	42	31.09	22.55	37.26	26.06	2.64**
BPST	45	6.63	4.47	11.20	4.77	27.93**

**p< .01

Table 2. Mean performance of child outcome before and after Intervention in control group

Performance measure	N	Pretest		Post Test		
		Mean	S.D	Mean	S.D	t-value
Mental age	30	6.99	3.89	8.77	4.42	8.92**
MDI	30	42.09	8.61	41.24	7.99	.69
Dmeq	28	14.65	10.56	13.05	7.48	1.04
BPST	30	3.47	3.05	4.9	3.5	9.60**

**p< .01

As evident from table I and 2, the subjects in experimental group displayed more striking performance gains assessed in terms of mental age and mental development index than those of control group. The pre to post test differences of MA were 3.57 and 1.78 in experimental group and control group respectively. Corresponding mean differences of MDI were 5.08 and (–) 0.85 in experimental and control groups. The pre to post measures on MA (t=5.70) MDI (t=4.099), Dmeq(t=2.64) and BPST(t=27.93) were highly significant in experimental group while it was also significant only on MA (t= 8.9)and BPST (t=9.607)in control group. The significance on MA & BPST in control group could be attributed to the general cognitive stimulation given as part of NIMH early intervention program.

The substantial gains as seen from the mean differences of MA (3.57), MDI (5.03), DmeQ (6.17) and BPST (4.57) by experimental group when compared to control group MA (1.78), MDI (-0.85),DmeQ (-1.59) and BPST(1.43) is indicative of the efficacy of psycho-ecological interactive model.

Reporting similar intervention gains from experimental groups, Sternberg (2002) pointed that the environment, training and motivation profoundly influenced the cognitive skills.

The problem solving tasks were the targets that formed the basis for planning activities where child's active engagement with the environment and emphasis on mother- child interactions helped the child to gain from intervention. In the present study, intervention targets, environmental arrangement coupled with following child's lead were considered important aspects of intervention. This further substantiates the efficacy of the problem solving interactive model. Intervention outcomes of PSIM with reference to chronological age

Table 3. Intervention outcomes with reference to age in experimental and control groups

Age(Months)	Mental age(exp)				Mental age (control)			
	Pre	Post	Gain	Rate of gain	Pre	Post	Gain	Rate of gain
4-13	5.16	7.92	2.76	0.77	3.84	4.82	0.98	0.24
14-23	10.56	13.63	3.06	0.94	7.33	9.43	2.09	0.51
24-33	13.82	16.97	3.15	0.99	14.42	17.23	2.81	0.76
Mean	8.33	11.33	2.97	0.87	7.00	8.78	1.78	0.44

In the experimental group, the children in the age group of 24-33 months had pre- and post-test MA of 13.82 and 16.97 and a higher rate of change of 0.99. The infants in the age range of 4-13 months exhibited lower performance outcomes on MA with a pre to post test difference of 2.76 and rate of difference of 0.77, which was the lowest. The infants in the age group of 14-23 months displayed a rate of change of 0.94 on MA. In control group the mean scores on MA in the age group of 24-33 months was notable with a pre to post test difference of 0.28 and rate of difference at 0.76.The lowest change on mean scores of MA was observed in 4-13 months age group.

A comparison of experimental and control groups reveal similar trends where performance outcomes on mean scores of MA was higher in the 24-33 months (0.99 in experimental and 0.76 in control) and lowest in the 4-13 months age (2.76 in experimental and 0.98 in control). The age was found to be a determining factor influencing MA. Intervention processes may be more likely to lead to differential outcomes. A plausible explanation could be mastery motivation. One aspect of mastery motivation relates to the children's attempts at object – related mastery. In early developmental stages, the children attempt to master problem posing tasks. Studies (Jennings, Yarrow, & Martin, 1984) indicate that mastery motivation measured during infant and toddler period predict higher levels of cognitive performance. Different qualities of social and physical environment operate to support different aspects of development at different ages (Slade, 1987; Wachs & Gruen, 1982).

The Problem Solving Interactive Model (PSIM) proved to be efficacious in promoting cognitive outcomes in children with developmental delays. This is clearly evident from the pre to post treatment differences, on mental age (3.57) mental development index (5.03) and deviation mental quotient (6.17) in the experimental group when compared to gains made on control group MA (1.78), MDI (-0.85),DmeQ (-1.59) and BPST(1.43) . The pre to post test differences were highly significant on all performance indicators in experimental group MA (t=27.88) MDI (t=4.099), Dmeq(t=2.64) and BPST(t=27.93) while it also showed significance only on MA (t=8.9)and BPST (t=9.607)in control group. Comparative trends between experimental and control groups with regard to chronological age showed higher mean differences in 24-33 months (3.15 in experimental and 0.76 in control) and lowest in 4-13 months age (2.76

in experimental and 0.98 in control).

Conclusion

The PSIM model with its emphasis on tridirectional reciprocity, helped to improve the performance of children with developmental delays. Therefore awareness may be created on task analysis of problem solving targets, task related interactions and task specific materials to mothers of children with developmental delays. The variations in intervention outcomes with respect to age of child indicated the need to plan and implement specialized interventions targeting these specific child characteristics. This also necessitates and calls for studying the interaction effects in further detail.

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Received: April 14, 2007
Accepted:September 22, 2007

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Acknowledgements: The author thanks the unstinted support of Dr. C. Beena, Professor & Head, Department of Psychology, Osmania University, Hyderabad for her guidance in carrying out this research. Many thanks are also due to all the children and their mothers in the sample and to all of my colleagues at National Institute for the Mentally Handicapped, Secunderabad.