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**ATINER's Conference Paper Series**

**PSY2013-0546**

**Use of Inter-Observer Reliability  
Measures for Applied Behaviour  
Analysis: Two Case Studies**

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**ISSN 2241-2891**

19/09/2013

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This paper should be cited as follows:

**Gupta, I., Thaman, S. and Jena, S. P. K. (2013) "Use of Inter-Observer Reliability Measures for Applied Behaviour Analysis: Two Case Studies"**  
Athens: ATINER'S Conference Paper Series, No: PSY2013-0546.

## **Use of Inter-Observer Reliability Measures for Applied Behaviour Analysis: Two Case Studies**

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### **Abstract**

Inter observer reliability measure are one of the fundamental requirements for research in behaviour modification. This is considered as the core of behavioural analysis. In the present study the authors have attempted to take the baseline inter observer reliability for assessing the base rate of occurrence of deviant behaviours in children, before and after an intervention based on techniques of applied behaviour analysis. In order to conduct this study, an initial behavioural definition was obtained through audio – visual demonstration of child behaviour to a group of potential observers trained in behavioural assessment. Subsequently, a set of index behaviours were identified for the sake of coding, which were then subject to time sampling recording by the above observers. Consequently the effect of applied behaviour analysis on child behaviour was seen using inter observer reliability as a tool. The findings of this study have been reported and suggestions for future researches have been given.

**Key Words:**

**Corresponding Author:**

## Introduction

Applied behavior analysis (ABA) has been used extensively for identifying the contingencies of reinforcement that sustain behaviour problems of children and treat them. Therefore, it continues to be at the forefront of applied behavioral research (Alberto & Troutman, 2006). It is concerned with the application of behavioral science in real-world settings such as clinics or schools with the aim of addressing the socially important issues such as behavior problems and learning of children and adults (Baer, Wolf, & Risley, 1968). Several review articles and meta-analyses have summarized large body of literature on applied behavior analysis (e.g. Didden, Duker, & Korzilius, 1997; DeMyer, Hingtgen, & Jackson, 1981; Herbert, Sharp, & Gaudiano, 2002) Each of these reviews supported efficacy of ABA-based procedures in the assessment and treatment of problem behavior associated with autism, mental retardation and related disorders, and a variety of socially important behaviors.

Much research involving applied behaviour analyses employs data collected by observers. They have recorded the occurrence of various target responses during specific time intervals (e.g. Ayllon & Roberts, 1974; Glynn & Thomas, 1974; Knapczyk & Livingston, 1974). Observational measures employ predetermined coding or rating schemes to quantify behaviour (Morrison, Phillips, & Chae, 1990). One of the methods to check validity is through interobserver reliability which is determined by evaluating the degree of agreement of two observers observing the same phenomena in the same setting (Tashakkori & Teddlie 1998). Different behaviours have been subjected to inter observer reliability study. Jena (2007) for instance studied posturing, self-manipulation, and on-task behaviour of an autistic child using a partial interval schedule in which behaviours were recorded on 20-second intervals. The initial 15-seconds of each 20-second interval was allotted for observation, which was followed by a 5-seconds recording period. 80 per cent inter-observer agreement was considered as criterion for valid observation by the primary observer. Similar procedures were used for assessing stereotyped body-rocking and disruptive noise making in a retarded children in classroom setting (Jena, 1995; 1998). It has been used in various other studies (e.g. Wing *et. al.*, 2002; Klesges *et. al.*, 1983; Gonzales *et. al.*, 2008; Watkins *et. al.*, 2002).

Some authors have used video recording as an observational tool. One of the biggest advantages is that there is a high degree of reproducibility of the observed data (Haidet *et. al.*, 2009). However, video recording provides only a portion of what actually happens. Also, it may lack important contextual data (Latvala, Vuokila-Oikkonen, & Janhonen, 2000), which is important of functional analysis. Even with multiple, strategically placed cameras, it may be difficult to capture the all of the targeted behaviours.

In the present study, two sets of behaviours were selected for intervention, such as (a) a group of behaviours that are labeled social skills and (b) overt self-talk.

Social skills deficits is often one of the major areas of concern for children, although its definition is often elusive. Despite the frequent use of the term 'social skill' does not have true consensus on the definition. As Curran (1979) remarked "everyone seems to know what good and poor social skills are...[but]...no one can define them adequately" (p. 321). Libet and Lewinsohn (1973) said "the complex ability to maximize the rate of positive reinforcement and to minimize the strength of punishment from others" (p. 311), thus defining it in operant terms. Walker (1983) explained it as "a set of competencies that (a) allow an individual to initiate and maintain positive social relationships, (b) contribute to peer acceptance and to a satisfactory school adjustment, and (c) allow an individual to cope effectively with the larger social environment" (p. 27). Social skills also include recognizing and managing emotions, developing care and concern for others, establishing positive relationships, making responsible decisions, and handling challenging situations constructively and ethically (Zins, Weissbert, Wang, & Walberg, 2004). Social skills training has been found to have an effect on school measures, including improved grades and greater involvement with school activities (Gottfredson, 1987). In addition, social skills training were found to reduce the number of inappropriate behaviours in the classroom such as aggression, impulsivity, and out-of seat behaviours (Kamps, Tankersley, & Ellis, 2000).

The second behavior which was intervened on was overt self-talk. Young preschool children frequently talk out loud to themselves as they play and explore the environment. This self-directed talk is known as private speech or self-talk. Vygotsky's sociocultural theory (1934/1987; cited in Daugherty & White, 2008) on cognitive development maintains that children's private speech is used for self-direction and that this language is the foundation for later complex mental activity. The literature suggests that private speech emerges in the toddler years, peaks in frequency during early childhood, then gradually reduces in prominence throughout the early school years, all the while following a shift from overt (out loud) self talk, to partially-internalised speech (whispers), to fully covert (silent, inner) speech or verbal thought (Manfra & Winsler, 2006; Winsler & Naglieri, 2003). However, ADHD children have not inhibited their reactions long enough for this skill to fully develop (Barkley R.A. 1997).

Thus, in the present study operant methods like differential reinforcement of other behaviour has been used to intervene with self-talk and deficits in social skills. Several studies have been conducted regarding effectiveness of interventions for problem behavior (e.g., Goh et al. 2002; Lerman et al. 2002; Ringdahl et al. 2002; Volmer et al. 1999). Providing a positive reinforcer when the target response does not occur for a given period of time may avoid the undesirable side effects of aversive procedures and at the same time effectively reduce responding. Reynolds (1961) called such a schedule the differential reinforcement of other behavior (DRO). DRO schedules have been successfully used to eliminate a wide variety of behaviors including disruptive behaviors (e.g., Bostow & Bailey, 1969), aggressive behaviors (e.g., Frankel,

Moss, Schofield, & Simmons, 1976), stereotyped behaviors (e.g., Ball, McCrady, & Teixeira, 1978), hyperactive behaviors (e.g., Patterson, Jones, Whittier, & Wright, 1965). DRO schedules have been used with a variety of populations including normal children (e.g., Lowitz & Suib), retardates (e.g., Frankel & Simmons, 1976), and psychotic adults (e.g., Sherman, 1965).

## **Method**

Case studies were conducted by the authors by (1) taking a group of children with social skills deficits and (2) a child with self-talk exhibited across multiple settings.

### *Participants*

In the first case a group of 4 underprivileged children 2 females (Heena and Mehak), 2 males (Ankur and Arjun) were enrolled for the study. They were in the age range of 7-8 years, who were enrolled in Class II and III. All of them were from a slum, which was located three kilometre away from the University of Delhi South Campus, New Delhi. They were brought to the laboratory-cum-classroom setting for observation and intervention.

In the second case an 8 year old child Shaurya with mixed autistic and hyperactive-like behaviour and mild mental retardation also participated in the study. He was observed in three settings: (a) actual classroom setting in his school (b) home setting as well as (c) experimental laboratory-cum laboratory setting.

### *Observers*

The observers who conducted observations of the behaviours were adult post-graduate trainees in the age group of 22 - 23 years. They were trained in applied behaviour analysis including behavioural assessment as a part of their instructional programme.

### *Procedure*

Informed consent and permission was obtained from the children, their teachers, as well as their parents before conducting the assessment. In this experiment, a group of 4 children were studied in a group setting in the Applied Psychology Department. The purpose of the experiment was to enhance their classroom-appropriate social skills for integration in a government school, in view of better social integration. These children were asked to interact with each other.

### *Setting*

The assessment as well as the intervention on the children was done in a classroom setting, using a camera (Nikon D90). The camera was set to video-record the children's behaviour focusing each target child and was handled by one of the authors. The group was given opportunity to freely interact with



each other. The recordings were conducted over a period of one hour and edited to exclude the artefacts.

#### *Interobserver Agreement*

Inter-observer agreement was obtained in the post-graduate classroom setting in three phases (a) video presentation of child behaviour, (b) description of index behaviours and (c) observational coding of behaviour on a coding sheet. Before observation, the observers were asked to watch the videos obtained from the above two recordings. Thereafter the deviant behaviours were identified and defined by each observer. On the basis of these descriptions behavioural categories were identified. Next, the observers were asked to record each behaviour as either present (√) or absent (x) each time they record behaviours for a given interval. After interval of 30 seconds, the video was paused for 5 seconds for the observers to record the behaviour and make entries in the scoring sheet.

The percentage agreement was calculated for each behaviour for each child. To examine the reliability of the percentage agreement, Fleiss Kappa was calculated. The significance of the results was assessed using the protocol provided by Landis & Koch (1977).

#### *Intervention*

The social skill deficits were identified and defined for coding as follows: *Aggression*: Verbal or physical actions intended to hurt other, like abusing, hitting and pushing. *Refusal to Help*: Refusal of voluntary actions intended to help others, like sharing. *Speaking out of Turn*: Not waiting for the other to complete his turn or to speak patiently and then take own turn. *Touching*: Unnecessary touching of other, or sitting too close to the other. *Noise-making*: Having a higher pitch of speaking and shouting

Differential reinforcement of other behaviour (DRO) was used as the method of intervention. The children were instructed that if they do not exhibit any of the target behaviours (social skill deficits observed earlier), during a specific period of time, they would be provided with eatables (e.g. sweets, chocolates and mints) as reinforcers. Initially, the time period for abstaining from these behaviours was stipulated for 15 minutes. They were reinforced at each 15 minutes intervals. Gradually, the time period was increased. In the last 2 sessions, it was extended to one hour. Thus, in the last two sessions, reinforcements were given only twice in the entire session in order to facilitate generalization.

An effort was also made to improve their social skills by engaging the children in various activities that facilitate social interaction including role play, playing knots and crosses game, drawing, clay modelling, story-telling and collage making. Children were asked to role play for the characters in the stories. They were also asked to make drawings. Children's Apperception Test cards were used for story-making and role-play. They were engaged in drawing and colouring in a group on a single large sheet of paper. Clay modelling was done by involving other children as partner for each child and also

individually. For story-telling, the researcher participated in narrating the story. The children were required to complete the incomplete stories. In another exercise, each child was asked to add one line to the single line provided by the researcher. These activities were conducted over 10 sessions, twice a week, lasting for 2 hours each. Their responses were recorded by the experimenter.

The second part of the study involved a single child Shaurya. An observation revealed mixed symptoms of hyperactivity, autistic tendencies and mild mental retardation in three settings namely (a) structured classroom, (b) home and (c) experimental setting. In the first setting observation was conducted when the regular classroom activities were on. The second observation, conducted in home-setting attempted to focus on behaviour when the child was alone with a cell phone and while responding to his mother's commands. Third observation was conducted while being taught by his mother in the experimental classroom setting in the University.

Self-talk was taken as the target behavior for intervention. A mixed method for intervention was used for this experiment. Differential reinforcement of other behaviour (DRO) was used as the prime method of intervention. The sessions primarily focused on mild reprimand "stop" pressing his hand mildly and differentially reinforcing for non-occurrence of self-talk (DRO) at every 30 second interval. In DRO, reinforcement is delivered, if the target behavior does not occur at all for a specified period (Reynolds, 1968).

Preferred edible and activity reinforcers like chocolate or biscuits or preferred play activity were selected for the purpose. The child was told that if he engages in the target behavior, he would not earn any of these reinforcers. Intervention was conducted for 10 sessions and between every session the mother was also demonstrated the method so that this could be implemented in home-setting. As Shaurya started making progress the reinforcement interval was increased. Post-treatment baseline was taken after these sessions.

## **Results and Discussion**

The aim of the present study was to calculate the interobserver reliability of behavioural coding using two case studies and then conduct behavioural intervention. In each study, video recording was done and shown to four observers for behavioural coding. Time sampling method was used.

In the first group, the interaction of a group of four underprivileged children was recorded and shown to a group of four observers. These children were individually observed for specific behaviours using time sampling technique. The behaviours were coded as either present or absent. The kappa values for all the behaviours for all the children were above 0.70.

For Ankur, the average percentage for each index behaviour has reduced from pre intervention to post intervention. The average percentage has reduced for touching (by 19.23%), aggression (by 55.76%) and noise-making (by 9.86%). Touching and aggression have been reduced to zero, indicating that they are not present at all in the post intervention phase. Noise-making too has

reduced in the post intervention phase, however, not to zero like the other behaviours. This implies that noise-making behaviour has been controlled only to an extent but not completely. Further intervention would be required in this area, or for a longer period of time. For refusal to help, the average percentage of the behaviour was 100% in the pre intervention phase and no decrease was found in the post intervention phase as well, thus indicating that the intervention had no effect on the child's helping behaviour at all. For speaking out of turn, there has been an improvement of 13.46%.

For Heena, touching, aggression, refusal to help, speaking out of turn and noise-making have all reduced from pre intervention to post intervention, by 11.53%, 38.46%, 1.68%, 14.06% and 32.21% respectively. These results indicate that the intervention has worked well for the child and she has responded well to the training. Mehak, too, has show improvement in touching (by 7.69%), aggression (by 46.63%), refusal to help (by 15.63%), speaking out of turn (by 10.34%) and noise-making (by 16.59%) from pre intervention to post intervention. For her, too, the intervention seems to have worked and has improved her targeted social skills.

Arjun, has shown decline in touching, aggression and noise-making. These skills have reduced and the activities focused on these specifically have worked for him. However, he has also shown an increase in refusal to help. He has shown no change in speaking out of turn. For these two skills the intervention did not work for him. Reasons for this could be that the video recorded in post recording could not reveal the extent to which the behaviour was present.

Many researchers have found operant training (including reinforcement) for social skills as an effective method of intervention (e.g., Barton, 1986). Differential reinforcement has been used for social skills training and found to be effective in many cases (Farkas et. al., 1981). Cooperative learning, which entails students to work together in completing a task, thus requiring them to cooperate, share, and assist each other in completing the task, has been found to be an effective technique for increasing likelihood of positive social behaviours (Slavin, 1990). In the present study too, in many sessions cooperative learning was used as a means to augment helping behaviour and collaboration amongst the students. Role playing activities were done in groups, along with the collage making activity.

It is clear from the results that the aggressive behaviour of all four children has reduced from pre intervention to post intervention. It has been proven that social skills training is an effective approach to deal with childhood aggressiveness and violence (Nangle et. al., 2002). The use of reinforcement to increase pro social behaviour and punishment to inhibit aggressive responses proved successful in achieving immediate improvements but failed to demonstrate more long-term maintenance and cross-setting generalization (e.g., Drabman & Lahey, 1974; Drabman, Spitalnik, & Spitalnik, 1974). Further, such short-term decreases in aggressive behaviour were not necessarily accompanied by increases in pro social behaviour or gains in peer acceptance (Bierman, Miller, & Stabb, 1987).

In the second study, a single child with mixed symptoms of hyperactivity, autistic tendencies and mild retardation was observed. The recordings were conducted across several behaviors such as out-of-seat behavior, self-talk, inattention, temper tantrums etc. In addition to that the recordings were obtained in multiple settings such home, classroom and simulated home setting.

In this study many behavioural deviances were identified and it was seen that the kappa for some of these behaviours was above 0.70. However, the intervention was narrowed down to one problem behavior i.e. overt self-talk. It is evident from the pre-intervention baseline assessment that there are differences in the kappa coefficient of self-talk with the kappa being 0.13, 0.5 and 0.93 in the school, home and one-one experimental setting respectively even when the behavior is of utmost concern for the parents and teachers. This could be because in some situations the behaviour is easier to identify than others.

The results of the pre and post intervention assessment of self-talk indicate that the inter observer reliability estimates have mostly changed from pre intervention to post intervention. It can be seen that the kappa value for self-talk has increased from 0.93 to 1.00(100% agreement). The possible reasons for this could be that the observers were able to identify the presence and absence of these behaviours in a manner, which was the same for all of them. The possible reason for this could be that these particular behaviours were exhibited, or not exhibited, very clearly by the child.

It can be seen that the present percentage of behaviour for the target behaviour for intervention i.e. self-talk has reduced from pre intervention to post intervention. The present percentage has reduced by 9.7%. Thus, the application of the techniques of Applied Behaviour Analysis designed for Shaurya to reduce self-talk has impacted the child. The stop technique was used to make the child conscious of the self-talk he was indulging in and it was coupled with differential reinforcement for other behaviour (DRO).

DRO procedures can produce rapid response suppression in applied settings. For example, behaviors decreased to near zero rates within one treatment session in several studies (Deitz et al., 1976; Repp, Deitz, & Speir, 1974; Repp, Deitz, & Deitz, 1976) and within five treatment sessions in other studies (Lowitz & Suib, 1978; Luiselli, Helfen, Colozzi, Donellon, & Pemberton, 1978).

The applied literature also contains several informal reports of response reduction during DRO training generalizing from the training setting to other settings where training did not occur (Barkley & Zupnick, 1976; Garcia & DeHaven, 1976; Peterson & Peterson, 1968; Weiher & Harman, 1975). In one formal investigation, Lowitz and Suib (1978) allowed a mother to administer reinforcers on a DRO schedule in the laboratory, following which complete response suppression was observed in the home, where DRO contingencies were never imposed. Many applied settings provide ideal opportunities for studying generalization of response suppression, and methods for programming generalization.

A major limitation of this study is that there was real-time recording by the observers in the actual setting in which behaviour was exhibited in both the experiments. The data was obtained from observers in a single set of observation. Multiple recordings would have been more useful in functional analysis. Also, there was lack of adequate observer training. Since it was a part of the curriculum of the observers, the experimenters relied on that. More appropriate observer training could have been followed. It was found that some behaviours had better inter-rater reliability than others. This could be because some behaviours were easier to identify than others. Better behavioural definition and reduction of behavioural categories for conducting simultaneous observation would have ameliorated the process of observation.

## Conclusion

In the present study, it was seen that the intervention, that is differential reinforcement of other behavior was found to be effective for most of the behaviours. Also, inter observer reliability was found to be an effective technique to assess the behaviour of children, and identify deficits, improvements as well as no change.

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## Appendix

**Tables****Table 1.** *Fleiss Kappa for Pre and Post Intervention for Case 1*

Subject	Behaviour	Fleiss Kappa (Pre)	Fleiss Kappa (Post)
Ankur	Touching	0.83	1.00
	Aggression	0.71	1.00
	Refusal to Help	1.00	1.00
	Speaking Out of Turn	0.83	1.00
	Making Noise	0.83	0.75
Heena	Touching	0.74	1.00
	Aggression	1.00	1.00
	Refusal to Help	1.00	0.75
	Speaking Out of Turn	1.00	0.84
	Making Noise	1.00	1.00
Mehak	Touching	1.00	1.00
	Aggression	0.88	0.72
	Refusal to Help	1.00	0.76
	Speaking Out of Turn	0.75	0.82
	Making Noise	1.00	0.81
Arjun	Touching	1.00	1.00
	Aggression	0.78	0.73
	Refusal to Help	0.88	1.00
	Speaking Out of Turn	1.00	1.00
	Making Noise	1.00	1.00



**Table 2. Average Percentage of Index Behaviours for Case 1**

Subject	Behaviour	% of Index Behaviours (Pre)	% of Index Behaviours (Post)	Difference
Ankur	Touching	19.23	0.00	-19.23
	Aggression	55.76	0.00	-55.76
	Refusal to Help	100.00	100.00	0.00
	Speaking Out of Turn	86.54	100.00	13.46
	Making Noise	19.23	9.38	-9.86
Heena	Touching	11.53	0.00	-11.53
	Aggression	38.46	0.00	-38.46
	Refusal to Help	92.31	90.62	-1.68
	Speaking Out of Turn	100.00	85.94	-14.06
	Making Noise	38.46	6.25	-32.21
Mehak	Touching	7.69	0.00	-7.69
	Aggression	65.38	18.75	-46.63
	Refusal to Help	100.00	84.38	-15.63
	Speaking Out of Turn	88.46	78.13	-10.34
	Making Noise	38.46	21.88	-16.59
Arjun	Touching	15.38	0.00	-15.38
	Aggression	38.46	18.75	-19.71
	Refusal to Help	78.85	100.00	21.15
	Speaking Out of Turn	100.00	100.00	0.00
	Making Noise	53.84	100.00	46.16

**Table 3. Fleiss Kappa for Pre and Post Intervention for Case 2**

Setting	Behaviour	Fleiss Kappa (Pre)	Fleiss Kappa (Post)
School	Out of Seat Behaviour	0.74	
	Self Talk	0.13	
	Jumping	0.84	
	Inattention	0.19	
	Inappropriate Laughter	0.23	
	Inappropriate Touching	0.28	
	Non-correspondence	0.2	
Home	Self Talk	0.5	
	Temper Tantrums	0.68	
	Out Of Turn Talk	0.41	
	Disobedient	0.83	
Experimental	Self Talk	0.93	1.00
	Seeks Prompting	0.67	
	Response Latency	0.03	

**Table 4.** *Average Percentage of Index Behaviour for Case 2*

Behaviour	% of Index Behaviour (Pre)	% of Index Behaviour (Post)	Difference
Self-talk	43.75	30	-13.75