

SYMPOSIUM ON TEACHING METHODS FOR THE SEVERELY SUBNORMAL

I—TEACHING TOOTHBRUSHING BEHAVIOUR IN SEVERELY RETARDED ADULTS: A REPLICATION STUDY

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Research efforts to establish basic social and self-help skills in retardates have resulted in various training programmes using systems analysis and contingent consequence procedures (Azrin and Armstrong, 1973; Baer and Guess, 1973; Horner, 1971; Leff, 1974; McLean, 1970; Striefel, 1974). The validity and hence the replicability of these programmes seems to be ensured by high inter-observer reliabilities, the experimental design (e.g., multiple baseline design across subjects or pretest-posttest control group design) and unambiguous operational definitions of training components. The efficacy of some programmes ("rapid programmes") can be accentuated when data suggest that even profoundly retarded adults who have been institutionalised for many years will acquire fairly complex skills (Azrin and Armstrong, 1973) or stop demonstrating chronic and severe behaviour problems (Azrin *et al.*, 1975; Webster and Azrin, 1973) in less than two weeks. Nevertheless, the replication potential of some of these programmes may be low, when used by other trainers under different conditions and with different subjects. Some of the problems may be due to a casual usage of nomenclature (Swartz and Clelland, 1975) or to an accumulation of various environmental constraints (Hall and Baker, 1973; Repucchi and Saunders, 1974; Smith *et al.*, 1975), many of which have enough "sabotage" potential" to abandon the programme eventually. Even after having taken care of all possible loopholes, the training of a skill may be a slow and tedious process rather than a smooth type of operation as suggested by the original data (Smith *et al.*, 1975).

Discussions with the staff and administration of an institution for the retarded about implementation of a toothbrushing programme (Horner and Keilitz, 1975), indicated that they were willing to use the programme, provided it was first tried out by someone else. Pre-experimental observations on the ward revealed that the current toothbrushing training consisted of a routine activity whereby the attendants turned on the water and put the toothpaste on the toothbrush. The residents then had to brush their teeth in an unidentified fashion for an unscheduled but limited time period. After the attendant or the resident himself indicated that he was finished, he was supposed to rinse his mouth, lay the toothbrush down and wipe his mouth. Some residents, however, would just dispose of the toothbrush, swallow the excess toothpaste and water, and wait for the attendant to wipe their mouths.

The reason for replicating the Horner and Keilitz programme (1975) was that it included sufficient information (high reliability, specification of the target behaviours and a sequence for training specific behavioural components) to warrant maximal utility and replicability. With the exception of some minor details (see method section) the procedures used in this study were identical to those used in the original study.

METHOD

Subjects

Four subjects (three males and one female) were selected from the highest functioning population of an institution for the retarded on the basis of their ability to understand basic verbal instructions and availability. They functioned within the severely retarded range ($IQ < 35$), were between 22 and 29 years of age (mean = 25.8 yr.) and had resided in the institution from 11 months to 7.5 years (mean = 5.3 yr.). All subjects showed at least some productive language. Only one subject (Hans) had serious dental problems (severe tooth decay). When opening his mouth he produced excessive saliva and mucous secretions, thus decreasing the likelihood of the attendants assisting him in brushing his teeth.

Trainers and Setting

Training of all four subjects was carried out by a male undergraduate psychology student with no prior experience with retardates or with the application of behaviour modification procedures. Another student served as a reliability observer.

Baseline observations and training were conducted in a small room with a large observation screen. Furniture included a sink with a mirror directly above it. Next to the sink was a (cloth) towel. A plastic cup, a toothbrush and a (closed) tube of toothpaste were placed on the sink. Baseline and training sessions were conducted after lunch each day, five to seven days a week.

Procedures

Baseline

A multiple baseline design across subjects was used. The baseline procedure was the same for all subjects. Shortly after the subject entered the room the trainer said, "(Name), here is everything you need to brush your teeth. Would you show me how well you can do it all by yourself? Do the very best you can. O.K. You can start." This procedure was repeated every baseline session. During each session the trainer observed and scored the number of correct responses, i.e., those which conformed to the behavioural definitions of all steps in Table 1, without consideration of the correct sequence in which they occurred. Baseline sessions were terminated when subjects stopped demonstrating behaviours related to toothbrushing (e.g., putting the toothbrush down, talking about getting coffee) and responded affirmatively to the trainer's question, "Are you finished brushing your teeth?" The number of baseline sessions for Rineke, Leendert, Bert and Hans were 3, 4, 5 and 6 respectively.

Training

Training sessions began with the trainer making the same introductory statement as during baseline. The toothbrushing steps were then trained according to the sequence and descriptions outlined in Table 1. All steps were trained in each session whether or not they were performed correctly. Sessions were terminated after completion of step 14.

The training techniques consisted of four types of assistance procedures, i.e., (1) No Help, (2) Verbal Instruction, (3) Demonstration + Verbal Instruction and (4) Physical Guidance + Verbal Instruction. The assistance procedures for each step were programmed to be used as follows: First the trainer provided **No Help** for about five seconds, thus allowing the subject to perform the step correctly by himself. If the subject failed to make the correct response within that time interval, the **Verbal Instruction** for that step was provided. The instruction consisted of a

brief statement about the behaviours to be performed for that step. For example, for step 3 the trainer would say, "Turn the cap on the tube and put it on the sink." If the subject again failed to respond correctly within a five-second interval, the next procedure, i.e., **Demonstration + Verbal Instruction** for that step was used. Demonstrations consisted of pointing to and demonstrating the correct behaviour. For

TABLE 1

Toothbrushing Steps

1. **Pick up the toothbrush and turn on the water.** The trainee should turn on the water and pick up the toothbrush by the handle.
2. **Wet the toothbrush.** The trainee, holding the toothbrush, should place the bristles under the running water for at least five seconds. Then he should turn off the running water and put the toothbrush down.
3. **Remove the cap from the tube.** The trainee should hold the tube with one hand while unscrewing the cap using the other hand. Then he should lay the cap on the sink.
4. **Apply the toothpaste on the brush.** The trainee should pick up the toothbrush by the handle and hold the back part of the bristles against the opening of the toothpaste tube. He then has to squeeze the tube while moving it slowly from the back to the front bristles. Then he should stop squeezing the tube and lay the toothbrush with the bristles up.
5. **Replace the cap on the tube.** The trainee should pick up the cap with one hand and screw it with thumb and index finger on the tube, held in the other hand. Then he should lay the tube down and pick up the toothbrush by the handle.
6. **Brush the outside surfaces of the teeth.** The trainee should brush the outside surfaces of the upper and lower teeth on both sides and in the centre of his mouth using an up and down motion for at least 30 seconds.
7. **Brush the biting surfaces of the teeth.** The trainee should brush the biting surfaces of all teeth, using a back and forth motion for at least 30 seconds.
8. **Brush the inside surfaces of the teeth.** The trainee should brush the inside surfaces of all teeth, using a back and forth motion for at least 30 seconds.
9. **Fill the cup with water.** The trainee should lay the toothbrush down, pick up the cup, place it under the faucet, turn on the water, fill the cup and turn off the water.
10. **Rinse the mouth.** The trainee should spit out the excess toothpaste foam, take a sip of water, switch it around in his mouth and spit it out. This step is to be repeated until the spit-out water does not contain any toothpaste foam.
11. **Wipe the mouth.** The trainee should take the towel and dry his mouth.
12. **Rinse the toothbrush.** The trainee should pick up the toothbrush by the handle, turn on the water, and place the bristles under the water until they are free from toothpaste (any toothpaste left by the water may be removed by drawing the fingers across the bristles), turn off the water and lay the toothbrush down.
13. **Rinse the sink.** The trainee should turn on the water, rub around the inside of the sink with the hand to wash any residue of toothpaste or foam down the drain, and turn off the water.
14. **Put the equipment away.** The trainee should put the toothpaste, tube, toothbrush and cup in the proper place (on the sink), pick up the towel, dry his hands and hang the towel on the side of the sink.

example, for step 6 the trainer would pick up the toothbrush and simulate brushing the outside surface of his teeth while repeating the verbal instruction for that step. No correct response within a five-second interval resulted in a repetition of this procedure. If the subject again failed to respond to this procedure, the next one, i.e., **Physical Guidance + Verbal Instruction** was used. This procedure consisted of instructing and physically assisting the subject in initiating the desired response while allowing him to complete it by himself. For example, for step 1 the trainer took the subject by his hands, physically guided him turning on the water while saying, "Turn on the water"; next he would guide the subject to pick up his toothbrush while saying at the same time, "Take your toothbrush." If necessary (i.e., when the subject failed to respond or made an incorrect response), this procedure was repeated. Then, regardless of how the subject responded to the second **Physical Guidance + Verbal Instruction** procedure, training of the next step, using **No Help** was initiated.

Correct performance on any step, regardless of the type of assistance procedure used, was followed by praise and training of the next step using the **No Help** procedure. For each step during training sessions, the trainer scored the types and frequencies of the assistance procedures used and the type of assistance procedure that resulted in a correct response. To be scored correct, the response had to meet the behavioural operations outlined for that step and to be made in the correct sequential order (Table 1). Hence, responses which met the behavioural definitions for any given step but occurring out of sequence were scored incorrect.

RESULTS

Agreement in scoring between trainer and reliability observer was assessed during the first and thirteenth session. During each session observations were based on all responses of each of the four subjects. Reliability was based on percentage agreement obtained from item-by-item comparisons. The percentage agreement was computed by dividing the number of agreements over the number of possible agreements, multiplied by 100. The agreement percentages of the first session ranged from 78.5% to 85.7% (mean = 83.9%), while those of the thirteenth session varied from 99.3% to 100% (mean = 99.8%).

Figure 1 shows the number of toothbrushing steps correctly performed by all four subjects during baseline and those requiring no assistance during training. While all subjects learned to perform 13 out of 14 steps correctly in the prescribed sequential order and with **No Help** in 22 to 29 training sessions, none of them ever met the predetermined criterion of performing all 14 steps for five consecutive sessions. Observations revealed that step 8, i.e., brushing the inside surfaces of the teeth, was extremely difficult to train. Some of the subjects never learned to turn the toothbrush when switching from the right to the left side and *vice versa*, while others evinced pain or a retching reflex when touching the inside of the mouth with the toothbrush. Therefore the study was terminated after each subject responded on 13 of 14 steps for at least five consecutive sessions.

All subjects made immediate gains during the initial sessions, except for Bert. Praise was not sufficient to change Bert's performance. From session 14 on, he was allowed to play soccer when he met criterion. Each new criterion was two steps more than the previous one, starting with five steps on session 14. From that point on Bert's improvement rate was like that of the other subjects.

Table 2 indicates the reduction of the assistance procedures during the first, every fifth following and the final training sessions. The table also indicates that all subjects needed two or more types of assistance during the last session, all of which concerned the performance of step 8.

TABLE 2**Frequencies of assistance procedures used during the first, every fifth following and final training sessions**

Subject	Sessions	Verbal Instruction	Demonstration and Verbal Instruction	Physical Guidance and Verbal Instruction
Rineke	4	11	1	0
	9	5	3	2
	14	5	2	2
	19	2	1	1
	24	1	0	0
	29	1	1	0
Leendert	5	11	3	1
	10	7	3	2
	15	6	2	1
	20	3	1	1
	25	2	1	1
	30	1	1	1
	33	1	1	1
Bert	6	13	3	2
	11	10	3	3
	16	8	3	2
	21	5	2	1
	26	3	1	1
	31	1	1	1
	32	1	1	1
Hans	7	12	3	3
	12	6	4	3
	17	3	3	3
	22	2	1	0
	27	1	1	1
	28	1	1	1

DISCUSSION

Present data are very similar to those obtained by Horner and Keilitz (1975) suggesting that the toothbrushing programme can be successfully used by other trainers, in different situations and with other subjects. All subjects showed considerable improvement of toothbrushing performance although none of them learned to complete all 14 steps without assistance. As pointed out before, the most difficult part of the training sequence was the acquisition of step 8, i.e., learning to brush the inside surfaces of the teeth for a period of 30 seconds. Therefore a revision of this programme should also indicate **how** to instruct, demonstrate and physically guide the trainees to perform this step and **how** to fade out these prompts. Similar problems are met when applying various self-feeding programmes (e.g., O'Brien, Bugle and Azrin, 1972; Berkowitz, Sherry and Davis, 1971) which do not indicate how to train and fade out physical assistance on food scooping behaviour.

Another, though less serious problem occurred when two subjects were praised after completion of each step on brushing the outside (step 6), the biting (step 7) and inside surfaces (step 8) of their teeth. During the first training sessions Hans would, when praised for completing step 6 repeat the same step while Bert would take the toothbrush out of his mouth, expecting to be finished. Apparently, the consequent event "good" also constituted, at least initially, a discriminative stimulus at that point of the behaviour chain. Although these problems dropped out "spontaneously" during the training sessions, obstacles like these might be avoided by praising the subject only once, i.e., after the completion of steps 6, 7 and 8 instead of praising him after the completion of each single step.

Additional target behaviours to be included in the training sequence may be **Cleaning dental prosthesis** and **Rinsing the cup**. Upon completion of the training sequence Rineke was trained to clean her dental prosthesis and Hans to rinse the cup. A more functional sequence would be to insert these steps between steps 12 and 13 as a routine part of the training programme.

As pointed out by Horner and Keilitz (1975), the programme is limited to the acquisition of toothbrushing behaviour. Although the attendants reported improved toothbrushing performance of these subjects in the washrooms, questions related to the generalisability and durability of the newly acquired behaviour remain of interest. Until the last training session, the subjects were praised for completing each step in the correct order. In contrast, toothbrushing behaviour of normals is usually not controlled by such an intensive consequence schedule of explicit social stimuli but by other consequences such as the passage of time, various tactile and visual stimuli or the avoidance of undesirable odours and visits to the dentist. Because durability and generalisation of newly acquired behaviours should be programmed rather than assumed, the presently described toothbrushing programme probably should be supplemented by an additional maintenance programme. The purpose of such a programme would be to fade out the high density of programmed social stimuli while at the same time the behaviour is brought under the control of more natural events in the subject's daily environment.

Present data, like those of Horner and Keilitz (1975) were obtained under relatively favourable training conditions (highly motivated and educated trainers, training on a one-to-one basis, unlimited time for baseline observations, and close supervision from experienced behaviour modifiers). Whether the same results could be obtained by other trainers in less controlled situations remains to be demonstrated. During the initial training sessions it took the trainer, on the average, 20 minutes for each subject to complete the training sequence; the final sessions lasted about 10 minutes per subject. Although the individual training sessions were relatively short, it may only be a special education or special project teacher who, within the institutional setting, can spend that much time per individual subject.

Personnel involved in teaching retardates basic self-help skills are in need of training programmes which contain both detailed information on the procedures to be used and the techniques for evaluating the effects of these programmes. Although the results from this replication study did not correspond exactly to those obtained by Horner and Keilitz (1975), the toothbrushing programme should be acknowledged as being very useful for training this skill. Referenced questions concerning specific behaviour components and generalisability to other situations (ward) are currently under investigation.

References

- Azrin, N. H. and Armstrong, P. M. (1973). The "Mini-meal": a method for teaching eating skills to the profoundly retarded. *Mental Retardation*, 11, 9-13.
- Azrin, N. H., Gottlieb, L., Hughart, L., Wesolowski, M. D. and Rahn, T. (1975). Elimination of self-injurious behaviour by educative procedures. *Behaviour Research and Therapy*, 13, 101-111.
- Baer, D. M. and Guess, D. (1973). Teaching productive noun suffixes to severely retarded children. *American Journal of Mental Deficiency*, 77, 498-505.
- Berkowitz, S., Sherry, P. J. and Davis, B. A. (1971). Teaching self-feeding skills to profoundly retarded using reinforcement and fading procedures. *Behaviour Therapy*, 2, 62-67.
- Fox, R. M. and Azrin, N. H. (1973). *Toilet training for the retarded: A rapid programme for day and night time independent toileting*. Champaign (Ill.): Research Press.
- Hall, J. and Baker, R. (1973). Token economy systems: Breakdown and control. *Behaviour Research and Therapy*, 11, 253-263.
- Horner, R. D. (1971). Establishing use of crutches by a mentally retarded spina bifida child. *Journal of Applied Behaviour Analysis*, 4, 183-189.
- Horner, R. D. and Keilitz, I. (1975). Training mentally retarded adolescents to brush their teeth. *Journal of Applied Behaviour Analysis*, 8, 301-309.
- Leff, R. B. (1974). Teaching the TMR to dial the telephone. *Mental Retardation*, 12, 12-13.
- McLean, J. E. (1970). Extending stimulus control of phoneme articulation by operant techniques. In F. L. Girardeau and J. E. Spradlin (Eds.), *A functional analysis in speech and language behaviour*. ASHA Monograph, No. 14, pp. 24-47.
- O'Brien, F., Bugle, C. and Azrin, N. H. (1972). Training and maintaining a retarded child's proper eating. *Journal of Applied Behaviour Analysis*, 5, 67-72.
- Repucci, N. D. and Saunders, J. T. (1974). Social psychology of behaviour modification: Problems of implementation in natural settings. *American Psychologist*, 29, 649-660.
- Smith, P. S., Britton, P. J., Johnson, M. and Thomas, D. A. (1975). Problems involved in toilet-training profoundly mentally handicapped adults. *Behaviour Research and Therapy*, 13, 301-307.
- Striefel, S. (1974). *Managing behaviour, Part 7: Teaching a child to imitate*. Lawrence (Ks): H & H Enterprises.
- Swartz, J. D. and Clelland, C. C. (1975). A note on nomenclature. *Mental Retardation*, 13, 45.
- Webster, D. R. and Azrin, N. H. (1973). Required relaxation: A method of inhibiting agitative-disruptive behaviour of retardates. *Behaviour Research and Therapy*, 11, 67-78.

Footnote

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FIG. 1.

The number of toothbrushing steps performed correctly by four severely retarded adults

