THE MODIFICATION OF DROOLING BEHAVIOUR IN THE SEVERELY RETARDED SPASTIC PATIENT

E. S. BARTON, E. B. LEIGH and G. MYRVANG
Meanwood Park Hospital, Leeds, U.K.

INTRODUCTION

The inability to control saliva is not uncommon amongst the cerebral palsied. In those of normal intelligence this is generally treated from an early age with special feeding techniques, exercises to improve lip closure, admonitions to swallow and exercises to aid this (Blockley & Miller, 1971), and (Finnie, 1968).

The severely retarded cerebral palsied patient, however, often does not respond to these techniques, lacking the motivation or the discrimination required. Furthermore, in the institution the drooling behaviour may well be accepted by the staff and other patients as an inevitable part of the patient's disability. Consequently, in considering treatment with this type of patient, there are a number of problems: the original difficulty arising from the poor muscle control, the possibility of sensory loss, the lack of motivation, the lack of discrimination of drooling being wrong, and the long history of acceptance.

A number of authors have advocated the use of behaviour modification techniques with physiotherapy as a way of overcoming physical difficulties in the mentally handicapped. In a brief review of the different and conflicting types of physiotherapy treatment available for the spastic, Weiss *et al,* (1967) point out that most of the treatments require the patient to have a "considerable degree of conscious awareness" and be able to "supply conscious movements and to assimilate them and coordinate them into meaningful actions"; this would make ineligible most cases of cerebral palsy seen in the subnormality hospital. However, quite a few authors have found that using the behavioural procedures of fading, shaping, modelling and reinforcement, it is possible to train the patient to carry out the exercises required to improve some motor skills, particularly walking. (Meyerson *et al* 1967; Loynd & Barclay, 1970; Horner, 1971.) Auxter (1969) also improved motor skills using reinforcement. Johnson *et al* (1966) used social reinforcement to develop play on a climbing frame in a physically timid eight year old child. Connolly (1968) improved a finer motor skill by shaping target hitting behaviour. Foss (1966), while pointing out technical and engineering problems, feels biofeedback techniques could be appropriately applied to spastic children to enable them to increase their range of movement, similarly to the athetoid to enable him to reduce unwanted movement. Behavioural techniques have also been used to improve control of muscles such as the sphincter (Kohlenberg, 1973) with some success. Rice *et al* (1968) used operant procedures to increase movements in profoundly retarded multiply handicapped children and Spearing and Poppen (1974) used feedback to reduce foot dragging in a 23 year old male student suffering from athetoid cerebral palsy.

There are, therefore, a number of other papers on improving muscle control in both normal and cerebral palsied subjects. Commonly these involve posture, or spasm control and include many papers on pursuit rotor skills. There seems to be little, however, on treatment of drooling using operant procedures except for one by Garber (1971) who treated a 14 year old boy of normal intelligence suffering from choreathatotic cerebral palsy, right hemiplegia, dysarthria and constant drooling. However, he could swallow and he could propel the saliva back with his tongue. He was instructed and prompted to swallow before speaking and was praised for doing this. Non-drooling was rewarded with pennies with the criterion period of time gradually increased. On baseline he drooled for approximately one minute; after twenty five sessions drooling decreased to zero.

The literature, as a whole, suggested that it would be worthwile attempting to modify the drooling behaviour of severely retarded subjects.

METHOD

Subjects

The subjects were 2 severely retarded men resident in a long stay subnormality hospital. The first patient, Melvyn, aged 24 years, IQ 30, had a left hemiplegia, slightly dysarthric speech and was able to swallow on request. He drooled profusely, his clothing being constantly wet. Melvyn had a ebullient personality and was highly distractible. The second patient, Keith, aged 28 years, IQ 45, was unable to speak or swallow and suffered from hemiplegia; he was quiet and withdrawn. Neither appeared able to propel the saliva back and both drooled at a high rate. Keith held his lips closed until he could hold the saliva no longer and then exploded a mouthful of saliva.

Procedure

It was decided to teach the patients to swallow, if they were unable, and then reinforce swallowing and signal drooling behaviour. Control of saliva involves two mechanisms in normal people — moving the saliva back into the mouth and swallowing. A pilot study on using "slurping" to control the saliva was successful but it was felt that the "slurping" noise was just as socially undesirable as the drooling. Furthermore, the patient tended to "slurp" the saliva back in his mouth, then let it roll forward again to his open lips. Swallowing was, therefore, chosen as

TABLE 1 — Melvyn

Procedure	*No. Sessions (15 mins.)*	*Place*	*Note*
Baseline	8	Psych. Dept.	
Shaping	9	Psych. Dept.	Prompts given to "slurp" and swallow.
Reinforcement 100% and Buzzer	18	Psych. Dept.	Smarties and tokens. Prompts gradually faded.
Reversal	2	Psych. Dept.	No prompts, no reinforcement.
Reinforcement 100% to 50% and buzzer	19	Psych. Dept.	Minimal number of prompts.
Reversal	1	Psych. Dept.	No prompts, no reinforcement.
Reinforcement 50% and 40% and buzzer	61	Psych. Dept.	Prompts faded completely by session 51. Reinforcement (tokens, buzzer) gradually faded.
Reversal	2	Psych. Dept.	As before.
Reinforcement 100% - 0% and buzzer	499	Psych. Dept.	Reinforcement schedule gradually reduced to zero, then token machine removed, then mirror removed.
Reinforcement 100% - 0% and buzzer	291	Workshop	In order to gain generalisation.
Reinforcement 100% and buzzer	1	Psych. Dept.	As a boost.
Reversal probe	1	Psych. Dept.	
Reinforcement 100% and buzzer	1	Psych. Dept.	As a boost.
Negative Reinforcement (buzzer only)	1	Ward	For generalisation.
Future Plan: To get boosts 2 per month in workshops and 0.5 per month in training room in Psychology Department.			

TABLE 2 — Keith

Procedure	*No. Sessions (10 mins.)*	*Place*	*Note*
Baseline	34	Psych. Dept.	Observed alone; no reinforcement.
Swallowing training	20 (half hour)	Psych. Dept.	Training plus verbal praise.
Reinforcement 100%	88	Psych. Dept	Token reinforcement and buzzer.
Reinforcement 50%	9	Psych. Dept.	
Reversal	1	Psych. Dept.	No reinforcement.
Reinforcement 50%	10	Psych. Dept.	
Reinforcement 100%	21	Psych. Dept.	Rate increased to overcome possible effect of environmental changes.
Reinforcement 100% with cue light 130-170	41	Psych. Dept.	Light signal at 15 second intervals in order to reduce and control rate of swallowing.
Reinforcement 90% - 10%	104	Psych. Dept.	Reinforcement schedule gradually decreased.
Reversal probe	1	Psych. Dept.	
Reinforcement 10% - 0% with cue light	24	Psych. Dept.	
Probe reversal	3	Psych. Dept.	No light.
Cue light only	11	Psych. Dept.	Every 15 seconds, as before.
Cue light fade	31	Psych. Dept.	15 seconds cue but brightness gradually dimmed.
Probe reversal	1	Psych. Dept.	No light, no reinforcement.
Cue light fade	19	Psych. Dept.	
Generalisation training using noise cue	83	Workshop	To generalise swallowing, training transferred to workshops. Cue gradually faded in intensity.
Future Plan: boosts 1/2 per month in workshops and Villa.			

the target behaviour. The teaching of correct swallowing is a basic speech therapy technique and was carried out by prompting the swallow (stroking the throat etc.), making the patient aware of his mouth and throat movements, giving lip closure exercises, sucking with straws and so on. Melvyn could swallow and soon learned to swallow to a verbal prompt. Keith learned after some weeks of prolonged training and for some time prompted himself with his hand on his throat, though this gradually faded out. They then moved on to the second part of the training where they were given reinforcement to increase swallowing rate as shown in tables 1 and 2.

From 1 to 6 sessions were held daily and were of 15 minutes for Melvyn and 10 minutes for Keith. The patient was seated at a table alone in a small bare training room containing a one-way viewing screen. On the table was a buzzer, a token dispenser and a mirror in which he was asked to check his appearance. The item for which he was saving tokens was in sight on a shelf. The trainer/observer and a second observer (when reliability was taken) was seated behind the screen with recording equipment and the controls to the buzzer and the dispenser. Swallows were reinforced with tokens. Drooling was indicated by a buzz on the buzzer. As the patient could not swallow to remove the drooled saliva, he removed it by wiping with a handkerchief (which he did normally when he remembered or noticed the chin was wet).

When the reinforcement schedule was reduced it was done randomly, according to tables prepared from random numbers. No explanation was given to the patient. For reversal no different instructions were given; the machine simply produced no tokens. In generalisation training the observations and training were done whilst the patient was at work; the therapist sitting beside him in the workshops.

A cue light was introduced to pace Keith as it was felt he was swallowing at a painfully fast rate and it was thought that he needed to learn to monitor this.

Observations and Recordings

Observations were made using a simple code on a form divided into ten second units. If the patient's chin was wet at any time during a ten second period it was recorded. They were observed for ninety/sixty consecutive ten second periods: 15/10 minutes. It was found impossible to reliably record drooling separately from wet chin (where previous drool remained) or to differentiate between small or large amounts of drool which was unfortunate as it reduced considerably the sensitivity of the data.

Any wetness on the chin or wetness dripping off the lip was recorded; wet lips alone were not considered to be undesirable. Swallows were defined as a definite upward movement of the "Adam's apple" accompanied by characteristic mouth movements. Wiping was also recorded whether done with handkerchief, hand, sleeve or whatever, also whether successful or not. Coughs were also recorded where an intercurrent infection appeared to be affecting saliva control. Talking was recorded for a while for Melvyn as it was felt that this was interacting with his swallowing but this was not shown to be significant so it was discontinued. "Slurps" were first recorded for Melvyn but "slurps" were discontinued when it was realised that these were as antisocial as the drooling itself.

Observations were made of each training session and generalisation observations were also made in other situations: those where the patient spent most of his time. This was mainly the work situation, in the sheltered workshops, but was also on the ward, and during speech therapy sessions. Sampling data (checks) were also taken at random intervals in order to try and get a picture of how the patient was coping when not in the training or observation situation. It proved impossible, however, to take data without the patient being aware of it.

Reliability of observations

Reliability data was taken on a number of training and generalisation observation sessions by simultaneous but independent observers. A number of different people were used as reliability observers including psychologists, students and hospital volunteers.

RESULTS

Reliability

Reliability was taken in observations on Keith on 7 occasions: 100%, 86%, 98%, 99%, 100%, 99% and 98%. On Melvyn's observations, 11 reliability checks were made: on generalisation data: 99%, 90%, 89%, 93%, 90% and 80%; on training data: 98%, 97%, 99%, 98% and 100%.

Experimental results

The data for training sessions for Keith is graphed on Figure 1. During baseline sessions Keith swallowed rarely and with some difficulty. After training swallowing reached a high rate and continued at this rate until it was felt that Keith should be taught a slower rate. This was done by introducing a light cue on session 146 to which Keith quickly responded, the light cue was gradually faded as was the

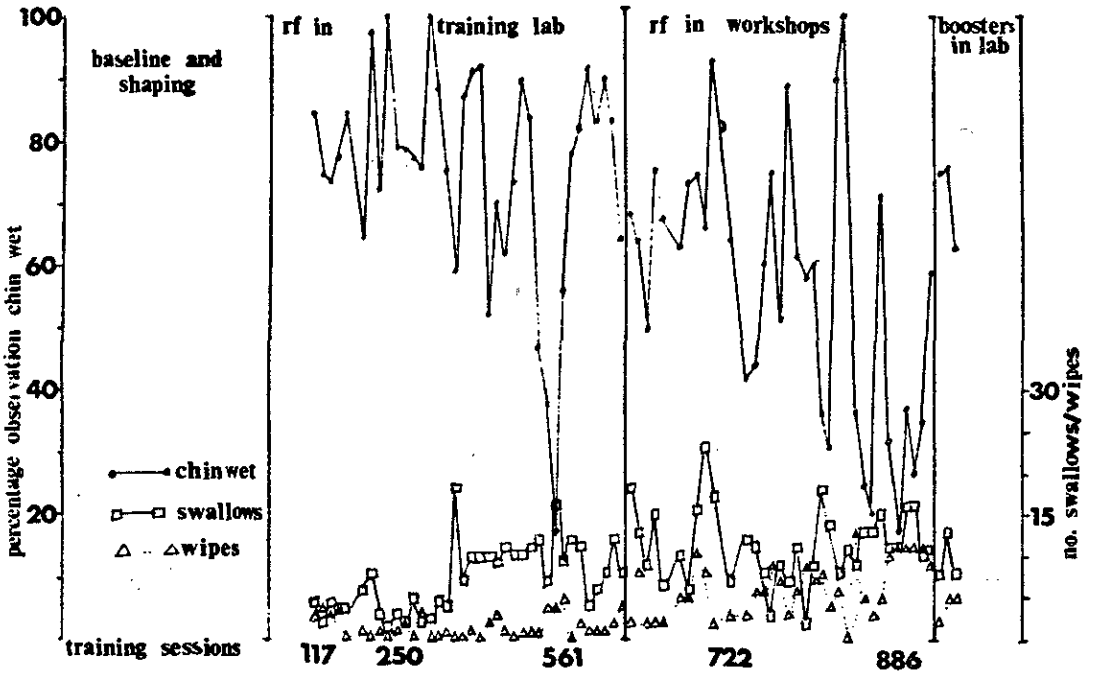

Figure 1.
The data from Keith's training sessions.

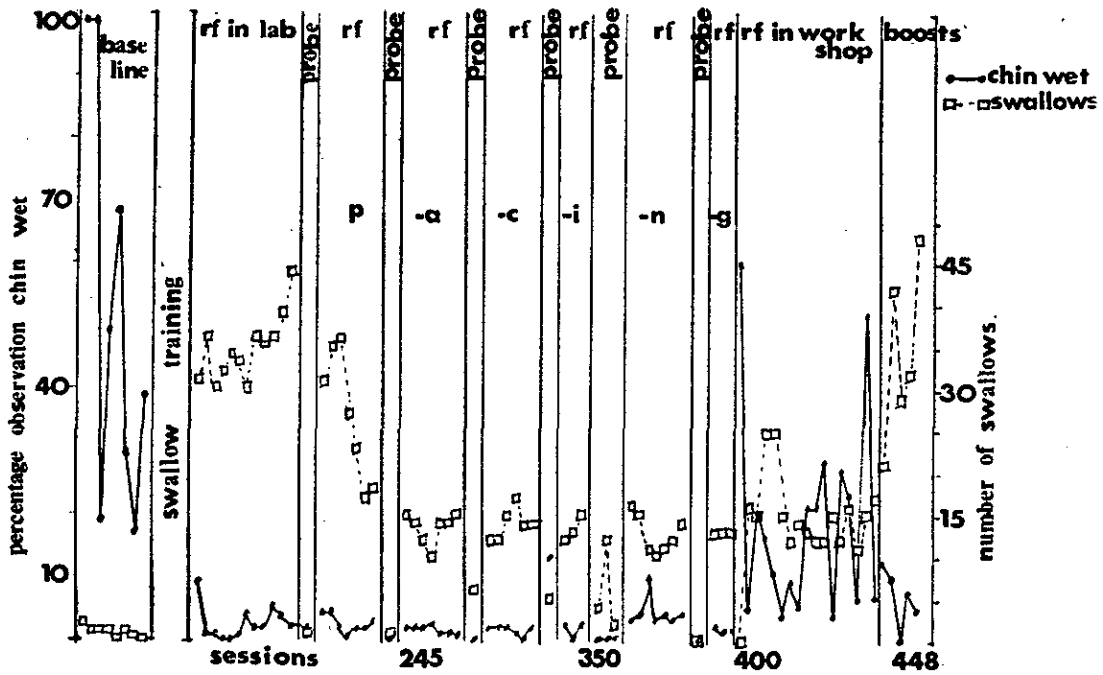

Figure 2.
Generalisation data for Keith complied from random observations at work.

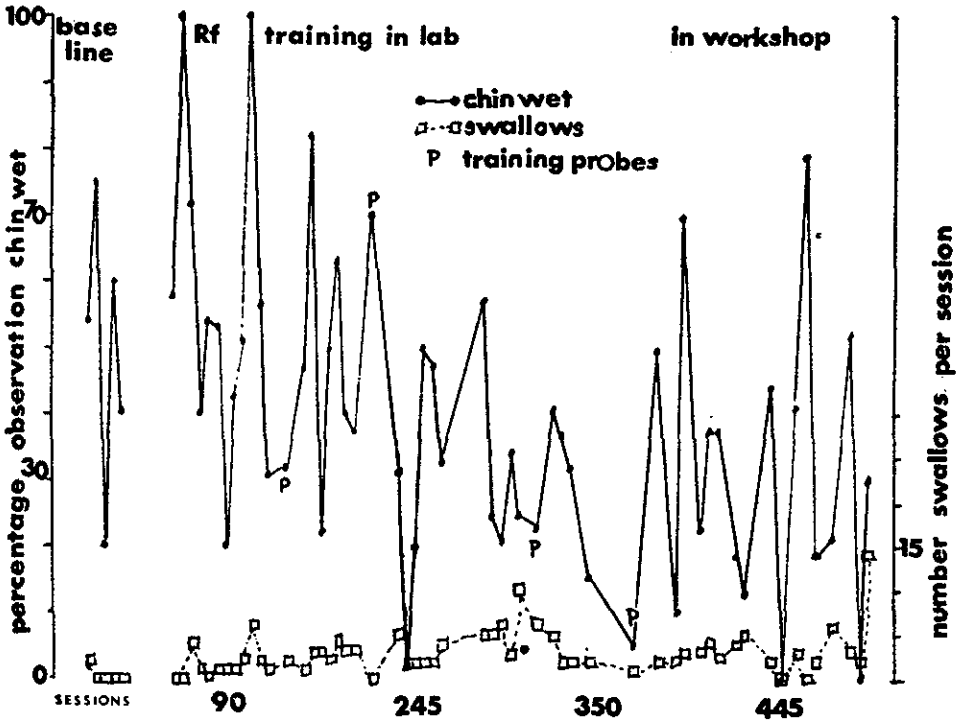

Figure 3.
The data from Melvyn's training sessions.

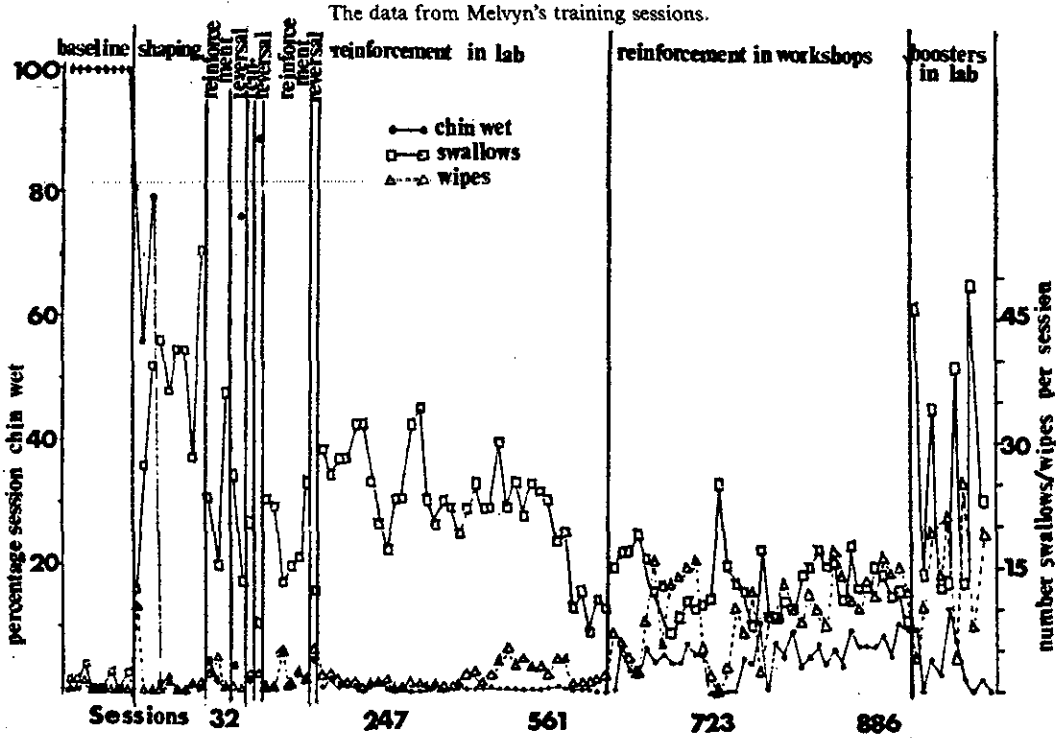

Figure 4.
Generalisation data for Melvyn complied from random observations at work.

reinforcement schedule with no loss in rate of swallowing. Meanwhile, generalisation data from the workshops showed only a slight improvement in rate of swallowing there; consequently it was then decided to transfer the training to the workshops and alternate training and probe generalisation sessions. The rate of swallowing during training sessions was maintained on transfer; the light cue was exchanged for a noise cue (a variable note played on a Kalimba) as this was more practical in the workshop situation. Probe or generalisation observations showed the slight improvement to be maintained. Generalisation data is graphed in Figure 2.

The data from Melvyn's training session is graphed in Figure 3. The percentage of training session time his chin was wet improved dramatically when reinforcement started and was maintained at near zero levels throughout the remainder of the sessions in the training room. When training was transferred to the workshops, chin wet increased slightly but was at a very low level. The inability to remain at zero level was a side effect of Melvyn's greater distractibility in the workshop situation. Swallows were rare in the baseline situation and improved when reinforcement was introduced to acceptable levels. These were maintained while the reinforcement schedule was reduced though did show a slight slump when the schedule was dropped too rapidly at one point; reinstatement of a higher level of reinforcement and subsequent even more gradual lowering proved successful in maintaining the swallowing rate. Transfer of training to the workshops resulted in a slight but not clinically significant drop, again probably the result of increased distractions.

A number of reversals were carried out which are shown on the graphs. These all show the dramatic decrease in the required behaviour which demonstrated experimental control.

The results from the sampling observations were very variable and showed a gradual improvement over the period of the experiment.

DISCUSSION

The data show that operant conditioning is an effective means of controlling drooling in some patients, i.e. those who can, with help, learn to swallow. Generalisation is minimal unless major efforts are made to achieve it. Gradually reducing the reinforcement schedule proved most effective in decreasing reliance on the reinforcer once the behaviour was fully established.

A cue light or tone was found effective to pace particularly if it can be gradually faded. The choice of a musical instrument for a tone cue enabled a wide variety of tones at different intensities to be played.

Both Melvyn and Keith still drooled though at a lower rate than previously. Swallowing is much more evident; also they seem more aware of when their chins are wet and take action by wiping and swallowing whereas previously Melvyn did not notice at all and Keith only seemed aware of drooling when his workbench became wet.

The main disadvantage to the training, aside from the difficulties of generalisation, was the length of time involved. The behaviour is not one which is quickly learned and maintained by the severely subnormal patient, particularly where sensory loss complicates the difficulties.

Generalisation was achieved only to a small extent, and a special generalisation programme had to be developed with training taking place in both workshops and Villa. A number of studies (Barton, 1975) have found generalisation to be quite elusive in that the mentally handicapped person seems to need external reinforcers and discriminative stimuli to maintain a newly learned behaviour or to increase its use.

CONCLUSIONS ON PRACTICAL IMPLICATIONS

During the following year checks were made on both patients to ensure that continued maintenance of the swallowing behaviour was indeed happening. The psychologists who had become something of a discriminative stimulus, were not used as observers, instead other personnel were used (students passing through the hospital on six-weekly placements, nursing assistants, ward staff and trainers in the sheltered workshops). The advantage of broadening the number of people concerned meant that reinforcement (basically increased staff attention) was present in many situations and places and not confined to a training situation with the psychologists. Thus a carefully worked out interlocking chain of reinforcement was built up to the mutual benefit of the subjects and the staff who came into daily contact with them — and both Melvyn and Keith were described by all staff as being pleasanter to work with and vastly improved. This raises the issue of preparing chains of reinforcement before embarking on a training programme and ensuring that there are no gaps within the chains.

Keith is still swallowing although drooling is not completely eliminated because of problems in muscle control. He interacts more with staff and seems a happier, less withdrawn person. He is being trained in a communication system based on hand signs and is considerably more relaxed which seems to increase his rate of swallowing. Current plans for him are the possibility of employment in an outside workshop and centre for spastics. Thus giving Keith the training and opportunity to control an 'undesirable' behaviour — drooling — seems to have led to an increase in self-esteem and consequently opened up his future.

Once Melvyn was observed to have more control over his drooling by the medical staff, he was moved to a pre-discharge Villa at the hospital. This has paid dividends in increased awareness of his personal appearance and habits. A recent two-week random sampling of his swallowing (using a number of staff in the workshops and ensuring that Melvyn was not aware he was being watched) showed an average rate of swallowing of 10.4 per 15 minutes (range 7-16, mode - 10). It was noted that he tended to swallow before speaking. Thus, without tangible reinforcement, swallowing remains at a steady rate. Melvyn is still excitable which can lead to drooling, but this behaviour is again under environmental control (in this case superimposed staff values).

Thus both men are showing maintained improved behaviour seemingly brought about by a combination of

(a) Internalised reinforcement supplied by the patient himself.

(b) Reinforcement provided by the environment and not now dependent on the category of one person or group of people in particular (i.e. psychologists). Furthermore, their improvement is reinforcing to all people dealing with Melvyn and Keith and the complimentary comments of those with whom they have contact serves to set up the spiral of positive reinforcement which must be the ultimate aim of any such programme.

SUMMARY

Two cerebral palsied adult males were given training in swallowing to aid control of drooling. Reinforcement was then used to increase low rates of swallowing. The value of the reinforcer was demonstrated using a reversal design. In two patients high rates were achieved in the laboratory. A number of different techniques were then used to try and establish generalisation but this was limited.

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