Behavioural and Cognitive Psychotherapy, 2004, 32, 245–249
Printed in the United Kingdom DOI: 10.1017/S1352465804001201

IMPROVING ASSISTED AMBULATION IN A MAN WITH MULTIPLE DISABILITIES THROUGH THE USE OF A MICROSWITCH CLUSTER

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Abstract. We assessed the use of a microswitch cluster to improve assisted ambulation in a man with multiple disabilities. The cluster included two optic microswitches at the man's heels to detect his steps and a pressure microswitch under his right arm to detect his body posture (i.e. whether he had an upright, appropriate posture or was leaning forward). The man received 2.5 seconds of favourite stimulation at each step provided that his posture was appropriate. The results showed that there was a large increase in the man's appropriate posture during walking throughout the intervention phases and the 3-month follow-up.

Keywords: Assisted ambulation, multiple disabilities, microswitch cluster, upright body posture.

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Introduction

Microswitches are tools that can help people with multiple disabilities discover connections between their responses and environmental events and thus control such responses to optimize environmental input (Gutowski, 1996; Lancioni, O'Reilly, & Basili, 2001). The responses selected as targets are typically rather simple (e.g. hand movements and vocalization). Using microswitches with combinations of fairly complex responses may be even more significant, allowing a person to optimize environmental stimulation through a self-directed improvement of broad motor performance (Ketelaar, Vermeer, Hart, van Petegem-van Beek, & Helders, 2001). For example, microswitches might be used with a person with supported ambulation skills to enable him or her to obtain favourite stimulation by walking with an upright body posture (cf. Kearney & Fassey, 1991).

To pursue such an objective, a cluster of three microswitches might be used. Two optic microswitches might be at the person's heels to detect the performance of steps, and a pressure microswitch might be under the person's arm to detect leaning on the support equipment. Activation of any of the two microswitches at the heels would lead to positive stimulation provided that the microswitch under the arm is not activated (i.e. that the person has an upright body posture). We assessed such a microswitch cluster to improve assisted ambulation in a man with multiple disabilities.

Method

Participant

The man (Roger) was 19 years old. He had congenital cerebropathy with spasticity, reduced visual acuity, and lack of speech. No IQ scores were available but his level of functioning was rated in the profound intellectual disability range. He had no self-help skills and would usually sit in a wheelchair. His two main forms of occupation involved the use of microswitches to obtain favourite environmental stimulation while seated and assisted ambulation. Assisted ambulation could occur several days a week, for a few short (e.g. 10 minute) periods each day. It involved the use of a walker with a table, on which Roger placed his hands and arms for support. Roger's parents were highly favourable toward this study and had provided formal consent to it. According to the Italian law, this consent is considered acceptable for the study.

Recording, microswitch cluster, control system, and favourite stimuli

Recording concerned the steps Roger performed (each foot movement was counted as a step) and whether he had an upright, appropriate body posture during the steps. The microswitch cluster consisted of two optic microswitches (mini photocells) and a pressure microswitch (a push-button). The optic microswitches were at Roger's heels, attached to his shoes, and were activated by Roger's steps. The pressure microswitch was under Roger's right arm (close to his armpit), attached to a Velcro band that kept it in place. It was activated as Roger leaned on the walker's table. The microswitches were connected to a battery-powered, electronic control system that served to turn on favourite stimuli and to record the data (see below). The control system would ensure a 2.5-second stimulation period at each step (activation of one of the microswitches at the heels) provided that the microswitch under the arm was not activated at the time, i.e. that Roger had an appropriate posture (Lancioni, Singh, Oliva, Scalini, & Groeneweg, 2003).

Favourite stimuli (i.e. music and songs, a turning light, and a vibratory input) were used in a rotating fashion, contingent on the steps occurring concomitant with an appropriate posture. The stimuli were presented via a light device fixed at the front edge of the walker's table, a modified cassette recorder at the side of the walker, and a large vibrator on the walker's table. The stimuli were selected through preliminary observations and a stimulus preference screening (Crawford & Schuster, 1993).

Experimental conditions

Assisted ambulation sessions with the walker lasted 10 minutes and occurred in an educational centre familiar to Roger. Typically, Roger received four sessions per day, 3 days a week. Frequency of steps per session and steps performed with an appropriate posture were recorded automatically through the control system. The study involved an ABAB sequence (with A representing baseline and B representing intervention phases) and a 3-month follow-up.

Baseline. During the baseline sessions, the microswitch cluster and control system were available but no stimulation occurred.

Intervention. During the intervention sessions, the microswitch cluster, the control system, and the favourite stimuli were available. The stimuli occurred according to the conditions described above.

Follow-up. Throughout the follow-up period, sessions continued to occur regularly, according to the conditions prevailing during the intervention. However, checks with formal data collection occurred only three times, that is, 1, 2 and 3 months after the end of the second intervention phase. Each check included five sessions.

Results

Figure 1 shows Roger's data during the baseline and intervention phases and the three follow-up checks. During the first baseline, the mean frequency of steps per session was 311. Approximately 40% of those steps were performed with an appropriate posture. During the first intervention phase, the mean frequency of steps per session was 344. Approximately 60% of those steps were performed with an appropriate posture. During the second baseline, there was a declining trend particularly in appropriate posture. During the second intervention phase, the mean frequency of steps was 406. Approximately 90% of those steps were performed with an appropriate posture. A high percentage was also observed at the follow-up checks where the mean frequency of steps was about 600. The Kolmogorov-Smirnov test (Siegel & Castellan, 1988) showed that the differences on appropriate posture were statistically significant ($p < .05$) between the first baseline and first intervention as well as between the second baseline and second intervention and follow-up checks. The differences on frequencies of steps were statistically significant (Kolmogorov-Smirnov test) between the second baseline and the follow-up checks.

Discussion

A large increase in the percentages of steps performed with an appropriate posture together with an overall (final) increase in the frequencies of steps carried out indicate that the microswitch

https://doi.org/10.1017/S1352465804001201 Published online by Cambridge University Press

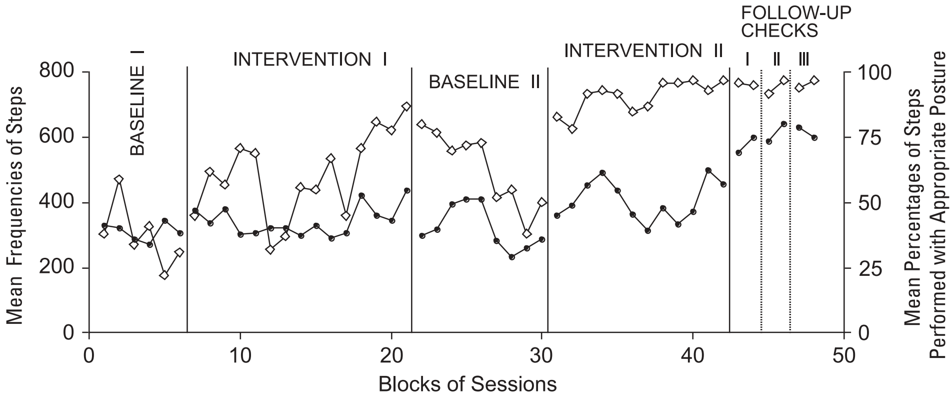

Figure 1. Dots represent mean frequencies of steps performed over blocks of three sessions (blocks of two sessions can occur at the end of baseline and intervention phases, and follow-up checks). Diamonds represent mean percentages of steps performed with an appropriate posture over the same blocks of sessions.

cluster was a valuable resource to link two behavioural aspects within an intervention programme. Exercising postural control during walking may amount to a successful form of self-directed physiotherapy (Bartlett & Palisano, 2002; Ketelaar et al., 2001). The achievement of this goal may reflect a strong reinforcing value of the stimuli used contingent on appropriate performance and the participant's ability to discriminate, associate and readily reproduce this performance (Kazdin, 2001). The alleged reinforcing value of the stimuli was supported by informal reports indicating that Roger had frequent smiles during the sessions. His positive mood and improved postural control (which might also have generalized outside the sessions) were probably strong motivating factors for people involved in the programme (cf. Lancioni et al., 2003). It is noteworthy that the programme continued after the end of the follow-up.

Although these results are very encouraging and may have wide practical implications for educational rehabilitation and physiotherapy, caution is needed because the study included only one participant. New research would need to (a) determine the generality of these results, (b) assess the possibility and ways of extending the technology and procedures to other situations, and (c) provide guidelines for integrating such technology and procedures with general physiotherapy approaches in daily programmes.

References

Bartlett, D. J., & Palisano, R. J. (2002). Physical therapists' perceptions of factors influencing the acquisition of motor abilities of children with cerebral palsy: Implications for clinical reasoning. *Physical Therapy*, *82*, 237–248.

Crawford, M. R., & Schuster, J. W. (1993). Using microswitches to teach toy use. *Journal of Developmental and Physical Disabilities*, *5*, 349–368.

Gutowski, S. J. (1996). Response acquisition for music or beverages in adults with profound multiple handicaps. *Journal of Developmental and Physical Disabilities*, *8*, 221–231.

Kazdin, A. E. (2001). *Behavior modification in applied settings* (6th ed.). New York: Wadsworth.

Kearney, S., & Fassey, I. (1991). The use of adapted leisure materials to reinforce correct head positioning in a brain-injured adult. *Brain Injury*, *5*, 295–302.

Ketelaar, M., Vermeer, A., Hart, H., van Petegem-van Beek, E., & Helders, P. J. (2001). Effects of a functional therapy program on motor abilities of children with cerebral palsy. *Physical Therapy*, *81*, 1534–1545.

Lancioni, G. E., O'Reilly, M. F., & Basili, G. (2001). An overview of technological resources used in rehabilitation research with people with severe/profound and multiple disabilities. *Disability and Rehabilitation*, *15*, 501–508.

Lancioni, G. E., Singh, N. N., Oliva, D., Scalini, L., & Groeneweg, J. (2003). Microswitch clusters to enhance non-spastic response schemes with students with multiple disabilities. *Disability and Rehabilitation*, *25*, 301–304.

Siegel, S., & Castellan, N. J. (1988). *Nonparametric statistics* (2nd ed.). New York: McGraw-Hill.