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Research Report

Enabling a Girl with Multiple Disabilities to Control Her Favorite Stimuli Through Vocalization and a Dual-Microphone Microswitch

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Microswitches are critical tools that can help people with multiple disabilities control aspects of their environment, including their favorite environmental stimuli through simple responses (Crawford & Schuster, 1993; Gutowski, 1996). One such response may be vocalization (that is, any brief sound emission) (Lancioni, O'Reilly, Oliva, & Coppa, 2001). Such a response can be present in children who have little motor behavior and seems to be highly valued by staff and parents, probably because it is closely linked to verbalization or speech (McCathren, Yoder, & Warren, 1999).

Two studies that were conducted to assess the possibility of establishing vocalization with individuals with multiple disabilities (Lancioni & Lems, 2001; Lancioni et al., 2001) used an experimental microswitch, consisting of a signal-detecting device connected to a throat microphone, to trigger preferred stimuli when vocalization was detected. A throat microphone was used instead of an airborne microphone to avoid the impact of outside noise. The results were highly encouraging for all four participants in the two studies who increased their level of vocalization.

Despite these results, some weaknesses were later discovered with regard to the microswitch. Specifically, it was observed that the microswitch could have false activations if children had heavily congested tracheal areas, dropped their heads forward, or showed dystonic head turning or movements (features that are likely in children who are blind or have low vision and pervasive intellectual and motor disabilities; see Lancioni et al., 2004). False activations can delay the association of a specific response with specific environmental events, thus hindering a child's progress (O'Brien, Glenn, & Cunningham, 1994).

A possible solution to the problem of false activations was thought to be the use of a microswitch with a dual-microphone arrangement (a throat microphone and an airborne microphone). Activation of the microswitch would require that both microphones were triggered (thus minimizing false positives that were due to the child's tracheal condition or movements or to outside noise). The study presented here assessed such a new microswitch with a girl with minimal residual vision and profound motor and intellectual disabilities, who showed a combination of tracheal congestion and unspecific or dystonic head movements. The girl's activation of the microswitch (by triggering both microphones) produced a brief period of her favorite environmental stimuli.

Method

Participant

The girl, aged 8, was diagnosed with congenital cerebropathy, low vision (caused by optic atrophy) with attention for light displays, extensive motor impairment, lack of speech, and profound intellectual disability. She was also diagnosed with epilepsy that was partially controlled by medication (sodium valproate and carbamazepine) and typically sat in a wheelchair. Given her extremely serious condition, no specific responses had been established that she could profitably use in her environment. The girl could emit brief vocalization responses and could react with smiles or other apparently positive facial expressions (such as alerting) to environmental stimuli. She lived at home with her parents and attended some basic physiotherapy and stimulation sessions. Her parents provided formal consent for the girl to participate in this study.

Target response, microswitch, control system, and favorite stimuli

Vocalization was defined as any brief sound emission of 50 decibels (dBs) or higher. The microswitch that was used for detecting such a response consisted of a battery-powered electronic unit 8 by 6 by 2 centimeters (about 3 by 2 by .8 inches) that was connected to a throat microphone (a piezo-electric sensor with a diameter of 2.2 cm, or about 0.9 inch, and a thickness of 0.5 cm, or about .02 inch) that was kept at the girl's larynx with a light neckband, and an airborne microphone that was placed on a table next to the girl's face. Activation of the microswitch (by triggering both microphones) turned on a battery-powered control system that recorded the response and, during intervention, activated the girl's favorite stimuli for six seconds (Lancioni et al., 2002).

Favorite stimuli (that is, stimuli that were considered to be pleasant for the girl) were selected through stimulus-preference screening (Crawford & Schuster, 1993). The screening covered multiple stimuli, each of which was presented 15–35 nonconsecutive times. Only the stimuli that were followed by the girl's positive reactions (alerting, orienting, or smiling) in 70% or more of the presentations were selected. The stimuli selected for the study included light displays, several types of music and songs, various kinds of noise, and vibratory inputs.

Experimental conditions

The girl was observed during an ABAB sequence of sessions, in which A represented a baseline phase and B represented an intervention phase (Richards, Taylor, Ramasamy, & Richards, 1999). A postintervention assessment was conducted two months after the second intervention phase. Typically, eight or nine sessions per day occurred within the study periods. Each session lasted five minutes, and the girl's responses were recorded automatically through the control system. A research assistant checked whether any response that was recorded by the system and was followed by favorite stimuli was a false positive (that is, was due to something other than the girl's vocalization). A second research assistant checked the reliability of the recording of false positives over a total of 45 sessions throughout the study. Interrater reliability was computed for groups of five sessions, each divided into five intervals of one minute. Agreements (that is, one-minute intervals for which the research assistants reported the same number of false positives, which could also be zero) were divided by the total number of one-minute intervals that were observed and were multiplied by 100. The mean reliability was 97%, with a range of 92% to 100%.

Baseline phases.

The two baseline phases included 14 and 9 sessions, respectively. The microswitch and control system were available, but microswitch activation did not produce the occurrence of favorite stimuli. At the start of the sessions, the girl was prompted to respond (by talking or making noise at her ear). The prompt was repeated during the sessions after periods of nonresponse of about one minute.

Intervention phases.

The two intervention phases included 81 and 86 sessions, respectively. The procedural conditions were the same as during the baseline phases except that activation of the microswitch produced the occurrence of favorite stimuli. A new activation occurring while the previous one was still being followed by the preferred stimuli (that is, within the six-second interval in which the stimuli were on) was not recorded and did not cause the presentation of an additional stimulus (Lancioni & Lems, 2001).

Postintervention assessment.

After the end of the second intervention phase, sessions that were comparable to those that occurred during the intervention continued to be held. Twenty of these sessions (carried out two months after the end of the second intervention phase) served as the postintervention assessment.

Results

During the first baseline phase (14 sessions), the girl had a mean frequency of about 6 independent responses per session (see Figure 1). During the first intervention phase (81 sessions), the mean frequency increased to about 17 independent responses per session. This frequency dropped to about half during the second baseline phase (9 sessions) and increased to a mean of over 19 per session during the second intervention phase (86 sessions). The intervention frequencies were maintained at the postintervention assessment (20 sessions). The differences between the baseline responding frequencies and the intervention and postintervention frequencies were significant ($p < .01$) according to the Kolmogorov-Smirnov test (Siegel & Castellan, 1988). Of the responses that were recorded, only about 5% appeared to be false positives.

Discussion

These data show that the girl learned to use vocalization to increase environmental stimulation effectively and that the new microswitch kept false positive responses to a low level. This evidence supports the notion that vocalization may be a reliable and useful response for people with profound visual, motor, and intellectual disabilities and underlines the relevance of the new microswitch (see Lancioni et al., 2001; Richards et al., 1999). Indeed, this microswitch may allow the use of vocalization with individuals with bronchotracheal congestion and dystonic movements of the head. For some of these individuals, vocalization may be the only response available to learn to control environmental stimuli and make some recognizable progress in development and, possibly, in the quality of their lives (Felce & Perry, 1995; Holburn, Nguyen, & Vietze, 2004; Schalock et al., 2002; Watson, Hayes, & Vietze, 1982).

In spite of the encouraging results, general conclusions cannot be drawn because the research is still at a preliminary stage (Green & Reid, 1994; Kazdin, 2001). New studies will need to extend the assessment of this response-microswitch combination with other persons with profound multiple disabilities, to determine the overall applicability of the combination and the generality of the findings, and to identify ways of reducing the cost of the present microswitch (which is about $200), to make it more affordable in educational and home settings.

References

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

Felce, D., & Perry, J. (1995). Quality of life: Its definition and measurement. *Research in Developmental Disabilities*, *16*, 51–74.

Green, C. W., & Reid, D. H. (1994). A comprehensive evaluation of a train-the-trainers model for training education staff to assemble adaptive switches. *Journal of Developmental and Physical Disabilities*, *6*, 219–238.

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.

Holburn, S., Nguyen, D., & Vietze, P. M. (2004). Computer-assisted learning for adults with profound multiple disabilities. *Behavioral Interventions*, *19*, 25–37.

Kazdin, A. E. (2001). *Behavior modification in applied settings* (6th ed.). Belmont, CA: Wadsworth/ Thomson Learning.

Lancioni, G. E., & Lems, S. (2001). Using a microswitch for vocalization responses with persons with multiple disabilities. *Disability and Rehabilitation*, *23*, 745–748.

Lancioni, G. E., O'Reilly, M. F., Oliva, D., & Coppa, M. M. (2001). A microswitch for vocalization responses to foster environmental control in children with multiple disabilities. *Journal of Intellectual Disability Research*, *45*, 271–275.

Lancioni, G. E., Singh, N. N., O'Reilly, M. F., Oliva, D., Baccani, S., & Canevaro, A. (2002). Using simple hand-movement responses with optic microswitches with two persons with multiple disabilities. *Research and Practice for Persons with Severe Disabilities, 27*, 276–279.

Lancioni, G. E., Singh, N. N., O'Reilly, M. F., Oliva, D., Scalini, L., Vigo, C. M., & Groeneweg, J. (2004). Microswitch clusters to support responding and appropriate posture of students with multiple disabilities: Three case evaluations. *Disability and Rehabilitation, 26*, 501–505.

McCathren, R. B., Yoder, P. J., & Warren, S. F. (1999). The relationship between prelinguistic vocalization and later expressive vocabulary in young children with developmental delay. *Journal of Speech, Language, and Hearing Research, 42*, 915–924.

O'Brien, Y., Glenn, S., & Cunningham, C. (1994). Contingency awareness in infants and children with severe and profound learning disabilities. *International Journal of Disability, Development and Education, 41*, 231–243.

Richards, S. B., Taylor, R. L., Ramasamy, R., & Richards, R. Y. (1999). *Single-subject research: Applications in educational and clinical settings.* Belmont, CA: Wadsworth/ Thomson Learning.

Schalock, R., Brown, I., Brown, R., Cummins, R. A., Felce, D., Matikka, L., Keith, K.-D., & Parmenter, T.

(2002). Conceptualization, measurement, and application of quality of life for persons with intellectual disabilities: Report of an international panel of experts. *Mental Retardation, 40*, 457–470.

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

Watson, J. S., Hayes, L. A., & Vietze, P. (1982). Response-contingent stimulation as a treatment for developmental failure in infancy. *Journal of Applied Developmental Psychology, 3*, 191–203.

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