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Persons with Multiple Disabilities Access Stimulation and Contact the Caregiver via Microswitch and VOCA Technology

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Abstract

We assessed whether eight persons (children and adolescents) with multiple disabilities would succeed in combining the use of a microswitch and a VOCA. The microswitch served to gain direct access to selected environmental stimuli and the VOCA served to contact the caregiver and obtain her social attention or mediation toward other forms of stimulation. The study also included a social validation assessment of the aforementioned microswitch-VOCA combination. Data showed that participants could learn to use the microswitch and the VOCA profitably. The social validation assessment showed that 64 university psychology students and 64 postgraduate clinical trainees employed as raters favored the combination of microswitch and VOCA over the microswitch and the VOCA alone.

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1. Introduction

Persons with combinations of intellectual, motor, and visual disabilities are often unable to access environmental stimuli on their own due to very limited response skills (Holburn, Nguyen, & Vietze, 2004; Lancioni, O'Reilly, Singh, Sigafoos, Oliva, & Severini, 2008a). A realistic strategy to intervene with these persons and effectively reduce the negative implications of their condition involves the use of microswitch technology (Mechling, 2006).

Microswitches are technical devices that these persons can learn to use to control stimulus events through simple/minimal responses (Mechling, 2006; Lancioni, O'Reilly, Singh, Sigafoos, Oliva, & Severini, 2008b). Thus, microswitch-based programs can provide the persons an opportunity to access positive environmental stimulation independently. The same programs, however, are not suited to satisfy a person's possible desires for social contact with the caregiver or for events that only the caregiver's mediation can ensure, such as edibles and motor play. Such contact or mediation could represent important objectives to target within a program for persons with multiple disabilities, as they would (a) allow an extension of the persons' range of inputs and (b) create a balance between independent and often mechanical forms of stimulation and more specifically personal or person-mediated events (Schlosser & Sigafoos, 2006).

To tackle this issue, we recently attempted to combine the use of microswitches for accessing environmental stimuli with the use of a Voice Output Communication Aid (VOCA) for requesting social contact (Lancioni *et al.* 2008a; 2008b; Lancioni, O'Reilly, Singh, Sigafoos, Didden, Oliva, *et al.* 2009). The present study served as a replication and extension of the aforementioned, early attempts to combine microswitches and VOCA by including a group of eight participants with multiple disabilities. These participants were recruited on the basis of their (a) reported interest in the verbal/physical attention and the mediation of caregivers (with reactions such as alertness and smiles occurring in relation to those events), and (b) ability to perform small responses (not necessarily matching those previously used in this research area) suitable for activating microswitch-VOCA combinations. The study also included a social validation assessment of such combinations, which was carried out by asking 64 university psychology students and 64 post-graduate clinical trainees to serve as social raters (cf. Cunningham, McDonnell, Easton, & Sturmey, 2003).

2. Method

2.1 Participants

The eight participants were between 5.2 and 17.9 (M = 11) years of age (see Table 1). They had encephalopathy due to congenital anomalies, prematurity, and perinatal or postnatal hypoxia, and were rated in the severe or profound intellectual disability range (although no standard tests or IQ scores were applicable with them). All of them presented with visual impairment (see Table 1), with diagnoses varying from functional/minimal residual vision (which allowed them to see objects in their proximity) to total blindness (see Geruschat, 1992; Morse, Teresi, Rosenthal, Holmes, & Yatzkan, 2004). All participants had serious motor disabilities and were nonambulatory. They responded with alertness and smiles to a variety of environmental stimuli (e.g., music and songs) and seemed to be alert to and enjoy the vocal and physical attention of their caregivers (see above). Two seemed more specifically interested in their caregivers' intervention in providing food items or motor play (Candy and Betsy). All of them lived at home with their parents and attended day programs. The study was approved by an ethics committee and received informed consent from the participants' parents.

Table 1 - *Participants' Characteristics*

Participants	Age	Visual Condition
Todd	5.8	Minimal residual vision
Boris	10.6	Functional residual vision
Doug	17.9	Total blindness
Daisy	5.2	Minimal residual vision
Candy	12.9	Functional residual vision
Alf	10.4	Functional residual vision
Kate	13.8	Minimal residual vision
Betsy	11.1	Total blindness

2.2 Responses, microswitches, VOCAs, and electronic control system

The responses used for microswitch and VOCA activation included hand pushing, eye and mouth opening, head turning or lifting, and arm/hand lifting or stroking. Some of these responses (i.e., the eye and mouth opening selected for Betsy and a lateral/facilitated form of hand stroking selected for Boris) had not been used in previous research in this area. The microswitch devices included pressure or touch sensors on specific areas of the wheelchair or the participant's body, tilt instruments on the participant's head or arm, and optic sensors on the participant's eyeglasses frame (Lancioni et al. 2008b). The VOCA devices included similar sensors linked to a vocal output apparatus. This apparatus served to emit messages requesting caregiver attention/intervention such as "Can you play with me?" or an equivalent one out of a pool of five messages recorded for each participant (see Lancioni *et al.,* 2008a).

The microswitch and VOCA devices were connected to a battery-powered, microprocessor-based electronic control system, which was fitted with specific software and had four functions. The first function was to turn on, for 8-10 s, stimuli selected for a target microswitch response when that response occurred (i.e., except in baseline). The second function was to trigger the vocal output apparatus of a VOCA device and, thus, the emission of a message, as a target VOCA response (sensor activation) occurred (i.e., except in baseline). The third function was to ignore a microswitch or VOCA response if this occurred while stimuli for a previous response were still on. The fourth function was to record the microswitch and VOCA responses automatically.

2.3 Selection of preferred stimuli to use for microswitch and VOCA responses

Stimulus preference screening (Lancioni *et al.,* 2008b) was used to select preferred stimuli, that is, stimuli followed by participants' positive reactions (e.g., alerting/orienting or smiling) in more than two-thirds of their presentations. The screening covered multiple stimuli; a stimulus was presented 15 to 45 nonconsecutive times. Based on screening, four to eight environmental stimuli (e.g., songs, vibrating boxes, and lights) were selected for the microswitch response of each participant. The stimuli were placed near the participants or fitted to their body and were operated automatically through the electronic control system (i.e., without any external intervention). The stimuli selected for the VOCA response (through the aforementioned screening) involved: (a) four to eight joyful sentences presented by a research assistant serving as caregiver and (b) positive physical gestures (e.g., caressing, embracing, tickling, and kissing) or, alternatively, food items or motor play (for Candy and Betsy) provided by the same research assistant. Each stimulus episode lasted 8-10 s.

2.4 Experimental conditions

Sessions lasted 10 min for Todd, Boris, and Doug, and 5 min for the other five participants. Session length was determined on the basis of staff and parents' advice. Participants received 3 to 11 sessions per day based principally on their availability. An adapted version of the multiple probe design across responses was used for each participant to assess the effects of Intervention I (Barlow, Nock, & Hersen, 2009). The study started with baseline on microswitch and VOCA responses (i.e., one response per session). Then, Intervention I focused on the microswitch response. Once this response had increased and steadied, new baseline and Intervention I occurred on the VOCA response. Subsequently, Intervention II focused on both microswitch and VOCA responses simultaneously. Finally, a social validation assessment occurred. During baseline and Intervention I, physical prompting was used to ensure responding after 30-60 s with no response.

Baseline. During the initial baseline phase, sessions involved the presence of the microswitch or the VOCA device, depending on the response targeted within the specific session. Responses did not produce any effects.

Intervention I. During the initial Intervention I phase, participants had the microswitch device. Microswitch responses produced the stimuli selected for them.

Baseline. During the second baseline phase, sessions involved the presence of the VOCA device. Responses did not produce any effects.

Intervention I. During the second Intervention I phase, participants had the VOCA device. VOCA responses produced one of the messages available to request contact. This was followed by research assistants' joyful sentences and (approximately one-half of the times) by their positive physical gestures also (see above) for Todd, Boris, Doug, Daisy, Alf, and Kate. VOCA consequences for the other participants included joyful sentences and food items (Candy) or joyful sentences and motor play, such as shaking of the wheelchair (Betsy), regularly.

Intervention II. During Intervention II, participants had both the microswitch and the VOCA during each session. Microswitch and VOCA responses produced consequences as during Intervention I.

Social validation assessment. Sixty-four university psychology students (with a mean age of about 23 years) and 64 post-graduate clinical trainees (with a mean age of about 32 years) rated the eight participants with multiple disabilities. The rating of a participant was carried out by a subgroup of eight university psychology students and a subgroup of eight post-graduate clinical trainees after they had watched one of the two videotapes of the participant. One of those videotapes reported three 3-min clips concerning intervention periods with the microswitch device, with the VOCA, and with the microswitch and VOCA together. The other videotape reported the same three clips, but the microswitch-VOCA combination was the first clip of the sequence. The clips were deemed highly illustrative of the participant's performance under

those intervention conditions. The rating was based on three questions concerning the three conditions' beneficial impact on contact with the outside world, their recreational-communicative potential, and their overall cost-benefit value. For each question, three scores were required (i.e., one per condition). The scores could vary from 1 (least positive) to 5 (most positive).

3. Results

Figures 1 and 2 summarize the data for the three participants with 10-min sessions (i.e., Todd, Boris, and Doug) and the five participants with 5-min sessions (i.e., Daisy, Candy, Alf, Kate and Betsy), respectively. The data of each participant are shown within a single figure panel, identified by his or her name, and are grouped into blocks of sessions. Four blocks (two per response) are used during the first baseline and two blocks are used for each of the subsequent phases. The number of sessions included in the blocks is indicated by the numerals above them. During the first baseline for the three participants included in Figure 1, the mean frequencies of microswitch and VOCA responses ranged between 4 and 12 per session. During the first Intervention I phase, the mean frequencies of microswitch responses were between 25 and 33 per session During the second baseline, the mean frequencies of VOCA responses were between 6 and 10 per session. During the second Intervention I phase, the mean frequencies of VOCA responses were between 21 and 27 per session. The Kolmogorov-Smirnov test (Siegel & Castellan, 1988) showed that the increase from baseline to Intervention I was statistically significant ($p < .01$) for each of the two responses for all three students. During Intervention II, the participants' mean cumulative (microswitch plus VOCA) response frequencies were between 32 and 40 per session. The VOCA responses represented between 27% and 43% of the total.

The data for the five participants included in Figure 2 also showed statistically significant increases from baseline to Intervention I for each of the two responses. Candy's Intervention II was interrupted after a relatively small number of sessions, due to her health problems and hospitalization.

ANOVAs carried out with the scores of each of the two groups of raters separately showed that the differences among conditions were statistically significant on each of the three questions, with $F(2, 189)$ ranging from 14.31 to 142.25 ($p < .01$) (Hays, 1988). Post-hoc paired t-tests showed that the scores for the microswitch-VOCA combination (which averaged between 4.1 and 4.5 across the three questions for the two groups of raters) differed significantly from (were more positive than) those available for the microswitch and the VOCA alone conditions on each of the three questions for both groups. The $t(63)$ values ranged from 4.98 to 19.84 ($p < .01$) (Bourke, Daly, & McGilvray, 1985).

Figure 1 - *The three panels show the data for Todd, Boris, and Doug, respectively. Within each panel, the striped and gray bars represent the mean frequencies of microswitch and VOCA responses, respectively, per blocks of sessions. The number of sessions included in the blocks (bars) is indicated by the numerals above them. The striped and gray sections of the stacked bars appearing in Intervention II represent the relative mean frequencies for the two responses within the blocks*

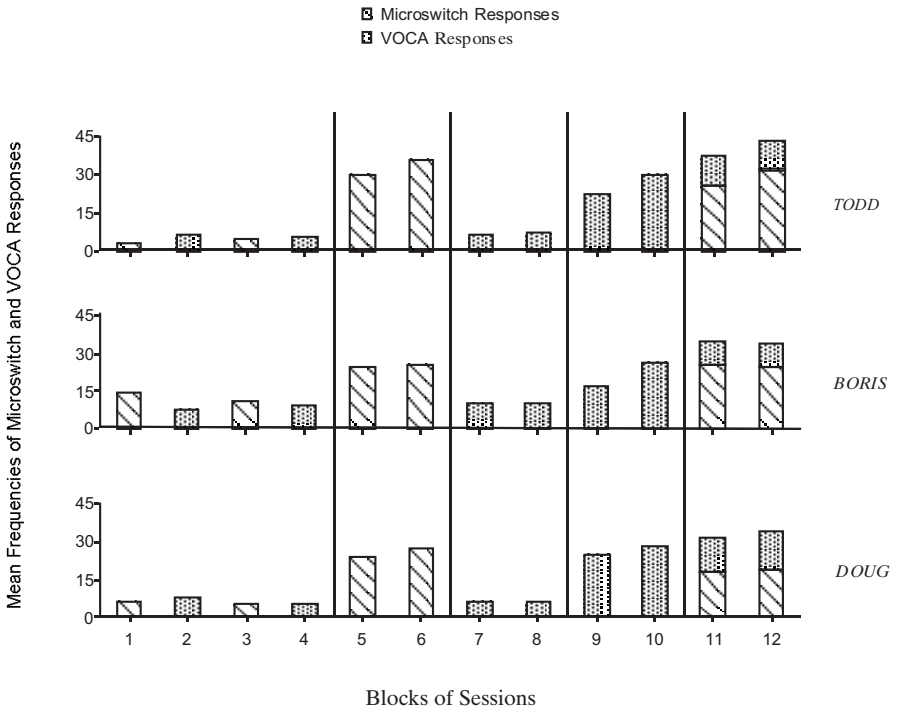
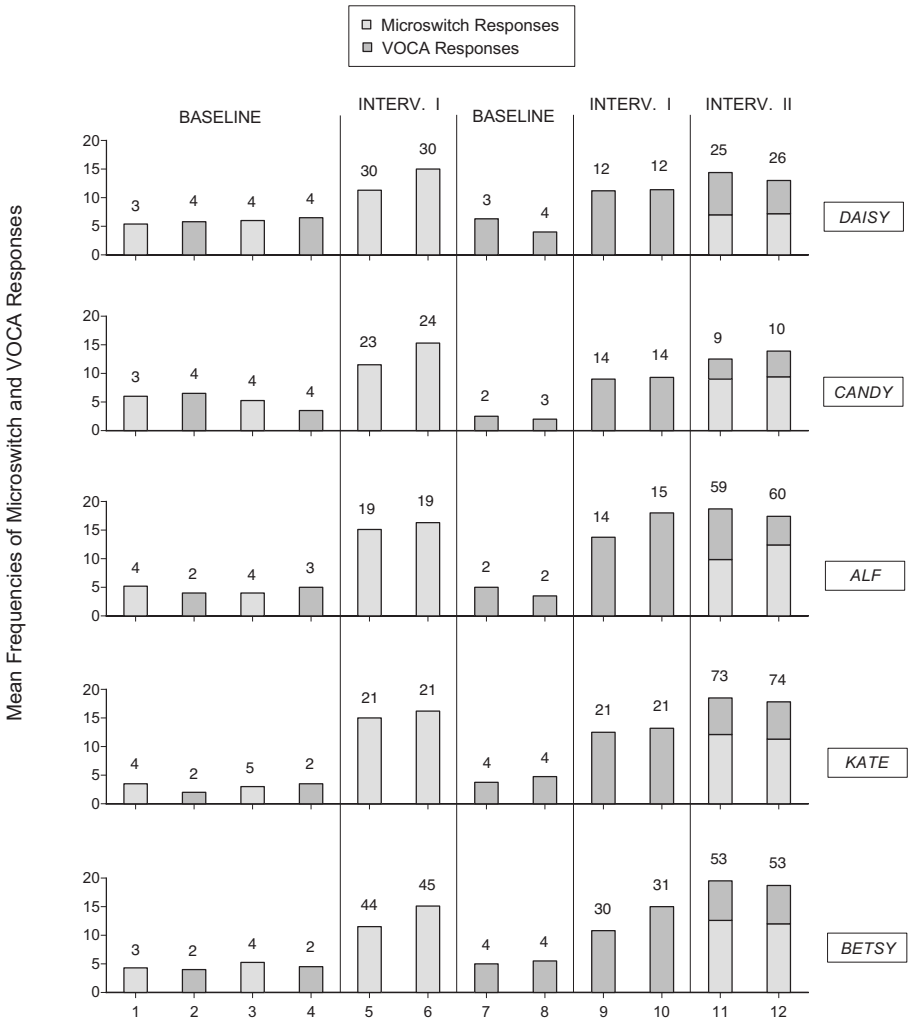


Figure 2 - *The five panels show the data for Daisy, Candy, Alf, Kate, and Betsy, respectively. The data are plotted as in Figure 1*



4. Discussion

In line with previous data (Lancioni *et al.*, 2008a; 2008b; 2009), these participants generally showed consistent microswitch responses as well as VOCA responses. The fact that the participants' VOCA responses were aimed at different objectives (i.e., social contact or caregiver mediation for other forms of stimulation) reflected differences in personal interests. Even so, VOCA responses were for all participants a means to enrich their input in a relevant way through a functional interaction with their caregivers.

The reasons why the frequency of VOCA responses tended to be lower than the frequency of microswitch responses were not investigated. One might hypothesize that (a) the social attention/contact or the caregiver-mediated stimulation had a lower reinforcing power than the stimuli available for microswitch responses at least for some participants, and (b) those participants' response choice reflected such a difference of stimulus impact (Kazdin, 2001).

In spite of the fact that careful balance between microswitch-related stimuli and VOCA consequences needs to be found for some students, the combination of microswitch and VOCA can still be considered a valuable strategy with clearly positive implications. This view seemed to be widely supported by the social validation data, which provided a strong endorsement for such a strategy from both groups of raters.

In conclusion, the results of this study (a) provide new evidence of the applicability of microswitch-VOCA combinations with persons with multiple disabilities, (b) indicate that the consequences of the VOCA can include caregiver-mediated stimulation opportunities (as an option for participants with modest reactions to social attention only), and (c) show a clear endorsement of the microswitch-VOCA combination by university psychology students and post-graduate clinical trainees. Building on the outcome of this study and the previous ones on this topic, new research could extend the evaluation of microswitch-VOCA combinations with the use of new devices (i.e., suitable also for persons with very serious response restrictions) as well as with larger combinations of devices (e.g., two or three microswitches and one VOCA).

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