Effects of Microswitch-Based Programs on Indices of Happiness of Students With Multiple Disabilities: A New Research Evaluation

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Abstract

The effects of microswitch-based programs on indices of happiness were evaluated with 9 students who had profound multiple disabilities. Each student received an ABAB sequence in which A represented baseline phases and B, intervention phases. During the latter phases, microswitches were used to enable the students to control preferred environmental stimulation with simple/feasible responses, such as hand-pushing and foot-lifting. Results show that all students increased microswitch responding during the intervention phases. Seven of them also had significant increases in indices of happiness, whereas the other 2 did not. In an attempt to shed some light on the reasons underlying the different outcomes, we examined procedural and methodological aspects of the study.

Students with profound multiple disabilities can pose serious problems within rehabilitation and care programs (Gutowski, 1996; Realon, Bliegen, La Force, Helsel, & Goldman, 2002). The simultaneous presence of intellectual, motor, and sensory disabilities can, in fact, prevent the students from acquiring self-help skills or job abilities and can also limit their interaction with and control of environmental stimulation (Holburn, Nguyen, & Vietze, 2004; Murphy, Saunders, Saunders, & Olswang, 2004). Such a situation can have deleterious effects on their overall level of activity and their mood (Carver, 2000; Green & Reid, 1996, 1999; Lancioni, Singh, O’Reilly, Oliva, & Basili, 2005; Ross & Oliver, 2003). One strategy to help students develop constructive responses and control of environmental stimulation is represented by microswitch-based programs (Holburn et al., 2004; Kinsley & Langone, 1995; Lancioni, O’Reilly, & Basili, 2001). In these programs, the microswitches are linked to sources of preferred stimulation. The students can activate
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the microswitches to turn on the related stimuli through simple (feasible) responses, such as hand-stroking or head-turning (Lancioni, O’Reilly, Si-gafoos et al., 2004; Lancioni, O’Reilly, Singh et al., 2004).

Microswitch-based programs are considered useful not only to promote constructive response engagement but also to improve the students’ overall mood with increases in indices (expressions) of happiness (Lancioni, O’Reilly, Singh, Oliva, Campodonico, & Groeneweg, 2003; Lancioni, O’Reilly, Singh, Oliva, & Groeneweg, 2002). Several studies have been reported in which the students showed an increase in their indices of happiness parallel to their increase in responding and self-determined (microswitch-aided) environmental stimulation (Lancioni et al., 2002; Lancioni, O’Reilly, Singh, Oliva, Campodonico, & Groeneweg, 2003; Lancioni, Singh et al., 2003; Lancioni, O’Reilly, Singh et al., 2004; Lancioni, Singh, O’Reilly, Piazzolla et al., 2005; Lancioni et al., 2006). This outcome is deemed very relevant because happiness constitutes a distinctive aspect of a good quality of life and a desired goal of any intervention effort (Carver, 2000; Lancioni, O’Reilly, Singh, Oliva, Coppa et al., 2005; Robinson, 2000; Szymanski, 2000).

Researchers who have assessed microswitch programs in relation to happiness included a total of 16 participants and evaluated mood outcome for 15 of them. The data indicated that all 15 had increases in their indices of happiness; 3 of them had modest (albeit significant) increases, whereas the other 12 had moderate to large increases. In view of these data, one could argue that the amount of positive evidence available is considerably large and reassuring. Even so, a totally confident generalization of the findings may be premature (cf. Kazdin, 2001; Richards, Taylor, Ramasamy, & Richards, 1999). It is important to note that in previous research the participants were not selected on a random basis (random selection is unlikely in this research area; cf. Sullivan, Laverick, & Lewis, 1995) and might have had a positive tendency to display indices of happiness in response to stimulation (cf. Lancioni, Singh, O’Reilly, Campodonico et al., 2003).

Our aim in this study was to evaluate the effects of microswitch-based programs on indices of happiness with 9 new students who had profound multiple disabilities. These students were recruited based on their participation in microswitch programs, independent of any screening on or particular requirement about their mood characteristics. In light of this strictly nonselective (albeit nonrandom) recruitment of a relatively large group of students with multiple disabilities, we believed that the data generated in this study would add considerably to previous findings on microswitch-based programs and indices of happiness. More specifically, extensive replication of previous findings would strengthen the notion that microswitch programs can also serve to improve mood. Partial replication could open a debate as to the reasons accounting for different outcomes and their possible implications (cf. Lancioni, Singh, O’Reilly, Oliva, & Basili, 2005; Richards et al., 1999).

Method

Participants

The 9 students (Jessica, Lenny, Paul, Joan, Meg, Max, Troy, Molly, and Theo) were between 3.9 and 18.8 years of age, with a mean of 10.6 (see Table 1). They had cerebropathy due to congenital anomalies, prematurity, perinatal hemorrhage, and perinatal or postnatal hypoxia; were rated in

<table>
<thead>
<tr>
<th>Student</th>
<th>Age</th>
<th>Sensory condition</th>
<th>Anti-epileptic medication</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jessica</td>
<td>14.0</td>
<td>Minimal residual vision, typical hearing</td>
<td>No</td>
</tr>
<tr>
<td>Lenny</td>
<td>8.6</td>
<td>Moderate visual impairment, typical hearing</td>
<td>Yes</td>
</tr>
<tr>
<td>Paul</td>
<td>18.8</td>
<td>Total blindness, typical hearing</td>
<td>Yes</td>
</tr>
<tr>
<td>Joan</td>
<td>6.0</td>
<td>Minimal residual vision, typical hearing</td>
<td>Yes</td>
</tr>
<tr>
<td>Meg</td>
<td>6.1</td>
<td>Minimal residual vision, typical hearing</td>
<td>Yes</td>
</tr>
<tr>
<td>Max</td>
<td>13.6</td>
<td>Moderate visual impairment, typical hearing</td>
<td>No</td>
</tr>
<tr>
<td>Troy</td>
<td>3.9</td>
<td>Severe visual impairment, moderate hearing loss</td>
<td>Yes</td>
</tr>
<tr>
<td>Molly</td>
<td>13.8</td>
<td>Minimal residual vision, typical hearing</td>
<td>Yes</td>
</tr>
<tr>
<td>Theo</td>
<td>10.5</td>
<td>Total blindness, severe hearing loss</td>
<td>Yes</td>
</tr>
</tbody>
</table>
the severe or profound intellectual disability range (although no IQs were available); and presented with extensive motor impairment and lack of speech. Only 2 of the students were reported to have hearing impairment. However, all of them had visual impairment, which varied from moderate to minimal residual vision and total blindness (see Morse, Teresi, Rosenthal, Holmes, & Yatzkan, 2004; Sakai et al., 2002). Seven students were diagnosed with epilepsy and took antiepileptic medication (see Table 1). All students lived at home with their parents and were involved in educational programs, which were mainly characterized by physiotherapy and basic stimulation (e.g., body massage, music, and singing). Parents provided informed consent for their participation in the study.

Position, Responses, Microswitches, and Control System

During the sessions, the students were sitting in their wheelchair except for Joan and Max, who were lying on a sofa. The responses used for microswitch activation and the related microswitches are listed in Table 2 for each student. As shown in the table, the responses included foot- and leg-lifting, hand-pushing, head-turning, single eye blinks, and head or arm/hand upward movements. The various microswitches used for the students (see Table 2) were rather conventional except for the optic sensor. These sensors, which were used for Meg and Mike consisted of an infrared LED positioned in front of the student’s left eye and a mini infrared light-detection unit (see Lancioni, O’Reilly, Sing, Oliva, Coppa et al., 2005). A change in infrared light reflection (with consequent microswitch activation) occurred when the student blinked.

The microswitches were linked to an electronic control system. This was a portable, battery-powered case connected to a variety of preferred stimuli selected for the study (see below). During the intervention phases, the system turned on one or more of those stimuli for 2.5 to 4 s (Meg and Max) or 6 to 9 s (other students) following microswitch activation (Lancioni, O’Reilly, Sigafoos et al., 2004), a new microswitch activation occurring while the stimuli for the previous activation/response were still on (i.e., within the 2.5 to 4 s or 6 to 9 s periods programmed for the stimuli) was ignored by the system (Lancioni, O’Reilly, Singh, Campodonico et al., 2004).

<table>
<thead>
<tr>
<th>Student</th>
<th>Response</th>
<th>Microswitch</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jessica</td>
<td>Foot- and leg-lifting</td>
<td>Two tilt devices fixed at the right foot and ankle</td>
</tr>
<tr>
<td>Lenny</td>
<td>Hand-pushing</td>
<td>A wobble-like device fixed at the student’s chest</td>
</tr>
<tr>
<td>Paul</td>
<td>Head-turning</td>
<td>A tilt device fixed on a headband</td>
</tr>
<tr>
<td>Joan</td>
<td>Arm/hand upward movement on the sofa’s surface</td>
<td>Two touch bars placed on the sofa, at each side of the neck</td>
</tr>
<tr>
<td>Meg</td>
<td>Single eye blinks</td>
<td>An optic sensor mounted on eyeglasses</td>
</tr>
<tr>
<td>Max</td>
<td>Single eye blinks</td>
<td>An optic sensor mounted on eyeglasses</td>
</tr>
<tr>
<td>Troy</td>
<td>Hand-pushing</td>
<td>A wobble device placed in front of the student</td>
</tr>
<tr>
<td>Molly</td>
<td>Head upward movements</td>
<td>Two tilt devices fixed on a headband</td>
</tr>
<tr>
<td>Theo</td>
<td>Foot- and leg-lifting</td>
<td>Two tilt devices fixed at the left foot and ankle</td>
</tr>
</tbody>
</table>

Selection of Preferred Stimuli to Use Within the Program

Stimulus preference screening (Crawford & Schuster, 1993; Lancioni et al., 2002) was used at the start of the study to select preferred stimuli, that is, stimuli followed by the students’ positive reactions (e.g., alerting/orienting or smiling) in more than 70% of the presentations. The screening covered multiple stimuli; a stimulus was presented 15 to 40 nonconsecutive times (spread over several screening sessions) for about 10 s each time. Following the screening, five to eight stimuli were selected for each student. For example, the stimuli selected for Joan were songs, mother talking, noises, a hand fan, vibrating tubes on the legs, a vibrating box on the chest, and chimes. For Molly, the stimuli were colored lights, children’s songs, excited voices, popular songs, chimes, sounds of
familiar objects/events, and vibrating sponges on the sides of her trunk. Finally, the stimuli selected for Theo were hair dryers, a hand fan, a vibrating pillow on the chest, vibrating rings on the arms, and a vibrating brush on the shoulders.

Subsequent to the selection of the single stimuli, some combinations of stimuli were also presented to the students to check their reactions. If the reactions were positive (matching or exceeding those observed with the single stimuli) in at least three out of four nonconsecutive presentations, the combinations were adopted for the study. Combinations were deemed useful to produce variations and enrichment in the stimulation available for the responses and thus enhance the responses’ strength and consistency over time (Kazdin, 2001). Stimuli were fixed near the students or on their body and were operated automatically through the electronic control system (i.e., without any external intervention).

**Sessions, Measures, and Data Collection**

Students received two to seven sessions per day based essentially on their availability. Sessions were conducted in the students’ home or educational context and lasted 10 min for Jessica, Paul, and Molly and 5 min for the other students. Session length was determined on the basis of staff and parents’ advice. The measures were the responses performed for microswitch activation (see Table 1) and indices of happiness (Favell, Realon, & Sutton, 1996; Green, Gardner, & Reid, 1997; Green & Reid, 1996, 1999; Lancioni, Singh, O’Reilly, Oliva, & Basili, 2005). With regard to the latter, the basic expression used with all students as an index of happiness was smiling. This index was identified through repeated observations of the students within their daily context and was confirmed by the students’ parents. Some students (e.g., Jessica and Lenny) also presented other indices/signs of happiness, such as laughing with open mouth and/or excited vocalization with or without body movements (see Favell et al., 1996; Green & Reid, 1996, 1999; Lancioni, Singh, O’Reilly, Pizzolla et al., 2005).

The microswitch activation responses were recorded directly during the sessions. For this purpose, research assistants relied on a LED fixed to the control system. The LED was lit as soon as a response occurred and remained so for the time interval (i.e., the 2.5 to 4 s or 6 to 9 s) programmed for the response-related stimulation. Thus, any other microswitch activation occurring during that interval was ignored (Lancioni, O’Reilly, Singh, Campodonico et al., 2004). The indices of happiness were recorded from the videotapes of the sessions. This recording occurred according to a partial interval system, in which 10-s observation intervals were followed by 5-s scoring periods. The 10-s intervals were scored positive as long as any of the expressions identified as indices of happiness appeared, regardless of their duration. Interrater agreement was checked in about 20% of the sessions for both measures. The percentages of interrater agreement were computed by dividing the smaller reported frequency by the larger frequency and multiplying by 100 (on microswitch-activation responses) or by dividing the number of intervals with agreement by the total number of intervals and multiplying by 100 (indices of happiness). The percentages varied between 85 and 100, with means exceeding 95.

**Experimental Conditions**

Each student received an ABAB sequence in which A represented baseline phases and B, the intervention phases (Richards et al., 1999). During the first baseline and first intervention phase, students received verbal and physical prompting for microswitch responding at the start of the sessions and after 30 to 60 s of nonresponding during the sessions. Prompting during the first intervention phase was aimed at increasing the frequency of response–stimulation pairings, thus speeding up response acquisition. Prompting during baseline served as a basic control for its use/impact during the first intervention phase. Prompting was provided by research assistants in an unobtrusive manner (using the lowest level of assistance needed). Intervals between prompts could vary (see above) according to students’ general conditions but were consistent across baseline and intervention phases.

**Baseline 1:** At each session, the students had their microswitch technology and control system in place, but microswitch-activation responses did not produce the occurrence of stimuli. **Intervention 1:** Contrary to baseline, the control system activated the preferred stimuli selected for the student in connection with his or her microswitch-activation responses. **Baseline 2:** Conditions were as in the first baseline but no prompting was available. **Intervention 2:** Conditions were as in the first intervention phase but no prompting was available.
Results

The data on microswitch-activation responses and indices of happiness for the 9 students are summarized in Figures 1 and 2. Figure 1 shows the data for Jessica, Paul, and Molly (i.e., the 3 students with 10-min sessions). Figure 2 presents the data for Lenny, Joan, Max, Troy, and Theo (i.e., the 6 students with 5-min sessions). The graphs' ordinates indicate the mean frequencies of intervals with indices of happiness and microswitch-activation responses, respectively. The scales vary for the two figures. The graphs' abscissas indicate the sessions occurred across the four phases of the study. For each student, the sessions of every phase are divided into two blocks (halves) in order to represent possible performance trends. The numbers of sessions included in the blocks are indicated by the numerals above them. The first baseline for the 3 students included in Figure 1 (comprising 10 to 14 sessions) showed that indices of happiness occurred in means of 0 to 8 observation intervals. Mean frequencies of microswitch-activation responses ranged between 5 and 9. During the first intervention phase (comprising 51 to 83 sessions), indices of happiness occurred in means of 3 to 20 observation intervals. The mean frequencies of microswitch-activation responses were between 23 and 29. The second baseline (7 to 12 sessions) showed a decline in indices of happiness and microswitch responses. During the second intervention phase (56 to 72 sessions), indices of happiness and microswitch responses showed levels similar to those observed in the first intervention phase. A Kolmogorov-

![Figure 1](http://meridian.allenpress.com/ajidd/article-pdf/112/3/167/2029783/0895-8017(2007)112[167_eompoi]2_0_co_2.pdf)

**Blocks of Sessions**

Figure 1. The three graphs show the data for Jessica, Paul, and Molly, respectively. Within each of the graphs, the bars represent mean frequencies of intervals with indices of happiness (see left ordinates) over blocks of sessions. The diamonds represent mean frequencies of microswitch-activation responses (see right ordinates) over the same blocks of sessions. The number of sessions included in each block is indicated by the numeral on top of it.
Blocks of Sessions

Figure 2. The six graphs show the data for Lenny, Joan, Meg, Max, Troy, and Theo, respectively. The data are plotted in the same manner as in Figure 1.
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Smirnov test (Siegel & Castellan, 1988) indicated that the differences between baseline and intervention phases were statistically significant for all 3 students on both microswitch responses, \( p < .01 \), and indices of happiness, \( p < .05 \).

The data reported in Figure 2 show that all 6 students had statistically significant increases, \( p < .01 \), on the Kolmogorov-Smirnov test in microswitch-activation responses during the intervention phases as opposed to the baseline phases. The increases in intervals with indices of happiness during the intervention phases were statistically significant, \( p < .05 \) (Kolmogorov-Smirnov test) for Lenny, Max, Troy, and Theo.

Discussion

These data by and large support and extend those previously reported by Lancioni and colleagues (Lancioni et al., 2002; Lancioni, O’Reilly, Singh, Campodonico et al., 2004; Lancioni, O’Reilly, Singh, Oliva, Campodonico et al., 2003; Lancioni, Singh, O’Reilly, Pazzola et al., 2005; Lancioni et al., 2006). The general increase in students’ microswitch-activation responses during the intervention may suggest that they enjoyed the stimuli that were delivered contingent on their responses and were motivated to raise their level of occurrence (cf. Lancioni, Abels et al., 2003; O’Brien, Glenn, & Cunningham, 1994; Sullivan & Lewis, 1993). Although successful in microswitch responding, students differed in terms of indices of happiness. In fact, 2 of the 9 students involved in the study did not show significant changes in indices of happiness between baseline and intervention phases.

In an attempt to shed some light on the reasons underlying the different outcomes in indices of happiness, various (potentially relevant) aspects of the study may be analyzed. One such aspect concerns the type of responses and microswitches used. Of the 2 students who failed to show increases in indices of happiness, Joan used upward arm/hand movements with touch-bar microswitches, and Meg used single eye blinks with an optic microswitch. The response-microswitch combination used for Joan was not used for any of the other students in this study or previous ones, but it seemed simple enough and unlikely to interfere with any expression of happiness. The response-microswitch combination used for Meg was also employed with Max in the present study. Contrary to Meg, Max showed a modest, but statistically significant increase in indices of happiness. In view of the above evidence, it may be reasonably argued that the response–microswitch combination was not a condition that could directly account for the failures to show increases in indices of happiness (cf. Lancioni, Singh, O'Reilly, Oliva, & Basili, 2005).

The number and types of stimuli used contingent on the students’ responses could be another important aspect to examine in trying to understand the different outcomes. Although there is a strong theoretical basis for this point (cf. Crawford & Schuster, 1993; Kazdin, 2001), the information available on Joan, Molly, and Theo (see Selection of Preferred Stimuli) seems to cast doubts as to its specific relevance in this study. In fact, Theo seemed to be the student with the smallest number of stimuli, and yet he was successful in increasing his indices of happiness significantly. By contrast, Joan and Molly seemed to have rather large numbers of stimuli as well as similar types of stimuli, but their outcomes were still quite different.

Another aspect that may be considered important is the students’ baseline level of indices of happiness. In general, one might argue that the presence of those indices during baseline is a positive omen for an improvement in this area during the intervention period. The reality, however, seems to differ from this view. A rapid observation of the baseline data of the 9 students in the present study indicates that a zero or near zero level (see Paul and Max) was not a condition that would predict failure to show improvements in this area. At the same time, clear presence of indices of happiness during baseline was not a condition that could be used to predict an improvement. In fact, of the 7 students with a clear presence of these indices, 5 achieved a significant increase during the intervention, whereas 2 did not.

The possibility that the behavioral expressions recorded as indices of happiness were only marginally connected with happiness for some students could also be a point to examine. It may be noteworthy, for example, that Meg had expressions of presumed happiness during baseline (when no stimulation occurred and possibly happiness was not high) and maintained similar levels of the same expressions during the intervention (when stimulation was available). Perhaps her mood changes were conveyed by other (different) expressions that were not considered in the data collection or were not clearly visible in behavioral...
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