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Research Report

A Microswitch-based Program to Enable Students with Multiple Disabilities to Choose Among Environmental Stimuli

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Students with multiple disabilities, such as severe to profound mental retardation combined with motor and visual impairment, are usually unable to engage in constructive activity or play a positive role in their daily context (Holburn, Nguyen, & Vietze, 2004; Lancioni, O'Reilly, et al., 2004; Reid, Phillips, & Green, 1991). Microswitches are technical tools that may help them improve their status by allowing them to control environmental events with small and simple responses suitable to their condition. For example, a contact or pressure microswitch could enable a student with multiple disabilities to turn on a music source through a small wrist-movement response (Lancioni et al., 2005; Saunders et al., 2001). The source could stay on for a few seconds after each response.

For students with a greater interaction or communication potential, microswitches could also serve as a means for choosing among various environmental stimuli. For example, the student could be presented every 30 to 40 seconds with brief samples or previews of such stimuli as children's songs or parents talking. The student could choose to listen to any offered stimulus by activating a microswitch within 6 seconds or to bypass it by not activating the microswitch (see, for example, Lancioni, Singh, et al., 2006; Lim, Browder, & Bambara, 2001).

Where choice is possible, a program might be devised that (a) introduces sets of stimuli to enrich the student's environment, (b) ensures that the student can choose among the stimuli, and (c) monitors the student's purposefulness in selection (see, for example, Cannella, O'Reilly, & Lancioni, 2005; Lancioni, O'Reilly, et al., 2006; Sarimski, 2002; Singh et al., 2003). To enhance the evaluation of students' selections, stimuli that they might be expected to avoid (nonpreferred) could be interspersed with those they are likely to prefer (Van Acker & Grant, 1995).

Recently, a pilot study was conducted to assess such a program with a boy who had multiple disabilities, including total blindness and minimal motor behavior (Lancioni, Singh, et al., 2006). The results were encouraging, in that the boy became quite active and chose stimuli he was expected to prefer and bypassed those he was not, thus exhibiting purposeful choice behavior. The present study served as a replication and extension of the pilot study, with two new students who had multiple disabilities. These students relied on a vocalization response to activate the microswitch as opposed to the eyebrow movements used in the pilot study. A computer system was used to handle sets of expected preferred and nonpreferred stimuli: it presented brief samples of the stimuli and eventually turned them on for longer periods of time if students selected them.

Method

Participants

The students, Justin and Terry, were 6.3 and 14.8 years old, respectively, and had cerebropathy due to prematurity and prenatal or perinatal hypoxia with minimal residual vision, spastic tetraparesis, and, reportedly, severe to profound intellectual disability (although no specific psychological assessment or IQ scores were available). Terry was also diagnosed with epilepsy, which was satisfactorily controlled with medication (sodium valproate and topiramate). Neither of the students had specific speech abilities, but both could produce simple vocalizations during their interaction with caregivers and in relation to environmental stimuli. Both students usually sat in a wheelchair; they could make simple (often dystonic) head and hand movements, but did not show any manipulation of objects. They seemed to be interested in a variety of auditory stimuli, such as music and familiar voices, and could orient to the stimuli and show smiles and excitation. They lived at home with their parents and attended daily educational programs, which focused mainly on physiotherapy and stimulation procedures. Parents provided informed consent for this study.

Response, microswitch, and computer system

The response by which the students could choose the stimuli consisted of a brief vocalization, a fairly simple behavior deemed suitable to the students' general condition (Lancioni, Singh, et al., 2004). The microswitch technology used for detecting the vocalization responses included a microphone connected to a computer system with a software package that allowed the discrimination of responses classified as affirmative, "yes," from other vocal utterances or noises. The software package included a speech recognition program (Dragon Naturally Speaking V6.0 Standard, Scansoft Inc., 2002), together with an experimental control program that had been preliminarily adapted to the students' vocalization responses, similar to that reported by Lancioni, Singh, et al. (2004).

The computer system was equipped with a set of 18 stimuli at each session. Twelve of the stimuli were considered preferred by the students (e.g., pieces of folk songs or of fairy tales) while the other 6 were considered nonpreferred (e.g., distorted sounds). Preferred and nonpreferred stimuli were automatically interspersed. For each stimulus, the computer system (a) presented a 3-second sample and combined it with a verbal question, such as "Want this?"; (b) recorded the student's response to the sample and question (by microswitch activation or lack thereof within a 6-second interval); and (c) turned on the stimulus matching the sample for 15 to 30 seconds in the event of microswitch activation (except in the baseline phase; see below). A mean pause of about 10 seconds occurred between the end of a stimulus episode following a vocalization response or the lack of response to a stimulus sample, and the presentation of the next stimulus sample.

SELECTION OF STIMULI

Interviews with parents, informal observations, and a brief stimulus preference screening were used prior to the study to select preferred and nonpreferred stimuli. The screening involved the presentation of the stimuli identified through interviews and observations 4 to 10 nonconsecutive times, for about 10 seconds each time (Crawford & Schuster, 1993). Stimuli were retained for the study if the student's reactions (for example, smiles or alertness for presumed preferred stimuli, and lack of reactions or eye closing for presumed nonpreferred stimuli) matched expectations during 80% or more of the presentations.

The stimuli selected as preferred consisted of folk songs, children's songs, instrumental music, recordings of people talking to the student, and audio-clips of fairy tales. The stimuli selected as nonpreferred consisted of distorted sounds and voices and specific pieces of music. The stimuli were arranged into nine sets, each including 12 preferred and 6 nonpreferred stimuli. During the study, informal preference checks were carried out on stimuli included in the sets. Lack of expected positive or negative reactions could lead to stimulus replacement. Moreover, prior to the postintervention check (see below) new children's songs and clips of fairy tales were selected and arranged (together with nonpreferred stimuli) into two new sets.

EXPERIMENTAL CONDITIONS

The study was carried out according to a nonconcurrent multiple baseline design across students (Richards, Taylor, Ramasamy, & Richards, 1999). A postintervention check occurred one month after the end of the intervention phase. The students' response to the preferred stimuli and lack of response to the nonpreferred stimuli in the sessions were taken as a sign of purposeful selection (Cannella et al., 2005; Sarimski, 2002). The data from the sessions (microswitch activations and stimuli selected) were automatically recorded through the computer system. Sessions occurred four to eight times a day.

Baseline

The baseline included 8 sessions for Justin and 14 for Terry (in line with design requirements, see Richards et al., 1999). The students had the microswitch, and the computer system presented the stimulus samples, as described above. Prior to each baseline session, there was a demonstration trial in which the student was prompted (through the modeling of a "yes" vocalization response) to activate the microswitch in reaction to a sample of a preferred stimulus and related question. Microswitch activation did not produce any stimulus effects in this phase, however.

Intervention

The intervention phase was preceded by 3 demonstration sessions in which the students were prompted to activate the microswitch in response to the samples of the preferred stimuli. Microswitch activation produced effects as in intervention sessions (see the following section). The intervention itself consisted of 132 sessions for Justin and 143 for Terry. Procedural conditions were the same as in the baseline phase, except that microswitch activation in reaction to a stimulus sample led to the occurrence of that stimulus for 15 to 30 seconds.

Postintervention check

After the end of the intervention phase, the students continued with sessions similar to those in the intervention. At the postintervention check, sessions included the nine sets of stimuli used so far in the study, as well as two new sets of similar stimuli (see Selection of Stimuli, above), which allowed some assessment of generalization. The postintervention check comprised 14 sessions for each student.

Results

The two graphs in Figure 1 show the students' mean percentages, over blocks of two sessions, of microswitch activations (choice responses) for preferred and nonpreferred stimuli in the available sets. During the baseline phase, microswitch activations occurred for 30 percent or less of the preferred and nonpreferred stimuli available for the two students. During the intervention phase, microswitch activations occurred for about 90 percent of the preferred stimuli and about 10 percent of the nonpreferred stimuli for both students. The postintervention check showed data matching those of the intervention phase on the nine sets of stimuli used during the intervention and the two new sets of stimuli. During the study, five of the preferred and three of the nonpreferred stimuli were replaced for Justin, while three of the preferred and four of the nonpreferred were replaced for Terry. A Kolmogorov-Smirnov test (Siegel & Castellan, 1988) showed that differences in percentages of microswitch activations between baseline and intervention plus postintervention periods were significant ($p < 0.01$) for preferred but not for nonpreferred stimuli.

Discussion

These data, which replicate and extend those of the pilot study

(Lancioni, Singh, et al., 2006), show that the students were relatively inactive during the baseline and purposefully active during the intervention and postintervention periods. During these last two periods, they appeared relatively consistent in choosing the stimuli that they were expected to prefer and in bypassing those they were not expected to prefer. This performance was observable for the nine sets of stimuli used throughout the study, as well as for the two sets introduced concomitant with the postintervention check. The implications of these findings are likely to be relevant technically, practically, and in terms of quality of life (Brotherson, Cook, & Parette, 1996; Cannella et al., 2005; Petry, Maes, & Vlaskamp, 2005).

Technically, the program arranged in this study seems to represent a satisfactory solution for combining environmental enrichment and choice for students with visual impairment and multiple disabilities. In practical terms, the program reported can be viewed as relevant because (a) it appears fairly easy to use for professionals and parents alike; (b) it could be used on a daily basis, for several relatively long sessions a day, both to enhance the student's stimulation opportunities (including new stimuli for which no preference value is known) and to promote overall alertness and purposeful choice behavior; and (c) it could be combined with other, more conventional microswitch programs aimed at obtaining responses from the student that generate prearranged stimuli (Brotherson et al., 1996; Lancioni, O'Reilly, et al., 2006; Sarimski, 2002; Singh et al., 2003).

In terms of quality of life, two considerations can be put forward. First, the educational objectives targeted in this study, that is, the possibility of choosing among a variety of stimuli and the consequent self-determined opportunity to enjoy the preferred ones, can be considered highly desirable and significant (Lancioni, O'Reilly, et al., 2006; Spevack, Martin, Hiebert, Yu, & Martin, 2005). Second, these objectives could be deemed of basic importance within any educational or home context for persons with visual impairments and multiple disabilities (Parette, Brotherson, & Blake-Huer, 2000).

In conclusion, this study has found encouraging evidence for the possibility of using specifically developed microswitch programs to enable individuals with minimal residual vision, limited motor behavior, and circumscribed intellectual ability to choose among environmental stimuli. Further research may help determine the generalizability of these results and assess ways of integrating different microswitch programs into the daily educational schedule of such individuals (Lancioni, Singh, et al., 2006; Richards et al., 1999).

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