Increasing Adaptive Responses and Reducing Finger Mouthing in an Adolescent with Multiple Disabilities: Evaluation of an Upgraded Microswitch-Cluster Program

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We evaluated an upgraded version of a microswitch-cluster program used for promoting adaptive foot and head responses and reducing finger mouthing with a boy with multiple disabilities. The boy had been exposed to an early version of the program, which ensured that positive stimulation followed only adaptive responses occurring free from finger mouthing. The first extra feature of the new version was that the stimulation lasted for the scheduled time only if finger mouthing was absent all that time. Another feature of the new version consisted of extra stimulation arrangements. The boy showed significant performance improvement with the new version of the program. The improvement was maintained over a 7-month follow-up.

Persons with profound and multiple disabilities may frequently fail to engage in constructive activity and, instead, may display high levels of problem behavior (e.g., tongue protrusion and hand mouthing), which complicates their situation further and hampers their social image (Holburn, Nguyen, & Vietze, 2004; Kurtz et al., 2003; Luiselli, 1998; Matson, Minshawi, Gonzalez, & Mayville, 2006; Saloviita & Pennanen, 2003). Educational intervention with these persons needs to target both constructive responding and problem behavior to produce a clinically relevant outcome, with clear personal and social benefits (Lancioni, Singh et al., 2007). To pursue both these goals, microswitch clusters (i.e., combinations of microswitches monitoring concurrently adaptive and aberrant responses) may prove very helpful (Lancioni, O'Reilly, Singh, Sigafoos et al., 2006, Lancioni, Smaldone et al., 2007). For example, a microswitch cluster consisting of a pressure device on the participant's headrest and an optic sensor directed at his or her mouth may be used to ensure that adaptive head responses are followed by positive stimulation only when they occur free from finger mouthing.

Although a program such as that just mentioned may be adequate in fostering adaptive responding and reducing problem behavior, an upgraded (stronger) version of it may also be conceived for the longer term. Such version could ensure that the stimulation for adaptive responses occurring free from problem behavior (a) lasts the scheduled time if the person refrains from the problem behavior during all that time and (b) is interrupted if the problem behavior appears during that time (cf. Lancioni, Singh et al., 2007). The new version could also include extra stimulation arrangements in concomitance with adaptive responses to (a) maintain high response motivation and (b) possibly promote some proper use of body parts (e.g., hands) involved in problem behavior. This study evaluated an upgraded program version similar to the one just described (i.e., with stimulation interrupted at the appearance of the problem behavior and extra stimulation arrangements). The participant was an adolescent who had received a basic microswitch-cluster program such as that delineated earlier (i.e., without the aforementioned new features) to promote adaptive foot and head responses and reduce finger mouthing (Lancioni, O'Reilly, Singh, Sigafoos et al., 2006).

Method

Participant

The participant (Vincent) was 13.9 years old at the start of this study. He had congenital encephalopathy with spasticity, reduced visual acuity, and lack of speech. He was in a wheelchair and received antiepileptic medication. Although no IQ scores were available, he was rated in the profound intellectual disability range. His participation in the basic microswitch-cluster program had increased the frequencies of his adaptive responses (foot and head movements, targeted in separate sessions) and ensured that about 80% of those responses occurred free from finger mouthing and thus were followed by preferred stimulation. This lasted the scheduled time regardless of whether finger mouthing appeared during that time.

Responses, Microswitch Clusters, Control System, and Stimuli

The responses recorded during the present study were foot movements (i.e., moving one or both feet upward or sideward), head movements (i.e., moving the head backward or sideward),

finger mouthing (i.e., bringing fingers into or over the mouth), and object contact (i.e., bringing one or both hands in contact with objects). The microswitch clusters (see Lancioni, O'Reilly, Singh, Sigafoos et al., 2006) included (a) tilt devices for foot movements combined with an optic sensor for finger mouthing and (b) a pressure device for head movements combined with the aforementioned optic sensor. The optic sensor was held a few centimeters to the side of Vincent's mouth through a light wire fixed to his eyeglasses.

The microswitch clusters were linked to a microprocessor-based electronic control system that regulated the presentation of preferred stimuli according to the procedural conditions described below and recorded the data. Preferred stimuli had been selected through stimulus preference screening (cf. Lancioni, O'Reilly, Singh, Sigafoos et al., 2006) and included among others music and songs, vibratory inputs, and voices.

Data Recording
Four counters fitted to the control system recorded automatically (a) the frequencies of correct adaptive responses (i.e., foot and head responses performed in the absence of finger mouthing), (b) the length of time (in seconds) that finger mouthing remained absent during the stimulation following the correct adaptive responses, (c) the amount of session time (in minutes) that was free from finger mouthing, and (d) the amount of session time (in minutes) that was spent with one or both hands touching objects (see below). Recording of this last measure was possible through optic sensors placed in the box containing the objects (see below).
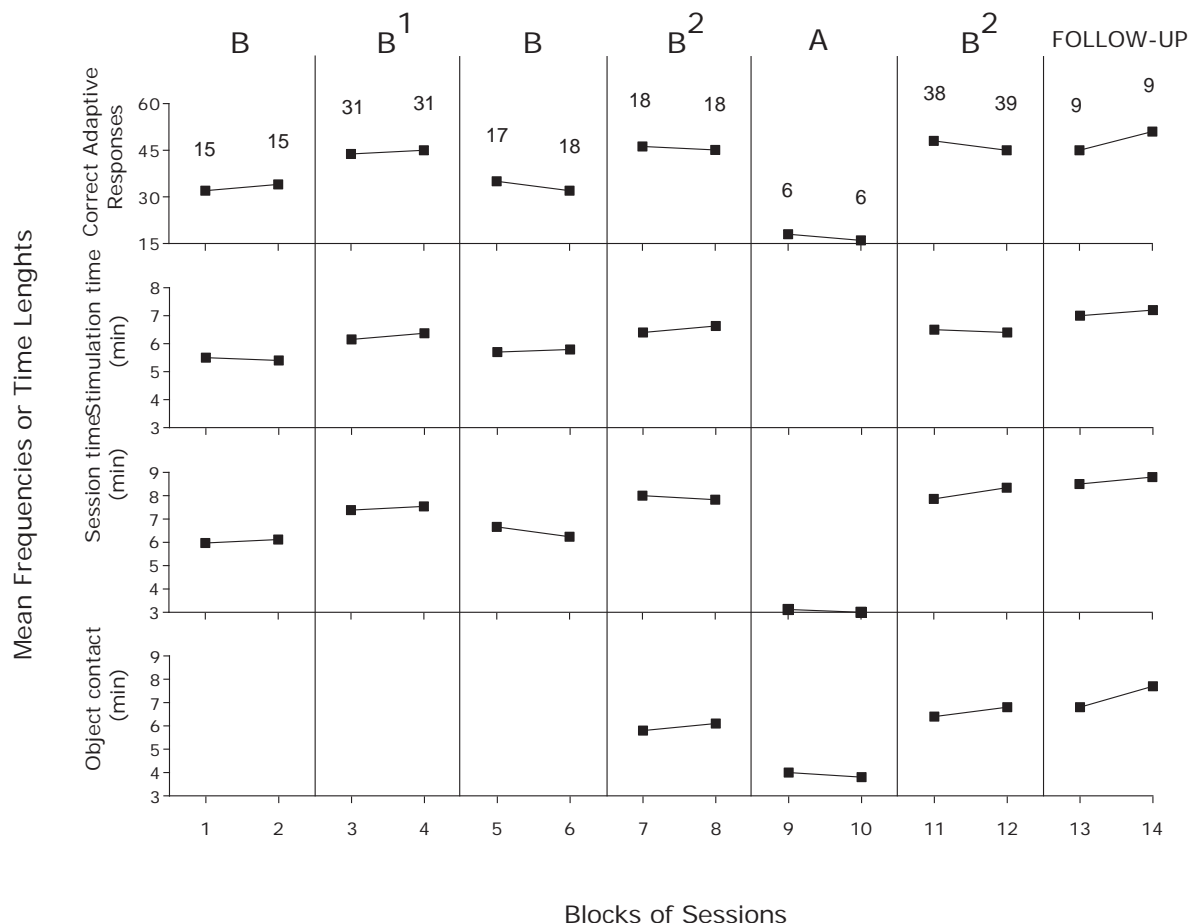
Experimental Conditions
The study involved a BB1BB2AB2 sequence with a 7-month follow-up (Richards, Taylor, Ramasamy, & Richards, 1999). The study started with a B phase (i.e., a natural continuation of the boy's original microswitch-cluster program, which provided a performance reference for the new, upgraded program version). B phases (30 and 35 sessions, respectively) involved the use of an 8-s stimulation for each correct response. The stimulation typically consisted of auditory combined with visual or vibratory inputs. Vibratory inputs were produced by any of various vibrating devices placed on different parts of Vincent's body. The B1 (62 sessions) differed from B in that stimulation lasted 8 s if Vincent refrained from finger mouthing all that time. Otherwise it was interrupted. The B2 phases (36 and 77 sessions, respectively) differed

from B1 in that a box with vibrating devices/objects was placed on Vincent's legs. The devices switched on and off concomitant with the stimulation provided for correct adaptive responses. The A (12 sessions) differed from B2 in that no stimulation occurred for correct adaptive responses. The box on Vincent's legs was used but the devices did not switch on. The follow-up (18 sessions) matched the B2 phases. About half of the sessions included the cluster for foot movements and finger mouthing and the other half the cluster for head movements and finger mouthing. The number of sessions per phase was decided on the basis of practical and methodological considerations. The latter were to ensure that a phase would not be terminated in the presence of data shifts precluding a clear interpretation of the next phase's impact (Richards et al., 1999).

Results
Figure 1 summarizes Vincent's performance over blocks of sessions. Two blocks are used for each phase of the study and the follow-up to portray possible data trends within each period. The number of sessions included in every block is indicated by the numeral above it. Sessions concerning the two adaptive (foot and head) responses were grouped together, given that the differences between them were minimal. During the first B, the mean frequency of correct adaptive responses per session was 33 (see top graph), the mean stimulation time per correct adaptive response elapsed free from finger mouthing was 5.5 s (see second graph) and the mean session time free from finger mouthing was about 6 min (see third graph). During the B1, the aforementioned measures were 44, 6.3, and 7.5, respectively. During the second B, the data matched those of the first B. During the first B2, the means for the first three measures were 46, 6.5, and 7.9, respectively. Moreover, the session time with object contact was over 5 min (see bottom graph). During the subsequent A, all measures showed a decline. During the second B2 and the follow-up, data on the four measures were similar or higher than those of the first B2. The Kolmogorov-Smirnov test (Siegel & Castellan, 1988) showed that (a) the first three measures increased significantly (with p values between .05 and .001) from the B phases to the B1, B2, and follow-up periods, and (b) object contact was significantly higher ($p < .001$) during the B2 and follow-up periods compared to the A phase.

Blocks of Sessions

The four graphs summarize the data for the four measures recorded, that is, (a) frequencies of correct adaptive responses (top graph) (b) stimulation time free from problem behavior (second graph), (c) session time free from problem behavior (third graph) and (d) session time with object contact (fourth graph). Each data point represents a mean over a block of sessions. The number of sessions included in each block is indicated by the numeral above it.

Discussion

Vincent's improved performance during B1 emphasizes the advantages of tailoring the stimulation time to the absence of the problem behavior. The interruption of highly reinforcing stimuli available for correct adaptive responses (i.e., in case of problem behavior) may have worked as a negative consequence for such behavior and as a form of prompt for a new correct adaptive response (Borrero & Vollmer, 2002; Ecott & Chritchfield, 2004).

Vincent's performance during the B2 and follow-up indicated (a) a consolidation of the data of the B1 (supporting the importance of tailoring

response-related stimulation to the absence of the problem behavior) and (b) a fairly encouraging development of object contact. This latter development could lead to three considerations. First, the vibratory input provided by the objects in the box may be seen as similar to part of the stimulation provided by finger mouthing and thus may represent a viable strategy to compete with such behavior and reduce it (Fischer, Iwata, & Mazaleski, 1997; Piazza, Adelinis, Hanley, Goh, & Delia, 2000; Rapp, 2006, 2007).

Second, the use of this type of stimulation during the early/basic microswitch-cluster program might have improved the outcome of that program. The improvement could have been more likely had the objects been presented close to Vincent's face (i.e., easily reachable by him without modifying his early tendency to keep his hands in the proximity of the mouth). Third, the introduction of these objects during the B2 might have contributed to improve Vincent's performance in relation to each of the measures recorded. It certainly also served to provide him an important occasion of contact with the immediate surroundings with positive

implications in terms of constructive engagement and social image (Nind & Kellett, 2002; Petry, Maes, & Vlaskamp, 2005; Vermeer, Lijnse, & Lindhout, 2004; Yazbeck, McVilly, & Parmenter, 2004).

In conclusion, this study provides encouraging evidence with regard to the effectiveness of the microswitch-cluster program in its upgraded version (i.e., with stimulation interrupted at the appearance of the problem behavior and extra stimulation arrangements). Although no social validation assessment was carried out about this (i.e., no staff personnel or parents were asked to rate the boy's performance within the different program conditions), one might assume that the positive changes reported with the upgraded version of the program would have been detected and appreciated by these raters (Lancioni, O'Reilly, Singh, Groeneweg et al., 2006). New research will need to ascertain the generality of the present findings with other persons with multiple disabilities (Kazdin, 2001; Richards et al., 1999). Replication of these findings would represent a critical step toward proving the reliability and applicability of the strategies used in this study.

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