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Teaching Individuals to Signal for Assistance in a Timely Manner

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Abstract

The study describes the adaptive-switch performances of 8 adults with severe multiple impairments. Each was given a series of progressively more difficult discrimination tasks that, if solved, would require the participant to close the switch to activate a device that was not operating or to stay away from the switch if the device was operating. Then in a 2-choice format, a preference test was conducted by providing 2 devices simultaneously that could be activated or deactivated by closure or release of the switch. Finally, a preferred device was activated and then surreptitiously deactivated. Switch closures in this contingency activated a speech-generating device that played the message, “Help me.” All 8 participants learned to control devices using their adaptive switch, but only 4 participants learned to make a request for help. Reasons for the different performances across learners and nonlearners are discussed.

Keywords

signaling; severely multiply disabled; adaptive switch; speech-generating device

An adaptive switch permits the control of battery-operated devices that provide visual, auditory or tactile feedback. A simple “momentary” adaptive switch is usually a flat plate that when closed, causes a device to activate and, when released, causes the device to deactivate. Individuals with severe intellectual and physical disabilities have learned to use adaptive switches to control various leisure items, such as radios, music players, and mechanical toys (Lancioni, Singh, O’Reilly, & Oliva, 2005; Saunders, Timler, Cullinan, Pilkey, Questad, & Saunders, 2003). Saunders et al. (2003), for example, described the results of more than 50 adults with profound disabilities. Each participant was provided with an adaptive switch that could be closed using a voluntary movement. Thirty-nine of 50 participants closed their switches more when a leisure device was connected to the switch than when the device was not connected. The authors suggested that these participants developed an awareness of the contingency between closing the switch and activating a leisure device.

A device similar to an adaptive switch is a single-plate, speech-generating device (SGD) that when closed causes a taped message to play. SGDs have been used by individuals with no other methods of communication (Dattilo & Camarata, 1991; Soto, Belfiore, Schlosser, & Hayes, 1993; Schepis, Reid, & Berhman, 1996). For example, Schepis et al. (1996) taught three adults with severe multiple disabilities to match pictures on an SGD with corresponding real items following a specific request. Next, participants were asked for a specific response with the SGD when the real items were not in visual range. Following training, all participants used their SGDs to request items in a variety of settings.

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Some professionals have suggested that a response generated by a device is not a true communication response unless it has certain features. Blackstone, Williams, and Wilkins (2007), for example, suggested that aided communication should be more than speech generating, but instead should be viewed "as a dynamic, transactional process that involves at least two people (p. 191)." Some skills that might be required as part of a dynamic, transactional process are an understanding of a need for the presence of a communicative partner (Jolleff et al., 1992) and knowledge of the message content (McLean & McLean, (1993).

These pre-language skills often are not evident in people with severe disabilities, however (Iacono, Carter, & Hook, 1998). One method of minimizing issues regarding understanding of the message or knowledge of a communicative partner is to use a request message on the SGD such as, "I want more" during scheduled activities where the message is appropriate. Individuals with severe intellectual impairments have learned to request in this manner (Schepis, et al., 1996; Soto, Belfiore, Schlosser, & Haynes, 1993).

Requesting is an important skill and one to which staff can be prompted to attend (Schepis and Reid, 2003). Teachers and caregivers are likely to attend to messages from an SGD at scheduled times in the day when requests are commonly used forms of communication, such as snack or leisure times. They are not likely to attend at other times in the day, however, if the message is not delivered within an appropriate context. For example, asking for a food item during play time might be ignored by a teacher or caregiver.

The purpose of the study described below was to teach requesting in a timely fashion. More specifically, the goal was to teach a request for assistance when help was needed to restore access to a reinforcing event. Adults with severe disabilities were exposed to a step-by-step program that first required control of leisure devices using an adaptive switch. Then preferences were assessed to identify the device that was most preferred. Lastly, the reinforcing event was provided and then interrupted. The interruption set the opportunity to use an SGD to communicate a request for assistance in restoring activation of the preferred device. The multistep protocol was utilized to insure that for each learning step, the participant had acquired the necessary prerequisites in the preceding step (e.g., cause-and-effect learning in the two contingencies required to demonstrate preference in a single-switch setup).

Method

Participants and Setting

Five male and three female participants from a larger study are described: Amber (female, age 45), Bill (male, age 41 yrs), Bob (male, 20 yrs), Sue, (female, age 38 yrs), Rory (male, age 40 yrs), Terry (male, 38 yrs), Jack (male, 15 yrs), and Mable (female, age 50 yrs). Amber and Bill were blind and had quadriplegia. Rory, Bob, Sue, and Mable were blind but had some functional motor control in their arms and legs. Terry and Jack had vision and some functional motor control. All participants resided at an institution for the intellectually impaired. The exception was Bob who attended a school that specialized in educating students with intellectual disabilities and low vision or blindness. None demonstrated functional gestures or other communicative behavior. All of the participants were judged to be in the severe to profound range of intellectual impairment, although their intelligence could not be tested using standardized testing.

Setting, Equipment, and Set-Up

Participants were seen individually once per day, five days a week for 20 minutes. The exceptions were Jack and Bob whose sessions were 10 minutes. Their sessions were shorter

because both often showed signs of agitation if sessions were longer than ten minutes. Sessions in the institution were conducted by a research assistant in a quiet area in their residence. Sessions for Bob were conducted by a para educator in a small room located near his classroom.

An adaptive switch was selected for each participant that allowed the user to close and release the switch with a voluntary movement Amber and Bill operated a switch mounted on their headrest using a head movement. The remaining participants each operated a switch mounted on a table top using a hand movement.

The switch was connected to an adapted leisure device. Leisure devices included MP3 players, vibration tubes, and mechanical toys. All items except the MP3 player were purchased through specialty catalogs. The MP3 was was attached to an adaptive interface (Saunders, Quastad, Cullinan, & Saunders, 2011) designed by a technician that allowed music to be heard as long as the switch was closed. When the switch was released, music continued to play but could not be heard through the participant's earphones or speaker. The MP3 had a window that allowed music genres to be displayed. Thus, music of a particular type could be selected by the research assistant or para, based on music that was reported by staff to be enjoyed by the participant.

In addition to the switch and leisure devices, a data collection interface was used that automatically recorded session length, cumulative switch closure duration, and a count of switch closures. The interface permitted the choice of three contingency options. The first option was that a switch closure produced activation of a leisure device (for as long as the switch remained closed by the participant). The second was that a switch closure produced deactivation of the device; that is, the device was activated all of the time until the switch was closed (and remained deactivated for as long as the switch remained closed). In the third option, the interface permitted concurrent contingencies for two devices. In the concurrent contingency, a switch closure simultaneously deactivated a currently operating device and activated a second device. When the switch was opened (i.e., pressure was removed), activation of the second device ended simultaneous with the re-activation of the first device. Switch closure duration was divided by session length to determine the proportion of each session that a device operated. In the concurrent contingencies, the operation of the second device equaled 100 minus allocation to the first device.

Phases of Control

All participants except Bob had some previous experience using an adaptive switch to control a leisure device. Prior to beginning the research protocol, participants practiced using their switches to activate a variety of leisure devices. During practice, prompts and prompt fading were provided as needed to increase their rate and length of switch closures. Practice was discontinued after all prompting was discontinued and duration of device operation occurred at least 20% of the session for two consecutive sessions. Devices that each participant operated longest in practice sessions were selected as the items by the research assistant or para educator for use for the remainder of the study.

Participants next were exposed to activation and deactivation contingencies across two learning phases followed by a preference test.

First learning phase—This phase was comprised of six sessions of the activation option followed by three sessions of the deactivation option with one device. Then one to three more devices were provided in the same way. Learning was inferred if the participant closed the switch longer in activation than deactivation contingencies.

Second learning phase—In this phase, two devices were tested that had shown learning in the first learning phase. The second phase included one session of the activation contingency alternated by one session of the deactivation contingency, and so forth for a total of six alternations with a single device. Then the alternating sessions were repeated with a second device. Mable was only tested with one genre of music because she cried when other genres of music were played. The purpose of the second phase was to determine whether the participant could learn to change strategies for device control across sessions. Learning was inferred if the percent of time closing the switch was longer in activation contingencies than deactivation contingencies. That result would be expected if the item operated was preferred.

Preference test—The purpose of this test was to determine which of two devices was the more preferred. The two contingencies—activation and deactivation—were provided concurrently and were alternated across devices across six sessions. That is, in one session Device 1 would be connected to the activation option and Device 2 would be connected in the deactivation option. In the next session, the setup was reversed. In the Preference Test, a device was inferred as the more preferred if the participant operated one device more of the time than the other device in five out of six sessions.

Protocol for Teaching Communication-Response Outcome Relationships

Signaling—In this phase of training, the device identified as preferred in the Preference Test was connected to the interface in the deactivation option; that is, the device remained on as long as the participant avoided closing the switch. After several minutes the switch was surreptitiously disconnected from the device using a remote switch that rechanneled the flow of electricity to an SGD. If the participant closed the switch, the SGD played the message, “Help me.” Then the research assistant or para educator responded immediately by saying, “I will help you.” The assistant then flipped the remote switch restoring the flow of electricity back to the leisure device. If a participant had learned to operate a device in activation and deactivation contingencies, then it would be expected he/she would close the switch when the device was turned off surreptitiously. Correct responses were scored if a switch closure occurred within three minutes following a surreptitious disconnection, and no closures occurred again until the next disconnection. Criterion performance was met when correct responses averaged 80% for ten consecutive opportunities (disconnections).

Modifications for high frequency and low frequency switch responders—Modifications to the above Signaling Phase were made for participants who developed error patterns in the signaling phase. If a participant had a high rate of switch closures when the device was operating, the switch position was changed to a location that required somewhat more effort for a switch closure to occur. For those using a hand or finger to respond, a distractor object was provided to keep hands or fingers busy when responding was not appropriate. The distractor remained with the participant during operation of the device as well as after disconnection. If the participant stopped interacting with a particular distractor, another item was tried. Distractors were objects of interesting texture or with LED lights that glowed when touched, or objects that the participant manipulated or held at other times in the day, such as magazines, and iPads. These modifications were made if the participant appeared to be “playing” with the switch. If the participant appeared to be closing the switch to obtain attention from the research assistant, then social interaction, such as the phase, “I will help you” was discontinued and the leisure item was restored without comment. If the participant had a low rate of switch closures after the disconnection, then praise was given for independent switch closures that occurred after the disconnection.

Results

The accuracy of the data collection interface was tested at the beginning of each session by the research assistant. The switch connected to the interface was closed several times and the count on the interface was observed after each closure. The research assistant also noted whether the clock was turned on a recording time to the 0.10 of a minute. The primary investigator observed a research session with every participant every two months across the period of the study to confirm that the research protocol was followed. The protocol was an electronic arrangement of switches and devices and not a set of behaviors by the research assistant, except for remote disconnections.

Results of the 1st and 2nd learning phases

Figure 1 depicts the percent of time the switch was closed in the first and second learning phases for all eight participants. In the first learning phase, all participants showed higher switch closure durations, shown as percent of time, under activation contingencies than deactivation contingencies with at least two devices. Switch closures also were longer in activation contingencies in at least five out of six pairs of alternating activation-deactivation contingencies for all eight participants in the second learning phase. These data indicate that participants learned to control the operation of their devices under two different operating contingencies.

Although the total duration of switch closures were longer in activation contingencies, the average frequency of closures across sessions in the first and second learning phases varied widely across participants. Table 1 shows the average number of closures per session in activation contingencies in the second learning phase. Data are shown from the second phase because by that time, participants had more practice in using their switch and the novelty of using the switch had diminished somewhat. Nevertheless, Amber, Jack, and Mable averaged more than 100 closures per session, whereas Bill, Sue and Rory averaged 10 or less closures per session. High responders would appear to “play” with their switches, as described above. Low responders moved on or off their switches infrequently.

Participants also varied in maintenance of operation of their devices across activation and deactivation contingencies. For example, in Figure 1, in the second learning phase when music was the outcome, Amber, closed her switch an average of 13% of the time during activation, and 14% of the time in deactivation. That means that the music device operated 14% of the time in activation and 86% of the time during deactivation, or an average of 48% overall. Amber operated her devices only slightly above 50% of the time across the entire second learning phase. Bob operated his music devices with 2 genres of music only an average of 57% of the time. Rory, Terry, Jack, and Mable all operated their devices an average of more than 70% of the time across devices in the second learning phase. These data indicate that some participants were better at controlling device activation with their switches than others.

Results of the preference tests

Results of the Preference Test are shown in Figure 2. Four participants, Sue, Rory, Terry, and Mable showed a preference for one device, as determined as five or more data points that were higher for one choice over the other choice. Results of the Preference Test were mixed for Bill. Bob and Amber almost never closed their switch regardless of what device was in operation. Jack closed his switch an average of 50% to operate both devices.

Signaling—Figure 3 shows the number of correct responses in each bundle of ten disconnections for participants in the Signaling phase. A correct response was scored if the

switch was closed within three minutes of a disconnection and was not closed again during the interval between the reconnection and the next disconnection. Bob had half as many disconnections per session because his sessions were 10 minutes in length and only two disconnections were scheduled in each session. As shown in Table 1, Rory, Terry, and Jack made most of their errors by closing their switches during operation of the device. Adaptations were initiated for these participants following 10 disconnections when errors frequently. Following these adaptations, closures during operation of the device occurred less often. A distractor was provided for Mable at the beginning of the Signaling phase and errors were minimal. Bob's errors were due to not closing the switch after disconnection. Amber, Bill, and Sue made errors of both types.

A comparison of results across the two learning phases, the Preference Test, and the signaling phase indicate that those participants who showed control of the operation of their devices in Phase 2 and showed a preference on the Preference Test, learned to signal. Those that did not show control of operation, did not show a preference, and/or had very low frequencies of switch closures in learning phases did not learn to signal.

Discussion

All eight participants showed a higher percentage of time closing their switch in activation contingencies than in deactivation contingencies in the first and second learning tests. Our assumption was that if they learned the contingencies required to maintain control of their battery-operated devices, and that at least one of those devices was preferred, they would signal at the appropriate time. Only four participants, however, learned to signal in a timely manner and otherwise stay away from their switches in phase 3.

An interesting question is, "What happened to the four participants who did not learn to signal?" Although the answer is not entirely clear, the data contain clues as to why these participants were not successful. Amber and Bill closed their switches with a head turn. Positioning a switch for someone who closes the switch in this manner is tricky because the position is dependent on the participant's head position in the wheelchair. Every day the position is slightly different and therefore the switch position must be selected carefully by the research assistant. The position had to be one in which the participant could both close the switch and avoid the switch with little effort. In the Learning Phases, the research assistant did not report difficulty in finding an appropriate switch position. The position was obviously one that met the criteria for accessing or avoiding the switch because no participant closed or stayed away from the switch 100% of the time. What might be perceived is that in activation contingencies, the switch position was one that required less effort to stay on the switch than to stay away from the switch. The opposite would be true in deactivation contingencies. Switch position became a constant concern for these participants in the Preference and Signaling phases, however. If the switch was located too close to the participant's head, extra closures occurred as a function of random head movements. If the switch was located further away, participants appeared to fatigue and responding decreased across the session.

Amber showed signs of fatigue by bobbing her head as she repeatedly tried to access her switch. Toward the latter part of the session she lowered her head and appeared to rest. Her data reflected these problems of control in the high frequency of switch closures but low operation time in early learning tests. Bill did not show signs of fatigue. He was able to control head movements quite well, although he had a periodic form of head turning, sometimes referred to as head weaving. His control of devices in Phase 2 indicated that he controlled operation of his music player more often than vibration. His Preference Test showed a weak preference for vibration. His error pattern in the signaling phase, however,

showed closures when music or vibration was in operation and no closures following disconnection of the device. His occasional head weaving that tripped the switch and his low overall frequency of switch closures produced a mixed response pattern that did not lead to a functional signal.

Sue had very flaccid muscle tone and no lateral hand movements. She controlled the switch by moving her hand up off the switch or down onto the switch. Observations of her switch behavior indicated that she would move her hand off the switch if the switch was in the deactivation mode, but she rarely returned her hand onto the switch. This lack of movement produced many occasions when she did not move her hand onto the switch to signal following a disconnection. She often showed signs of discontent over the disconnection, however, such as a groan, a raise of the eyebrow, or an opening of her eyes.

Bob had good physical movement but also did not learn to signal. His maintenance of operation of devices was low across both genres of music in the second learning phase. The results of his Preference Test showed no responding after the second session. He almost never closed the switch in the Signaling phase and resisted prompting to close the switch. An assumption might be that music was not a potent reinforcer.

How individuals with severe multiple disabilities respond to an adaptive switch may provide some clues as to whether they are likely to learn to signal in a timely manner using an SGD. In this study, those who discriminated when to close their switch and when not to close their switch, who had the physical ability to move on and off the switch, and for whom a preferred form of outcome could be controlled with the switch, were more successful in learning to signal in a functional manner. More individuals need to be tested, however, before predictions can be made about what skills are required for learning a functional signal.

A last point of discussion is whether participants in this study had a true communication response as described by Blackstone et al. (2007). None of the signalers were observed to orient visually or with their body toward the research assistant after activating their SGDs. There was also no indication that they understood the message on the device. Participants did learn when to send a message which is a step toward true communication. The next steps in teaching communication might be to teach multiple messages or turn taking using an SGD. Both are challenging to those with multiple disabilities.

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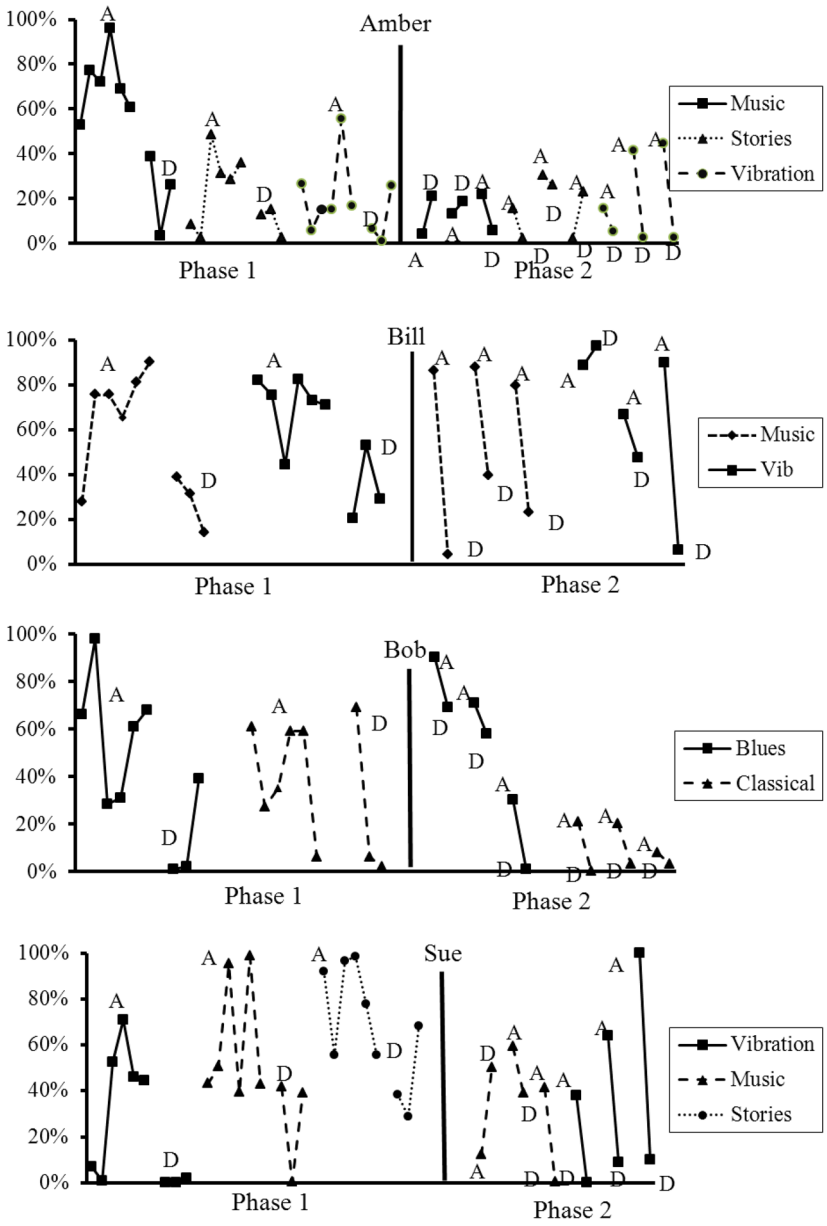

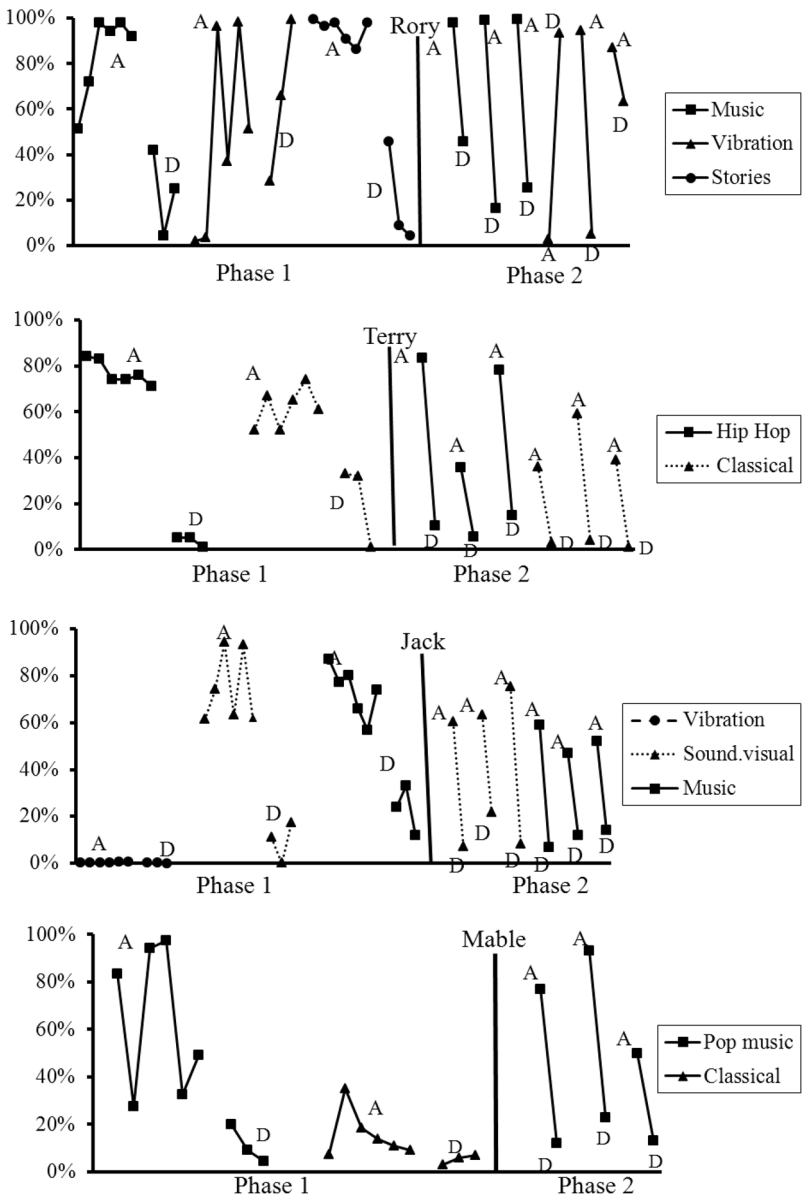

Figure 1.

Percent of time the switch was closed in the first and second learning phases for each participant. The first phase was comprised of 6 sessions of Activation (A) and 3 sessions Deactivation (D) contingencies with two or three different sensory outcomes. The 2nd phase was comprised of sessions with alternating contingencies (A then D, then A, etc.) with each of two or three sensory outcomes.

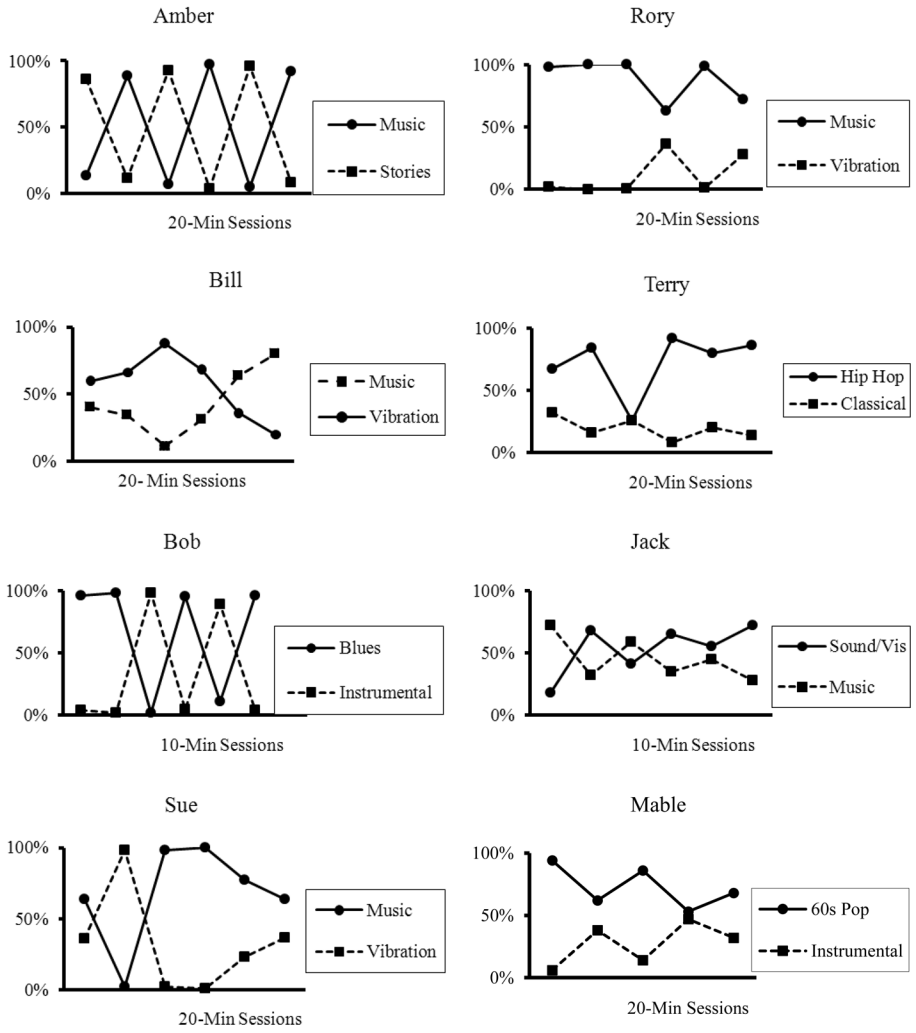

Figure 2.

Percent of time each of two sensory outcomes were operating during the Preference Test for each participant. In each test session, both forms of sensory feedback were available, one activated when the switch was closed and the other activated when the switch was released, with the contingencies alternated across sessions.

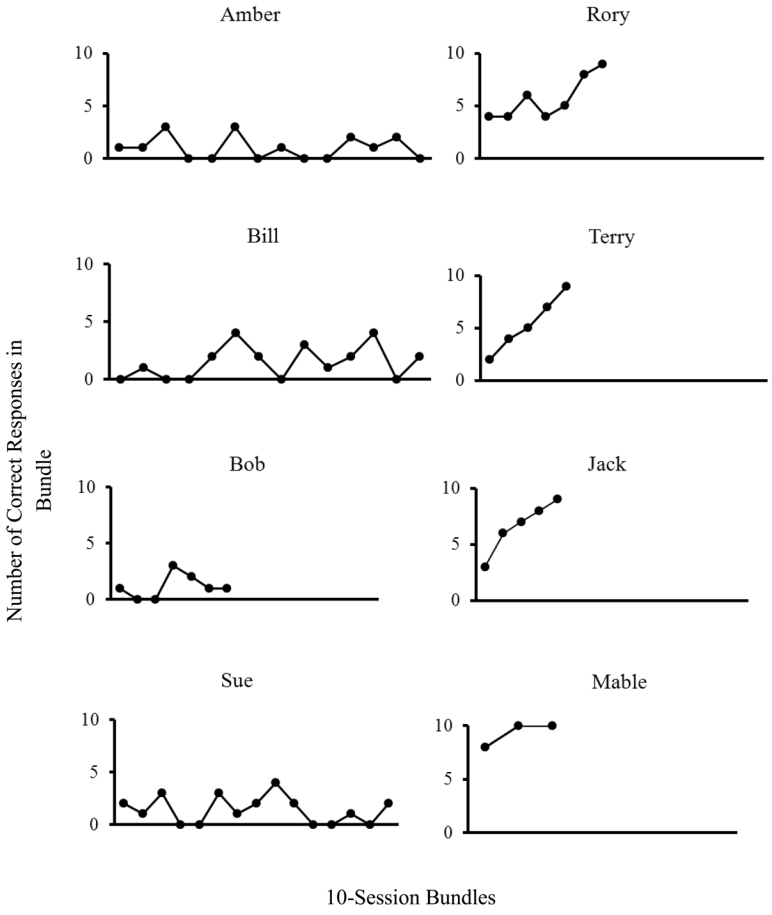

Figure 3.
Number of correct signaling responses in 10-opportunity bundles for each participant. A correct response was scored if the switch was closed within 3 minutes of a disconnection and did not occur after reconnection until the next disconnection.

Table 1

Average Number of Closures per Session in Activation Contingencies in the Second Learning Phase, and Percent of Correct Responses Occurring Before and After Disconnection in the Signaling Phase.

Participant	Average number of switch closures per session in 2nd Learning Phase	Average percent of occurrences in 10-response bundle that switch was closed within 3 min of disconnect in the Signaling Phase	Average percent of occurrences in 10-response bundle that no closures occurred during activation of device in the Signaling Phase
Amber	178.8	46%	12%
Bill	5.6	51%	46%
Bob	24.2	21%	87%
Sue	5.2	23%	47%
Rory	10.5	83%	53%
Terry	69.1	95%	53%
Jack	251.7	96%	57%
Mable	255.0	100%	93%