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Innovation of a Reinforcer Preference Assessment with the Difficult to Test

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Abstract

In this study, we continued evaluation of a two-choice preference assessment aimed at identifying a hierarchy of reinforcers for individuals with only one voluntary motor sequence—closing and releasing an adaptive switch. We assessed preferences among types of sensory stimulation in 6 adults with multiple profound impairments using concurrent synchronous reinforcement contingencies. Pre-experimental assessments with various types of stimulation led to the selection of music (A), vibration (B), and either olfactory or visual stimulation (C) as the 3 modalities for continued testing. Each participant received opportunities for familiarization with each type of stimulation in blocks of six 20-min sessions in which the closure of an adaptive switch produced the stimulation for as long as the switch remained closed. Next, participants could choose between pairs of types of stimulation in blocks of 12 sessions. In the first 6 of the 12 sessions, switch closure activated one type (e.g., A) and switch release activated the contrasted type (e.g., B). In the second 6 sessions, the contingencies were reversed. Two additional 12-session blocks completed all possible contrasts (AB, BC and AC). Four of the 6 participants showed distinct preferences in these two-choice tests with indications of preference hierarchies. The results demonstrate a method for obtaining indications of relative preference for potentially reinforcing stimuli from individuals without communication and without the abilities to act on more than one switch.

Many methods for testing preferences of persons with limited or no language abilities have been described in the literature (see Cannella, O'Reilly, & Lancioni, 2005; Hughes, Pitkin, & Lorden, 1998; Lohrmann-O'Rourke & Browder, 1998 for reviews). Common test procedures include concurrent display of multiple items and then observing for a consistent choice response, such as hand movement toward or grasping specific items (Fisher et al. 1992; Pace, Ivancic, Edwards, Iwata, & Page, 1985; DeLeon & Iwata, 1996). Those that are approached are inferred to be preferred over those that are not approached. Test procedures also have included contingent delivery of test items following simple motor responses (Pace et al., 1985; Fisher et al., 1992). Those items that produce increases in responding are inferred to be reinforcers.

Some individuals with profound intellectual and/or motor and sensory disabilities have required adaptation of these procedures (Ivancic & Bailey, 1996; Logan, Jacobs, Gast, Smith, Daniels, & Rawls, 2001). Adapted test procedures typically utilize a successive single presentation format because these individuals do not display the choice-making behaviors that are required for paired or multiple-choice presentations. Logan et al. (2001) reported beginning assessments with stimuli suggested by caregivers or caregiver records. Successive presentations of items were spaced, with 30 seconds of access allowed following

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an approach behavior. Those approached the most frequently were inferred to be preferred. Approach behaviors included active responses, such as reaching for objects or consuming edibles, as well as passive responses, such as smiling or laughing. At least one item was identified as preferred for all 6 participants using this method. The items identified as preferred then were presented contingent upon closing an adaptive switch. The results showed that for all 6 participants the items did not function as reinforcers or functioned inconsistently. Ivancic and Bailey (1996) tested 10 individuals described as having chronic training needs. Seventeen different stimuli were presented one at a time. Smiling or turning toward test items were judged as indicators of preference, and crying or turning away as indicators of nonpreference. Then an item identified as more preferred or less preferred was delivered contingent upon a switch closure. Two of 10 participants approached one or more stimuli 80% of the presentations. Reinforcement effects were shown in none of the 10 participants, however.

There are several hypotheses why these preference-testing procedures have not been more successful in producing consistent choice-making or in identification of reinforcers. One is that individuals who exhibit passive approach responses in preference assessments may also require a passive response in reinforcer testing. The motor response in testing may require too much physical effort (Logan et al., 2001; Spevack, Yu, Lee, & Martin, 2006). Although this may be the case, active motor responses are important in developing higher level communication responses. Indeed, preference and reinforcer testing in these individuals is often motivated by the desire to teach a simple communication response.

A second hypothesis is that individuals with severe intellectual disabilities may not be able to learn during the relatively short exposure to test contingencies (Logan et al., 2001; Stafford, Alberto, Fredrick, Heflin, & Heller, 2002). Ivancic et al. (1996) conducted as few as three 10-min sessions in each reinforcer test condition even though some participants were described as having slow movement. Perhaps longer sessions or more test sessions would have increased success by allowing for more opportunities for the participants' motor movements to activate the contingency. Baselines that employ extinction may also slow learning when the reinforcement contingencies begin.

Our previous research suggests that people with severe multiple disabilities can learn the "cause and effect" relationship between closing a switch and producing an outcome if the learning paradigm is simple. Thus, we have focused our recent research on a contingency that is said to produce "synchronous reinforcement" (Ramey, Hieger, & Klisz, 1972). The synchronous contingency has proven useful in studying learning in infants (e.g., Coldren, 1997; Colombo, 2001; Tyrrell, Zingaro, & Minard, 1993). In synchronous reinforcement with adaptive switches, closure of the switch results in the onset of a stimulus (e.g., music) and stimulation is delivered so long as the switch remains closed; release deactivates the device. It is hypothesized that the high degree of "temporal redundancy" is a factor that makes it effective in producing learning. Temporal redundancy refers to the fact that switch closure and stimulation onset are nearly simultaneous and switch release and the end of stimulation are nearly simultaneous. Thus, stimulation and switch closure are synchronized. Further, every switch closure starts stimulation; there are no nonfunctional switch closures that might signal a change in the contingency. We previously referred to synchronous reinforcement as a "momentary" contingency (e.g., Saunders et al., 2001, Saunders et al., 2003).

A related synchronous contingency is the momentary "deactivation" contingency, in which switch closure deactivates stimulation and switch release re-activates the stimulation (Saunders, Smagner, et al., 2003). We hypothesized that coupling these synchronous contingencies could set the conditions for assessing preferences in a two-choice arrangement, but with only a single switch. We (Saunders et al., 2005) reported a study conducted with this two-choice arrangement. Prior to these tests, the participants were provided with separate opportunities to learn in the momentary contingency (i.e, switch closure causes stimulus activation) and to learn in the momentary deactivation condition (i.e., switch closure deactivates the stimulus). Next, in the critical phase of the experiment, both contingencies were simultaneously in effect, permitting the opportunity to alternate between the two types of stimulation in any pattern. The contingencies were alternated for the two devices across sessions. Relative preference was to be inferred from response patterns in which one type of stimulation was kept activated more than the second type, irrespective of which contingency was in effect. Only two of the 10 participants, however, showed clear preferences. We speculated that daily alternation of the contingencies was not an ideal procedure, as it required the participants to learn anew every day.

The primary objective of the current study was to determine if participants would show preferences if the contingencies were alternated across blocks of sessions, rather than daily. A second objective was to determine whether any participants would produce data indicative of a preference hierarchy if we contrasted three sources of stimulation, two at a time (Dattilo, 1986; Dattilo & Mirenda, 1987). Our third objective was to determine whether relative preferences inferred from the results of the concurrent contingencies arrangement (e.g., music versus vibration) would be predicted by the results of sessions with a momentary contingency and a single outcome (e.g. music). As we will develop in the discussion, this comparison is an essential step in determining whether less-preferred types of stimulation in the concurrent arrangement are simply “less” preferred, or whether the participant finds that type of stimulation aversive.

Method

Participants and Setting

The participants were 5 females and 1 male between the ages of 24–55 yrs who lived in the same residential unit of a State-operated intermediate care facility. None of the participants had extensive experience with an adaptive switch, and none had access to switches immediately prior to the beginning of this study. All of the female participants were nonambulatory and had very limited voluntary movement. The male ambulated with assistance with a walker. None demonstrated functional verbal, symbolic, or gestural communication abilities. One of participants (P6) was blind. All research was conducted with informed consent of a parent or legal guardian and with approval and oversight of University and facility institutional review boards with responsibility for protection of research participants.

Setting, Equipment, and Set-Up

Experimental sessions for P3 and P4 were conducted in a large living/recreation room. All other participants were tested in a bedroom. Participants were positioned each session in a position that facilitated their voluntary movement. Three of the participants (P1, P2, and P5) were positioned sitting in their wheelchairs, P1 and P2 with the switch located on their chair tray, and P5 with the switch on the headrest. Two other participants (P3 and P4) were positioned in prone positions on mats and foam wedges. Their switches were located next to a hand. The ambulatory participant (P6) sat in a chair in front of a table. His switch was located on the tabletop. Switch type and position were based on each participant’s position and ability to close (and release) the switch using a voluntary motion.

Each switch activated a leisure device by movement of the switch. Three leisure devices were selected for each participant. One provided auditory feedback, another provided tactile feedback, and the last provided visual feedback, with one exception. Olfactory feedback was provided for P6 who was blind. Leisure items were selected through several steps. We talked with their care staff and solicited their inferences about the participants' preferences. We also noncontingently presented various items to the participants in attempts to register reactions (e.g., changes in affect, motor movement). For example, we provided vibration at various sites, such as behind the neck or behind the back. Music functioned as auditory feedback, vibration as tactile feedback, mechanical animals and a strobe light as visual feedback, and a defuser as olfactory feedback. The defuser contained a small fan that blew olfactory stimuli toward the participant.

All switches were momentary providing synchronous contingencies; that is, a leisure item connected to the switch was activated when the switch was closed and deactivated when the switch was released. In addition to the switches and leisure devices, a data collection interface was used. The interface automatically recorded session length, cumulative switch closure duration, and the number of switch closures, and displayed these data on LCD screens. In addition, the interface permitted concurrent contingencies for two devices as described above—one operating and one deactivated at any moment, depending on the behavior of the participant. Simple arithmetic procedures were used to calculate the relative proportion of each test session that each device was in operation.

Overview of Procedures

Each participant was provided with his or her switch and scheduled leisure devices during daily 20-minute sessions, 3–4 days per week. Prior to the start of the experiment, each participant received familiarization with switch use. Familiarization was provided first using physical prompts to control a single device. Closure of the switch activated a device (e.g., music tape player). Then familiarization was initiated for controlling two devices. In this two-device familiarization, closure activated one device, and release activated a second device, as described above. In the sequence of experimental conditions, familiarization with the various experimental leisure devices was provided through switch control of each device in block-session format, one at a time. Then in preference testing phases, the one and two-choice formats were used to assess relative preference.

Preliminary switch and contingency familiarization—Familiarization with the contingencies, was conducted for all experimental conditions that would follow. Familiarization began in sessions with a single device and with physical prompts to use the switch to turn on the device. Depending up the placement of the switch and the motor characteristics of the participant, the experimenter placed the participant's hand on the switch, moved the participant's hand toward the switch with a nudge to the elbow, or pushed the participants hand toward the switch from the side. The experimenter persisted in a prompt until switch closure occurred so that the participant experienced the sensory outcome. The number of initial prompts in a session depended on the success of the prompts. If the initial prompts resulted in several seconds of continuous switch closure by the participant, only two or three prompts were given. If the participant removed his or her hand immediately following the prompt, then more prompts were given. The number in each session was at the experimenter's discretion. Following these initial prompts, additional prompts were provided only whenever the participant ceased contact with the switch for 3 consecutive minutes. This type of familiarization continued for a minimum of four sessions and until the participant was making at least four independent switch closures per session. When this criterion was met, the participant received 6 more familiarization sessions, 2 with each of the 3 devices.

Next, sessions were initiated in the concurrent contingency paradigm. Pairs of devices (e.g., A and B) were rotated across these sessions. Familiarization with the concurrent contingency was continued for at least four sessions and until the participant was making at least four independent switch closures or four independent switch releases per session. When this criterion was met, the experimental phases were begun. From this point on, one demonstration of the contingencies in effect was given at the start of each session. Prompts were not used again.

One-choice experimental sessions—The first experimental condition consisted of a block of six sessions with Device A. These sessions began with the experimenter assisting the participant to make one switch closure and to maintain closure for 2–3 s, thus demonstrating the effect of switch closure and simultaneously establishing the location of the switch for the participant. No physical or verbal prompts were provided throughout the remainder of the session. A block of six sessions with Device B was conducted next.

Two-choice experimental sessions—Two-choice preference test sessions with Devices A and B were conducted next. In the first six sessions of this first two-choice test, Device B was turned on by connection to the interface at the start of the session. The experimenter next assisted the participant to make one switch closure and to maintain switch closure for 2–3 s. Switch closure turned off Device B and turned on Device A. Release of the switch closure by the experimenter and participant reversed the current such that Device B was again turned on and Device A was turned off. No further prompts were provided by the experimenter during the session. Next, 6 additional two-choice experimental sessions were presented. These sessions were identical to the preceding six sessions, except that Device A was turned on by the interface at the beginning of each session and switch closures turned off Device A and turned on Device B.

Further one-choice experimental sessions—Next, 6 single-device session blocks were conducted for each of the 3 devices in the order Device A, Device B, and Device C for a total of 18 sessions.

Further two-choice experimental sessions—Next, a preference test series of 12 sessions, as described above, contrasted Device B and Device C. This test series was followed by a third and final test series of 12 sessions in which Device A was contrasted with Device C. The 3 test series were constructed such that in each 6-session block of test trials, the participant would have to alter his or her behavior, relative to the preceding block of sessions, to maintain access to a potentially more preferred outcome in the preceding 6-session block. For example, the one-choice sessions with Device C, in which switch closure activated Device C, are followed by a test block in which the participant would have to refrain from closing the switch in order to allow the interface to maintain activation of Device C, and thus continue its presentation of stimulation. In the subsequent block of preference test sessions, the participant would once again need to close the switch in order to turn on Device C.

Results

Familiarization

Criterion performances for switch familiarization in one-choice sessions were obtained in 9 or fewer sessions. Criterion performances for switch use in two-choice sessions were attained in 7 or fewer sessions.

One-choice experimental sessions

The median percentages of time each device was activated in the blocks of one-choice sessions are shown in Table 1. Medians were selected as the measure because seizure activity, brief changes in behavioral state (e.g., alert to drowsy), and environmental distractions (e.g., lawn mowing nearby) can contribute to large across-session differences in switch use. Medians present a measure of central tendency less affected by these factors than do means. The data in Table 1 show a wide range of switch-use percentages across participants and within some participants. For example, P2 and P6 closed their switch a high percentage of time for two of the four devices. Also, individual session data are shown for P1 and P6 in Figures 1–4. Figures 1 and 2 show that P1 had low to moderate durations of switch closure for all devices. Figures 3 and 4 show that P6 had high durations of switch closure for vibration, but much lower durations for music and the defuser.

Two-choice experimental sessions

The results of the two-choice experimental sessions for all participants also are shown in Table 1. In the entries for the two-choice sessions, a median of 50% could mean that the participant closed the switch nearly 100% of each session, regardless of which device was activated by switch closure. Conversely, it could reflect a lack of switch closure in all sessions. Clearly, medians near 50% show little or no preference for either device. Medians such as shown for P6 indicate something quite different. In order to produce a median percentage of 96% in the comparison of Devices A and B, P6 would have to approximate a performance where P6 closed his switch nearly all of each session when switch closure activated vibration and nearly none of each session in which switch closure deactivated the vibration. Thus, P1, P2, P4 and P6 showed preferences for particular devices. P1 preferred music to vibration and the duck, but preferred the duck over vibration, as shown in Table 1 and Figures 1 and 2. As shown in Table 1, P2 showed a strong preference for music over the duck and somewhat of a preference for music over vibration. There was no apparent preference between the duck and vibration. It is interesting to note in P2's data that despite frequent switch closure in the one-choice sessions with vibration, in the two-choice sessions, vibration was not preferred. P4 preferred music and vibration to the strobe, but no preference between music and vibration. As shown in Table 1 and Figures 3 and 4, P6 preferred vibration to both music and the defuser and clearly preferred music to the defuser, despite infrequent switch closure for music in the one-choice sessions.

P3 and P5 showed no preference across the devices. The daily data from these participants show that P5 tended toward active switch closure in all two-choice tests whereas P3 tended more towards inactivity or less switch closure in all comparisons.

Discussion

The primary objective of this study was to determine if more participants would show preferences if the contingencies were alternated across blocks of sessions, rather than across sessions. Our results indicated that 4/6 participants showed preferences using this procedure as compared with 2/10 in previous research. Our secondary objective was to determine whether any participants produced data indicative of a preference hierarchy. All four who showed preferences showed evidence of hierarchies.

Another objective was to determine whether responding in the one-choice sessions with only one type of stimulation available would produce response patterns showing the same preferences as in the concurrent contingencies arrangement. For this objective, the results are mixed. P6's one-choice data for vibration are consistent with his two-choice data. But his one-choice performance with music would not appear to be predictive of his strongly indicated preference for it over the defuser. Thus, what appears to be a relative weak reinforcer may nevertheless be highly preferred over another stimulus. Similarly contradictory performances were shown by P2 with music and vibration. Her data show that what may be a relatively strong reinforcer (vibration) when it is the only stimulus available, may not appear as strong when contrasted with other stimuli. In contrast, P1's one-choice results with music and vibration show reinforcers of relatively equal strength, but music is preferred and vibration did not compare with an apparently weaker reinforcer, the duck.

The two-choice conditions employed in this study are distinctly different from other published articles describing preference-testing procedures. In previous articles an active approach response, such as a point or grasp, or a passive approach response, such as a smile or visual attention, were required to indicate a choice between items. In this study, during two-choice conditions, a single choice was available noncontingently and a second choice was available continent upon a switch closure. In this arrangement, switch behavior can be modified by reinforcers and/or aversive stimuli. We cannot know for sure whether switch use was positively or negatively reinforced, or both, from data produced from the two-choice conditions. Closing the switch may have produced the more pleasing outcome and/or ended an annoying outcome. P6, for example, may have found the defuser aversive or annoying. Music, while not a powerful reinforce, may have been a highly acceptable alternative to the defuser.

These results are somewhat limited in that only 4 participants showed preferences using the two-choice procedure. Two participants, P3 and P5 did not show preferences. It is unclear whether each of these participants preferred each outcome equally or whether other factors played a part. These two participants received their research sessions during repositioning on wedges and mats in a recreation/day room floor. These were the only times these participants could be available for participation. Unlike the conditions for the remaining participants, there would have been the possibility for considerable visual distraction as well high levels of ambient noise that could have affected music particularly. Another explanation for the failure to show preferences is that the learned "cause and effect" relationship between closing the switch and activating a sensory outcome may have been lost or impaired during two-choice conditions. More individuals need to be tested in order to fully evaluate these procedures.

Despite the results from P3 and P5, the study overall demonstrates a new model for preference testing in individuals with very limited motor repertoires. The model should be important for consideration by music and recreation therapists, as well as others that provide stimulation activities to persons with multiple disabilities. It is a model that can help prevent the continuous presentation of aversive stimulation to an individual with no means of escape and no means of communicating the unpleasantness of the situation. Conversely, the model holds promise for systematically identifying enjoyable stimulation. For example, the two-choice procedure could be used to identify a hierarchy of least to preferred types of music played at least to most preferred volume levels.

A primary purpose of reinforcer preference assessments is to find a stimulus that can be employed in the teaching of an adaptive response. In the case of individuals with characteristics similar to our participants, the array of teachable skills is very limited. We view switch use as a highly important adaptive skill for these individuals. Thus, an initial outcome of the present procedures is that the individual can be enrolled in daily opportunities to become more adept at switch use (through practice) while enjoying their preferred source of stimulation during leisure. A second outcome is that the individual can be enrolled in sessions to refine his or her preference hierarchy, such as contrasting different music genres in the concurrent momentary contingency. Refining the preference could have positive effects on the rate at which the individual improves their switch use (i.e., larger percentage of leisure sessions with the stimulation turned on). As an individual participates in additional concurrent momentary contingency sessions, they also might develop faster discrimination of contingency change. That is, when their preferred stimulation is noncontingent and then is made contingent (as between our blocks of sessions), they can learn to more rapidly shift to switch closure.

With individuals who become proficient in switch use with sensory devices and have learned to change rapidly from not responding to responding, and vice versa, consider the following training protocol: (a) provide the individual with a switch and noncontingent access to a preferred source of stimulation, (b) surreptitiously end the stimulation, and (c) which, given the learning history, rapidly leads to switch closure. Suppose, however, that the usual switch has been replaced with a speech generating device (SGD) that, in this case, emits “help me,” leading to caregiver assistance in restoring the stimulation. If the SGD device can be established as a reliable way to get assistance in leisure sessions, there are distinct possibilities its use could be generalized to other situations where assistance is needed and appropriate. Other extensions of use are not out of the realm of possibility.

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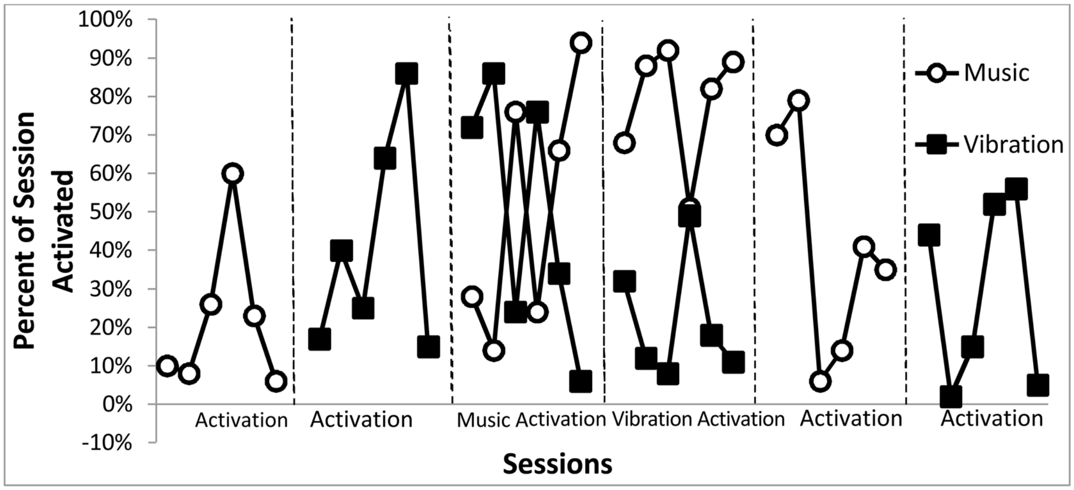

Figure 1.

The results of the first six phases of the experiment for P1. Each phase was six sessions in length. The first two phases tested the effects of switch closure (activation) with a single source of stimulation per phase (music or vibration). The third and fourth phases contrasted music and vibration in a preference test arrangement. In each phase, switch closure activated the device indicated below the data and switch release activated the other device. That is, activation of one device through switch closure deactivated the other device and vice versa. The fifth and sixth phases again tested the effects of switch closure with a single device per phase (music or vibration).

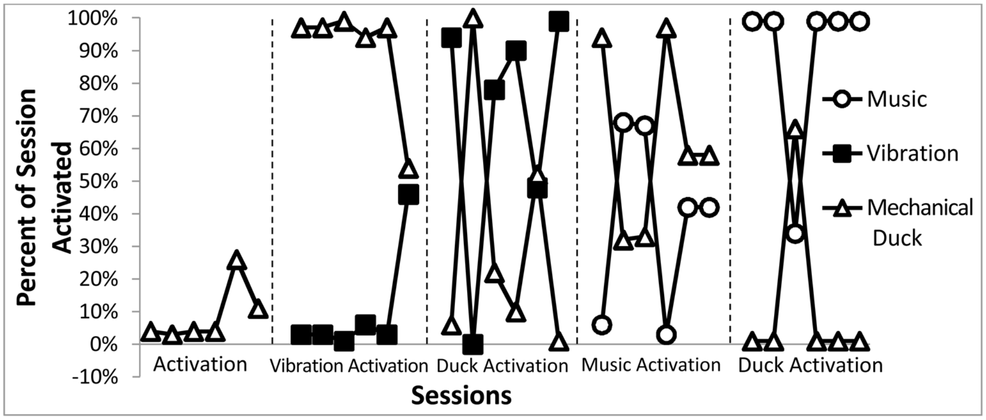

Figure 2.

The results of the last five phases (7–11) of the experiment for P1. Each phase was six sessions in length. The seventh phase tested the effects of switch closure (activation) with a single source of stimulation (a mechanical duck). The eighth and ninth phases contrasted the duck and vibration in a preference test arrangement. In each phase, switch closure activated the device indicated below the data and switch release activated the other device. That is, activation of one device through switch closure deactivated the other device and vice versa. The tenth and eleventh phases contrasted the duck and music in the preference test arrangement.

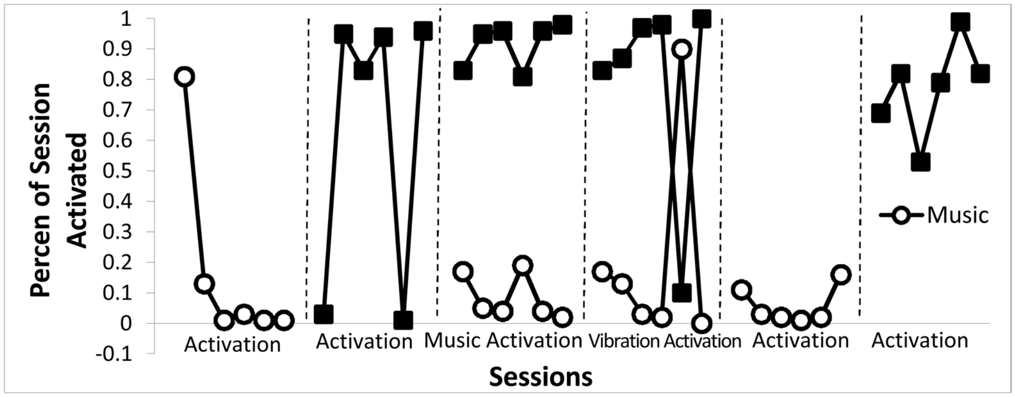

Figure 3.

The results of the first six phases of the experiment for P6. Each phase was six sessions in length. The first two phases tested the effects of switch closure (activation) with a single source of stimulation per phase. The third and fourth phases contrasted music and vibration in a preference test arrangement. In each phase, switch closure activated the device indicated below the data and switch release activated the other device. That is, activation of one device through switch closure deactivated the other device and vice versa. The fifth and sixth phases again tested the effects of switch closure with a single device.

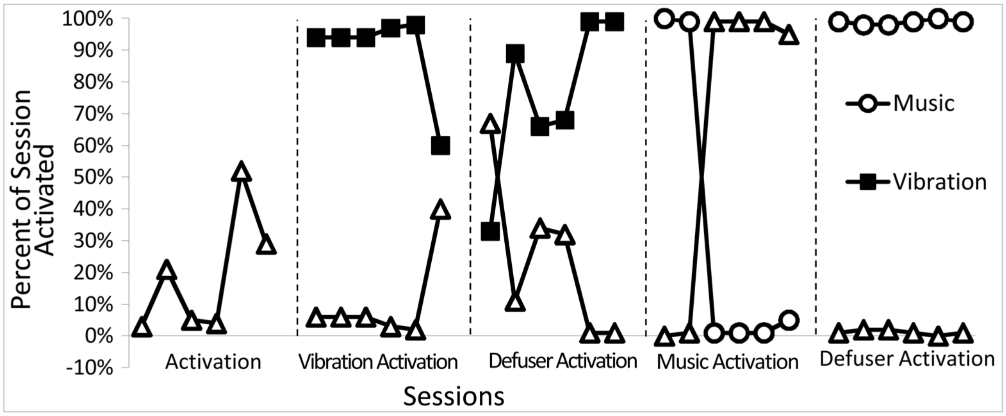

Figure 4.

The results of the last five phases (7–11) of the experiment for P6. Each phase was six sessions in length. The seventh phase tested the effects of switch closure (activation) with a single source of stimulation (an odor defuser). The eight and ninth phases contrasted the defuser and vibration in a preference test arrangement. In each phase, switch closure activated the device indicated below the data and switch release activated the other device. That is, activation of one device through switch closure deactivated the other device and vice versa. The tenth and eleventh phases contrasted the defuser and music in the preference test arrangement.

Table 1

Median percentage of each condition that each device was operating and producing stimulation. The percentage for the more preferred device is shown and labeled in the AB, BC and AC activation vs deactivation table cells.

	1 Device - Activation Mode			2 Devices – Activation vs Deactivation		
Participant #	**Music-A**	**Other-B**	**Other-C**	**A versus B**	**B versus C**	**A versus C**
1	25	33-Vibration	4-Duck	72-Music	74-Duck	68-Music
2	87	96-Duck	96-Vibration	99-Music	51-Duck	60-Music
3	49	13-Vibration	29-Strobe	53-Music	55-Vibration	5-Strobe
4	43	13-Vibration	48-Strobe	55-Music	63-Vibration	76 -Music
5	38	47-Vibration	43-Duck	53-Music	51-Vibration	Not tested
6	3	82-Vibration	13-Defuser	96-Vibration	94-Vibration	99-Music