The Development and Adoption of Controversial Default Technologies

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Default technologies evolve from failure. Within the realm of human behavior, technologies based on the use of aversive contingencies can be conceptualized as default technologies because they come into play when natural contingencies or positive reinforcement fail to produce a desired behavioral outcome. Historical as well as contemporary events suggest that it is a mistake for behavior analysts to advocate for the adoption of aversive technologies. We must, however, continue to play a leading role in the development of such technologies so that they will be used in an appropriate manner. Furthermore, the eventual elimination of aversive technologies will be possible only through continued, careful, and experimental analysis of the contexts of failure in which they are born.

Two years ago Henry Pennypacker, in his presidential address to the Association for Behavior Analysis, used this forum to discuss issues related to the transfer and subsequent adoption of behavioral technology (Pennypacker, 1986). I would like to continue that discussion, taking it in a slightly different direction. Although not explicitly stated, the issues that Pennypacker addressed are most pertinent to technologies of behavioral acquisition and in situations where the driving force for adoption, namely, economic reinforcement, is acceptable at face value. In such situations, the pressing question—which Pennypacker answered quite thoroughly—is: “How do we effect transfer while maintaining technological integrity?” But additional questions are raised in the case of behavioral reduction. In this area, technological improvement, adoption, and subsequent gain by the user, economic or otherwise, may conflict with certain patterns of behavior in our culture, as well as our own prediction about the state of affairs that may result from the widespread use of such tech-

nologies. These questions are: first, “What is our proper role in the transfer and adoption of technologies for behavioral reduction?” and second, “Should we even bother with the development of such technologies?”

The Problem

Heated controversy over the use of behavioral technology has been raging for several years now, arising from reluctance by some members of our culture to reinforce applications of punishment—particularly in the form of primary aversive stimuli—with dependent, noncriminal populations. In point of fact, behavior analysts have expressed similar concerns for many years, although we have been more tolerant of the selective use of punishment (Baer, 1970; Repp & Deitz, 1978). In spite of what some may claim, the extreme points of view in this controversy do not amount to a “pro” versus “con,” but are reflected in the following positions: a) Punishment amounts to cruel and inhumane treatment and should never be used (Guess, Helmstetter, Turnbull, & Knowlton, 1987); versus b) Applications of punishment have been empirically validated and can be justified in cases where immediate elimination of high-risk behavior is of paramount importance (Axelrod & Apsche, 1983; Matson & DiLorenzo, 1984).

My own involvement in the punishment controversy stems primarily from the fact that several colleagues, most no-

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tably Thomas Linscheid, and I have been associated with research on a technological device that has become one of the major focal points in the debate over the use of aversive contingencies (Landers, 1987; Viadero, 1987; Will & Reynolds, 1987). By the way, and for the record, that debate has been conducted indirectly for the most part. Both Tom Linscheid and I, in response to allegations of one kind or another, have personally contacted the sources of those allegations and have offered to meet with individuals or groups to discuss the issues. In almost every case, our contact has produced no direct response. Instead, selected portions of our communications have been taken out of context, and usually have been incorporated into further allegations that are made not to us, but to others by unnamed individuals, and are subsequently leaked to us by colleagues who stumble across the information.

Advocating for the Adoption of Controversial Technologies

My experiences related to our research on aversive contingencies and the controversy that surrounds it have prompted me to think critically about the proper role of behavior analysts in the transfer and adoption of technologies based on aversive stimulation. "Should we advocate for the use of such technologies?" Stated bluntly, my answer is "No," and in support of it I offer three principal reasons.

First, an advocacy position favoring the use of aversive stimuli is not likely to be an effective one, at least in the short run. Remember that, when we step beyond the boundaries of our research, attempts to lobby for adoption of technology are successful to the extent that adoption is reinforced (Pennypacker, 1986). Furthermore, we do not provide those reinforcers. With respect to the current controversy, we find a curious paradox within our culture. If anything, our society can be characterized as one that *actively promotes* the use of aversive contingencies on the behavior of its members. Nuclear arms, capital punishment, and expulsion

from school, as ineffective as they may be, are strongly supported by many members of our culture, and are tolerated by enough of us to allow their continuation.

Why is it that the same people who denounce the use of relatively harmless aversive contingencies to eliminate life-threatening behavior of a retarded individual not only support aversive cultural practices, but also routinely subject their own children and coworkers to stimuli that are functionally similar to the ones they abhor? Of course, the question is not easily answered in the empirical sense, but a behavior analyst who knows something about the history of treatment for retarded and autistic individuals can formulate a pretty good guess. For most of this century, these populations have lived grossly neglected lives in substandard environments, and they have been exposed to continual doses of both noncontingent and contingent aversive stimulation (Blatt, 1970; Rivera, 1972). Therefore, it should come as no surprise, now that the service pendulum has swung the other way, that parents and advocates literally cringe when they hear the words "punishment," "aversive," and so on, in reference to treatment for their children and clients. These words, and the practices they represent, have acquired aversive properties; they also may be discriminative for highly emotional and combative behavior of the type that was successful in eliminating neglectful conditions that existed previously.

The fact that improved technologies of aversive stimulation produce user gain, if only in the form of increased effectiveness at one's assigned job (i.e., client improvement), makes the situation even worse, because neglectful and abusive conditions also produce user gain, namely, staff convenience, preservation of order, and reduction of financial expenditures. As a further extension, those associated with objectionable practices may themselves acquire aversive properties.

If this interpretation only approximates an adequate account of such inconsistent behavior with respect to aversive

stimuli, it is immediately understandable why therapists who adopt a hard-sell approach to punishment are not popular among developmental disabilities advocacy groups. Thus, professionals who include aversive therapy as one of several options for treatment are much more likely to be effective if they allow someone else to serve as its advocate. And my experience has been that, under the appropriate conditions, those with whom we currently debate will take up that banner. But here I am getting ahead of myself.

My second reason for not recommending an advocacy position in favor of punishment is that it will not advance our applied field. Some say that research on punishment with humans has scientific value because it extends similar research conducted with nonhuman subjects. Whom are we kidding? It should be obvious by now that human behavior responds to aversive contingencies, and that we probably do not need to know much more about them in order to develop a generally effective technology of behavior change. After all, as behavior analysts, do we not clearly stand out among other sciences by frequently claiming that wars can be prevented, prisoners can be rehabilitated, children can be taught, and yes, graduate students can even obtain their Ph.D.'s, all without resort to aversive contingencies? A few of these claims have been documented, but there is much to be learned, demonstrated, and applied. How will we acquire that learning? We will use every encounter with an aversive contingency, or situations where the use of an aversive contingency is contemplated, as opportunities to learn more about the behavior in question, its controlling events, and ways in which reinforcement and extinction schedules may be used to bring about behavioral displacement. Through these experiences, we may not only solve the immediate problem, but also acquire the skills necessary to deal with the really tough cases in our culture—the drug dealers, the murderers, and so forth.

On the other hand, if we succumb too early to the temptation of using aversive

contingencies, we will learn only how to punish the pushers and murderers more effectively. *And the most unfortunate fact is that our punishing behavior with these populations will be strongly reinforced within the culture.* Can you imagine a worse fate for the field of applied behavior analysis? We must continually be vigilant lest we fall into this irreversible behavioral trap.

If I have been unconvincing thus far, let me try a third time, using a slightly different rationale, one that selectively and ultimately accommodates the use of aversive contingencies. The point is that we do not need to advocate for the use of such contingencies in order to secure effective treatment for our clients.

In "Why Are We Not Acting to Save the World?" Skinner (1982) provided a nice analysis of contingency shortcomings. Natural selection produces an organism that is adaptable to situations as they existed in the past, but fails to prepare the organism for optimal functioning in a drastically changed future environment. Physical contingencies of operant conditioning overcome this failure to some extent by arranging for behavior change during an individual's lifetime. But these contingencies, in their purest forms, do not always change behavior immediately; furthermore, they require exposure to the natural consequences of behavior, some of which are dangerous if not fatal. Hence, we have developed, formalized, and institutionalized social or contrived contingencies and their attendant rules.

One can extend this analysis to the therapeutic situation by considering any planned intervention to change behavior as a default technology, that is, one whose development is based on previous failure—failure to prevent the occurrence of a genetic or acquired organic disorder, which somehow inhibits responding; failure to provide occasions for behavioral acquisition through direct interaction with a stimulating physical or social environment; failure to correct the early mismanagement of social contingencies, which promotes the acquisition and maintenance of bizarre forms of behav-

ior. In this context, a technology of aversive stimulation is the third-order and ultimate default technology, preceded by natural contingencies and those involving the careful application of contrived positive reinforcement. But, in the case of aversive contingencies, the previous failure of positive reinforcement usually (and I emphasize usually) is not an inherent one. Instead, aversive contingencies are called into play when *we* have failed to find or to establish a positive reinforcer, when *we* have failed to deliver that reinforcer in an effective manner, when *we* have failed to find a suitable response to displace the target, when *we* have failed to examine the stimulus conditions that contribute to the problem, and when *we* have failed to generate the resources necessary to maintain a successful program.

At this point, I am compelled to digress a bit by commenting on what others have said about the preventability of such failures: "If we would only conduct a functional analysis of the behavior problem, we always will find a nonaversive solution." Actually, nonaversive solutions do not require a prior functional analysis; they *always* are available; the question is whether or not they *always* work. Based on Ted Carr's (1977) elegant theoretical treatise on the origins of self-injurious behavior, my colleagues and I were among the first to describe an experimental approach to the analysis of behavioral function with that serious disorder (Iwata, Dorsey, Slifer, Bauman, & Richman, 1982). We suggested that such an approach, or one similar to it, *might* make the process of treatment selection less arbitrary and *might* reduce the necessity of relying on aversive contingencies. We had, however, absolutely no basis for suggesting that knowledge about a behavior's maintaining contingency would eliminate the need for punishment, and that suggestion has garnered little by way of additional support through subsequent research conducted by us and others. Yet, somehow, our methodology has been imbued with power well beyond its supporting data base and has been given a life of its own. For example, in a

recent protest written to a highly respected colleague of mine [with whom I was collaborating], the director of a national advocacy group noted that: "... through comprehensive functional behavior analysis, ... positive programs of behavior management can be designed and effectively implemented ... we are prepared to offer you the names of experts that can offer assistance. ..." Although my colleague made no subsequent request for help, I must admit that both of us are curious about the names on that list.

Another claim, this one presented at a recent press conference, by one from among our own ranks, has been that most if not all self-injury is communication and that communication training is the treatment of choice. Those of us who have conducted extensive research on self-injurious behavior are not impressed by this assertion. Our collective data indicate that a significant proportion of self-injurious behavior is not communicative (e.g., Baumeister, Frye, & Schroeder, 1984; Cataldo & Harris, 1982; Iwata, Pace, Willis, Gamache, & Hyman, 1986), and behavioral research conducted over the past 20 years indicates that every box of magic bullets comes well supplied with duds.

A final input: "Our review of the literature and experience with over 500 cases convinces us that strategies are presently available to deal with *any* problem without resorting to aversive events" (Donnellan & LaVigna, 1987). This statement comes close to presenting the ideal case, namely, that strategies are available. Yet I have heard both authors admit that their strategies do not always work. One, upon further questioning, stated that, when all else fails, this person uses aversive contingencies. Therein lies the truth of the matter. In the ideal world, treatment failures do not occur. But in the actual world failures do occur, in spite of our best efforts, leaving us with these options: continued occurrence of the behavior problem toward some devastating endpoint, restraint, sedating drugs, or aversive contingencies. I predict that if we apply our skills so as to maximize the

effectiveness of positive reinforcement programs, we will succeed often. After following such a course, my further prediction is that if we reach the point of having to decide among these ultimate default options, the client advocate, the parent, or, if necessary, the court will select for us the option of aversive contingencies. Why? Because under such circumstances it is the only remaining ethical action.

*Controversial Technology
Development: An Example*

By now you may be wondering about the consistency of this message, if not the messenger. I am suggesting that we *not* advocate for the use of punishment, when across the hall you can find The Self-Injurious Behavior Inhibiting System (SIBIS), an instrument for delivering an aversive stimulus, whose existence is partially a product of my behavior. My association with the SIBIS project has been in the area of technology development; here is where I think that we can and must make a contribution, even though our efforts might be strongly opposed by others. To clarify this point, I will describe the SIBIS project in greater detail, because only a handful of people know the full story.

The forerunner of SIBIS was conceived following futile attempts by Leslie and Moosa Grant to obtain effective treatment for their autistic daughter's severe self-injurious face and head hitting, which had produced lacerations to the bone and almost severed an ear. In medical parlance, the Grants went "shopping," requesting assistance from one professional after another, only to meet with eventual failure. After years of exposure to ineffective treatment, the Grants became well versed in behavior modification and learned that contingent electric shock was an effective means for eliminating otherwise untreatable self-injury. The Grants built a shock device, equipped with an accelerometer to activate the stimulus. The device was quite cumbersome, but it served its purpose by rapidly elimi-

nating their daughter's self-injurious behavior. Justifiably, the Grants wondered why they had subjected their daughter to repeated failure using other approaches, and why devices such as the one they had built were not more readily available.

Thus began their search for someone to build a better device for their daughter and for others similarly affected. Eventually they approached the Johns Hopkins Applied Physics Laboratory (APL). Designed as a research institution specializing in the transfer of space technology, APL inventors have produced devices such as the cardiac pacemaker and the implantable infusion pump. APL engineers were moved by the Grants' plight and agreed to build a prototype. In fact, they considered the problem only a minor technological challenge, which apparently it was, but they did not nor could they consider the behavioral side of the technology.

Realizing in 1982 that the development of SIBIS posed a number of questions about apparatus-behavior interactions, APL asked Tom Linscheid, then on the medical faculty at Georgetown University, to serve as an unpaid consultant to advise on matters of behavioral technology. Tom had previously conducted clinical research on the use of contingent electrical stimulation as a treatment for life-threatening infant rumination. He subsequently invited my colleagues, Gary Pace and Michael Cataldo, and me to join him; and I eventually provided unpaid technical consultation from the Kennedy-Hopkins program. From the beginning we considered a number of questions about the ramifications of our involvement.

Question: Did we really believe that we or others would use aversive stimulation frequently enough to justify our participation in a long-term and controversial endeavor? The answer: Yes. Our treatment program on self-injury had an overall staff-to-client ratio of about 5:1, with B.A.'s, M.A.'s, and Ph.D.'s outnumbering clients by better than 2:1. Despite all this expertise, our reinforcement-based approaches to treatment were not always successful. For us, there was a clear need

to have available a treatment option based on aversive stimulation.

Question: Was electrical stimulation the way to go? The answer: Yes. Careful reading of the basic research literature suggests that many currently used forms of aversive stimulation are not desirable because they are delayed, extremely difficult to quantify, awkward to administer, potentially confounded with social interaction, and/or they expose the client to stimuli that linger after the punished behavior has ceased.

Two additional considerations prompted us to commit our time to the SIBIS project. First, APL seemed uniquely suited to accomplish the engineering task at hand. Second, we hoped our involvement with APL might pave the way for technological extensions based on SIBIS although, at the time, we had no idea what they might be.

The development phase for SIBIS lasted about 4 years, during which the behavioral capabilities of the system were gradually expanded in significant ways. The original prototype called for automatic detection of forceful blows to the head via accelerometer; contingent, immediate, and automatic activation of a stimulus unit worn on the arm or leg via radio signal sent from the accelerometer; and a counter to record the number of shocks delivered. First, a response counter was added. Next a brief tone was added to precede the delivery of the shock. Then the system was given remote capability so that it could be used with other forms of self-injurious behavior. The final and most important modification was to use the technology that improved the delivery of aversive stimulation to improve the delivery of positive reinforcement. Throughout these stages of development, every suggestion that Tom and I made was considered seriously by the patient staff of about a half-dozen research, engineering, and medical manufacturing organizations, including APL and Human Technologies, Inc., and just about every suggestion was incorporated into the design of SIBIS.

The current capabilities of SIBIS are as follows.

1. Automated Response Measurement. A piezoelectric velocity sensor, contained in a headband, measures impact force. Above-threshold responses activate a signal transmitter, also worn in the headband.

2. Therapist-assisted DRO. Another device contains a programmable timer, capable of setting fixed- or variable-time intervals from 1–999 s, allowing the therapist to select a DRO interval. If, by the end of the interval, no above-threshold responses have occurred, a brief tone cues the therapist to deliver reinforcement.

3. Automated DRO. As an alternative to reinforcement mediated by a therapist, reinforcement may be delivered directly through a peripheral device (e.g., television, radio, food dispenser, or other electrical apparatus) upon successful completion of the DRO interval.

4. Timeout from Positive Reinforcement. The automated DRO function may be reversed, so that reinforcement (e.g., access to television) is terminated upon occurrence of an above-threshold response.

5. Automated Punishment. Above-threshold responding will activate a stimulus unit worn on the arm or leg, which delivers a brief tone followed by a relatively mild electrical stimulus (85 v, 3 ma, for .08 s).

6. Therapist-assisted Punishment. For forms of self-injury not involving forceful contact (e.g., scratching, biting, etc.) the therapist must activate the reinforcement or punishment functions.

Because the original design of SIBIS was limited to the aversive stimulation component, the first clinical study evaluated that aspect of the system. Tom Linscheid treated three of the five original subjects and additional subjects have been treated by Don Williams and Bob Ricketts, both of the Texas Department of Mental Health and Mental Retardation. Figure 1 shows the condition means, expressed as responses per minute, for all five subjects who participated in the study. Each subject was exposed to a series of conditions in a reversal design. Three of the conditions were control

Figure 1. Mean number of self-injurious responses per minute across subjects and experimental conditions.

phases: Baseline (all subjects), Baseline with the client wearing a protective helmet (two subjects), and Baseline with SIBIS worn but not activated (all subjects). The two treatment conditions were SIBIS, with automated response detection and stimulus delivery (all subjects), and SIBIS Remote, in which response detection and stimulus delivery were controlled by the therapist (two subjects). SIBIS treatment conditions were associated with almost complete elimination of self-injury.

What would have happened to SIBIS if behavior analysts were not involved with its development? I pose this question because the roles that Tom Linscheid, I, and others have played in the project have been criticized by individuals inside as well as outside of the Association for Behavior Analysis and because there has been an effort by some groups to bring all work on SIBIS to an immediate halt (Halt urged, 1988). I cannot say what would have happened, but here are some distinct possibilities. SIBIS probably would have been developed as nothing more than an automated electrical stimulator. By "nothing more," I do not mean to imply that such a device would have no value, because SIBIS represents a significant technological improvement over currently used methods of delivering aversive stimulation. That is not saying much, however, within the larger context of behavioral treatment. SIBIS certainly would not have contained any of the positive reinforcement capabilities that it now has, capabilities that can be used independent of the aversive component. It also is likely that the evaluation of SIBIS would have consisted of simple pre-post tests or, worse yet, uncontrolled evaluations in which the data consisted of subjective verbal report.

Conclusion

To summarize, I would like to distinguish between the development of technologies for aversive stimulation, and subsequent efforts for their adoption. *We*

should not advocate for adoption of aversive technologies because such activity, at least by us, is not effective, not in the best interest of our field, and not necessary. Instead, we should leave adoption to advocates, parents, and courts, whom I trust will eventually find a place for aversive stimulation in the pecking order of default technologies.

At the same time, *we must allow the development* of such technologies to occur. Recall that the other options, at least in the case of self-injury, are restraint, sedation, or further devastation.

Additionally, *we must support controversial technology development* to the extent that it needs the support of a science-based organization in order to produce valid and useful results. If ABA is to remain a science-based organization, it must continue to support apparently irrelevant, unpopular, and even highly controversial empirical work, as long as that work is conducted in an ethical manner. Otherwise, the controlling variables for our research behavior will shift completely to the realm of public opinion. Ironically, if that happens, we will still do research on punishment; only the clientele—if you can consider drug dealers, rapists, and murderers as such—will change.

Finally, some of us who experience failure using positive reinforcement *must actually do the work on aversive technologies*. We must do the work because, whether or not we like it, default technologies will evolve whenever there is failure and, in the case of aversive stimulation, we are in a unique position to make several contributions. First, we can modify the technology so that it is effective and safe. Second, we can improve it by incorporating contingencies of positive reinforcement. Third, we can regulate it so that application will proceed in a judicious and ethical manner. Last, and surely most important, by studying the conditions under which default technologies arise, as well as the technologies themselves, we might eventually do away with both. Can you think of a better fate for the field of applied behavior analysis?

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