Contingency Diagrams as Teaching Tools

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Contingency diagrams are particularly effective teaching tools, because they provide a means for students to view the complexities of contingency networks present in natural and laboratory settings while displaying the elementary processes that constitute those networks. This paper sketches recent developments in this visualization technology and illustrates approaches for using contingency diagrams in teaching.

Key words: contingency diagrams, graphic visualization, behavior analysis

Not only did Skinner say it first, he also drew it first. Skinner sometimes used diagrams to clarify the terms involved in behavioral contingencies (see, e.g., Skinner, 1957, pp. 38–39, 84–85). Words are often poor media to portray complex concurrent phenomena, because by their very nature they generally must be presented one . . . word . . . at . . . a . . . time. Images, on the other hand, given their expanded bandwidth, allow many bits of data to be viewed concurrently as a transactional whole (Bertin, 1983; Mundie, 1989; Tufte, 1983, 1990). For example, in our current research examining the multiple antecedents and consequences associated with acts of violence, we are using relatively complex contingency diagrams as a primary analytic medium. Several of us work together to refine them, integrating what is known from the literature, and later our studies, into meaningful subtypes.

As the classes of actions become increasingly complex, graphic tools are likely to become increasingly important to behavior analysts, not only for analysis but also for education. One particular advantage of their use in teaching is that diagrams allow students to see the ways in which behavior analysis can capture complexity, as well as how this complexity is constructed from relative-

ly simple elements (as is true in other natural sciences).

The graphic visualization of behavioral contingencies in this article has largely been sparked by the work of Malott (Malott, 1992a, 1992b; Malott, Whaley, & Malott, 1993). One of his diagrams is reprinted in Figure 1 (Malott, 1993b). Note that the situation shown here is already relatively complex, incorporating not only the basic three-term contingency as well as an establishing operation, but also representing, in Malott's terms, a rule-governed analogue of reinforcement (tomatoes do not appear immediately after planting). The graphic also shows the motivating condition resulting from the establishing operation; this is in some ways a less central concept, but is an extremely useful notation for teaching purposes. Malott and his colleagues have also developed and disseminated a variety of teaching tools that incorporate contingency diagrams (e.g., Malott, 1993b).

I recently described several modifications of the basic notation that I have found to be valuable (Mattaini, 1993). Many of the arrows in the following contingency diagrams are double headed, reflecting the transaction nature of behaviorally significant events in complex, particularly social, situations. The arrows used dashed lines rather than solid ones to indicate that operant relations are probabilistic rather than mechanistic (i.e., contingencies affect rate but do not automatically elicit responses). To capture the full situation,

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Figure 1. A simple contingency diagram (from Malott, 1992a).

it is often important to show multiple concurrent consequences associated with a single behavior, as well as multiple antecedents.

Finally, the diagrams that follow incorporate the *class-and-object* symbol (a dark rectangle surrounded by a gray one) from object-oriented systems analysis in computer science to represent a class of functionally equivalent instances. This notation increases precision, because behavior analysts are seldom interested in a single instance of a behavior, a consequence, or even an establishing operation, but rather in multiple instances (e.g., stimulus classes, response classes). Where a single event or condition is of primary interest, however, the gray rectangle is omitted. Further variations not shown here may be required to adequately capture the interlocking contingencies of interest for cultural design, particularly where sequences are important (Mattaini, in press).

Examples

Contingency diagrams are particularly useful for the analysis and presentation of the complex concurrent contingencies often found in natural

settings. For example, Figure 2 portrays some important antecedents and consequences related to the rate of acts of affection provided by a previously neglecting father, including those provided as part of an intervention plan. Without the intervention, note that current supports for affection are relatively weak. In the meantime, extinction of the desired paternal repertoire will probably result from terminating the intervention before natural contingencies supporting the desired behavior stabilize. This figure uses everyday terms (some borrowed from Malott) to make the image accessible to students with limited technical verbal repertoires. Others below incorporate more precise technical language.

The contingency diagram shown in Figure 3 moves toward applying this technology to cultural practices and cultural design. (For the moment, ignore the gray box on the right.) The graphic depicts consequences associated with school attendance for a class of individuals—certain young mothers on welfare. For simplicity of presentation, antecedents have been omitted here. It is not hard to understand why attendance for such a student may be poor—there

Figure 2. A more complex contingency diagram.

are few reinforcing consequences and significant aversive consequences associated with this behavior. Note also what is missing: Often these families do not notice or reinforce attendance, much less achievement. Now imagine that a transparency is laid over this image (an effective teaching technique) adding the \$60 per month bonus shown in the gray box, as is done in Ohio. The data suggest that this helps in about 20% of the cases, which is impressive to some but fails to be a “slam-bang” effect. (Of particular concern is the fact that a corresponding penalty is levied on the other 80%, resulting in increased poverty overall; Opulente & Mattaini, 1993.) Why is the effect not greater? The answers are clear in the diagram. Not only is the bonus relatively small

and poorly scheduled, but the other contingencies involved have not changed. This is a good teaching example, showing why functional analysis is often required, and that there are limits to simply reinforcing reports of attendance. (Given the delay involved, the procedure probably should be viewed as, at best, analogous to reinforcement. The delay, for a group of subjects with relatively weak tracking and pliance repertoires established, may account in part for why the bonus is not effective in the vast majority of cases.) The use of transparencies simplifies overlaying and separating multiple contingencies, but note that color (or gray) can also be used, as here, to depict such layering (see also Tufte, 1990, chap. 3).

Other questions emerge from the di-

Figure 3. Consequences associated with school attendance for some young mothers.

agram. For example, why do family members sometimes not reinforce attendance, and why do teachers often subtly (or not so subtly) punish it? Here is where the diagrams become particularly important, precluding any attempts to blame the victim. The teachers are not

inherently evil or intellectually inadequate. Rather, the natural contingencies are “just devastating” (Malott, 1993a, p. 52). The limited support for a primary emphasis on positive reinforcement by teachers can be traced in contingency diagrams (see Mattaini, 1993,

Figure 4. Contingencies supporting aversive, punitive acts by a teacher toward academically low-functioning youth with attendance (and perhaps behavior) problems.

p. 245), as can those for their current punishing repertoire, as in Figure 4.

Once the contingencies are clarified, plans to change them can be developed. Note that this may require changes in the behavior of other classes of actors in the behavioral ecosystem, for each of whom it may be necessary to develop a detailed contingency diagram, until a stable, interlocking system is achieved. Developing a series of such diagrams may itself be a useful student assignment. With some planning, it is possible to layer several diagrams over each other on transparencies so the behavioral situation can be examined as a whole and can also be deconstructed.

Construction of complex contingency diagrams need not be difficult or

time consuming. I usually work from a prepared blank template that allows me to simply add words (and edit as necessary) either on a transparency in class or at the computer for more finished work. To prepare these templates or finished work, all that is required is a program that allows drawing rectangles and arrows and the placement of text. High-end drawing programs (like Canvas or Framemaker) provide extensive options for details like the shape of arrowheads, but the straightforward drawing tools in current standard Windows or Macintosh word processors (e.g., Microsoft Word or WordPerfect) are entirely adequate. These programs can produce rounded rectangles in various shades of gray and format text as

desired, easily producing professional-looking output. The diagrams can then be printed on paper or transparencies with a basic laser or ink-jet printer.

Teaching Strategies

I have used contingency diagrams in a variety of ways in my classes and in workshops, and suspect that an instructor could develop many other creative approaches. In written handouts, I commonly diagram sample case situations; I also ask students to diagram their own examples on templates (a strategy borrowed from Malott, 1993b). Another approach is the use of transparencies with an overhead projector in class. The instructor can begin with a blank diagram, insert the behavior of interest, and then use a Socratic process to guide students in exploring the complexities of the contingency networks within which the behavior is embedded. As an example, I may put "act of physical abuse" on the diagram, and ask students to identify consequences and antecedents that could shape and maintain such behavior. It can be valuable to divide the class into small groups for 5 to 10 min and ask each group to draw their own diagram; these are then presented and evaluated in the larger group, and a composite is developed. This process often leads to active discussion and energetic participation, both in the small groups and during the preparation of the composite.

Another useful strategy is to use the diagrams to present research findings, particularly to coherently integrate the results of multiple studies. For example, in looking at youth violence, one can become overwhelmed with the sheer volume of available information. Contingency diagrams offer a way to put it all together—to see that some risk factors are actually establishing operations, and reminding us of the essential connections among antecedents, acts of violence, and their consequences. It is possible to shape verbal repertoires in this process, for example,

by calling some condition or event a "contextual factor" and then discriminating those that are more precisely establishing operations from those that are structural antecedents. Experience suggests that students need not be primarily behavior analytic in orientation to be engaged by these methods.

Contingency diagrams can clarify for students what otherwise can be very confusing and complicated situations. They can facilitate learning, because students can learn to construct and unpack them piece by piece, and as they do so, come to see that behavior analysis can aid in understanding complex patterns of human behavior, including social exchange and cultural practices.

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