HYPOTHETICAL CONSEQUENCES OF CUMULATIVE BENEFITS FROM A SMALL INTERVENTION EFFECT

Cumulatively Large Benefits of Incrementally Small Intervention Effects: Costing Metacontingencies of Chronic Absenteeism

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ABSTRACT: Metacontingencies are relations among practices within an organizational culture and their molar environmental consequences for the culture. They can be summarized by the ratio of all revenues from operations (or budgets received) to all expenses paid for operations. Rates of attendance/absenteeism have consequences in terms of effects on a culture’s ratio of revenues received (budgets funded) to expense payments that appear as profits (losses) or budget surpluses (deficits) over some time interval. For a host of reasons OBM researchers place a premium on identifying and adopting practices that result in large immediate effects on behavior and performance in the short run. However, some practices created by OBM interventions can have small short-term effects and appreciably larger cumulative effects on revenue.

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to expense and budget to budget expenditure ratios in the longer run. The importance of estimating cumulative benefits and/or costs of OBM interventions when intervention effects are small is demonstrated in this article using data from an operant based intervention that produced an immediate small increase in attendance. [Article copies available for a fee from The Haworth Document Delivery Service: 1-800-342-9678. E-mail address: getinfo@haworthpressinc.com] [Website: http://www.haworthpressinc.com]

THE CONTEXT OF ABSENTEEISM

Values have been generically defined as the “collection of activities and results that some human social institution or agency strives to achieve, that it values” (Brown & Herrnstein, 1975, p. 168). Activities in an organization are no more nor less than all the human operant behavior (Poling & Braatz, in press) that occurs within the organization including behavior occurring across its boundaries during exchanges between the culture and its environments, e.g., interactions with suppliers, customers, political institutions and their regulators (Mawhinney, 1992a). Tangible results of these activities that support institutional aims, goals, or objectives have been called accomplishments (Gilbert, 1978). Accomplishments are the products of an organization’s culture. “An organization’s culture [emphasis added] can be characterized in terms of the dominant practices of its members and a description of the causes of these practices” (Redmon & Mason, in press). The dominant practices of an organization’s members are observed in their individual and/or social operant behavior including practices of an organizational culture’s leader, coalition of leads and union leadership, among organizations with a union subculture. Each organizational culture will have environmental consequences in terms of reactions among other organizational cultures, institutions, and agencies based on its input/output exchanges with these environmental entities (Brethower, 1982). Every culture’s survival ultimately depends on how its environment responds to its outputs, e.g., goods and/or services. Contingent relations among aggregations of internal practice (an organization’s culture) and molar (cumulative) environmental consequences of them are called metacontingencies (Glenn, 1988, 1991; Mawhinney, 1992a; Redmon & Mason, in press).

Organizational and agency values are achieved when they construct contingent relationships among consequences that reinforce activities of their members upon which accomplishment of organizational objectives depend (Balcazar, Hopkins & Suarez, 1986; Balcazar, F. E., Shupert, M. K., Daniels, A. C., Mawhinney, T. C., & Hopkins, B. L., 1989). Whether they can tact them or not, organizational authorities arrange and maintain three-term rein-
Forcement contingencies responsible for the rates of various behaviors that occur among working people within their organizational cultures (Mawhinney, 1992a; Parsons, 1992). The means by which they do this can be called institutional or managerial practices (Handlin, 1992). These practices are aimed at instigating and maintaining or extinguishing work related behavior or task related practices among other organizational members. For example, when Henry Ford introduced assembly line methods to workers in his factory, many task related practices at the factory floor level were changed, not the least of which was the behavior required of working people within the factory. The new methods reduced skill requirements among workers and replaced them with the requirement that workers engage in a high rate of repetitive task activity. Turnover among workers subsequently rose to 380 percent. Faced with the requirement of recruiting more than 1000 new workers and a high turnover rate, Ford introduced the now famous organizational practice of paying a $5 per day wage (Halberstam, 1986). Ford was then swamped with applicants seeking work on his assembly line. Without a sufficient labor force the Ford Motor Company would have had insufficient outputs to survive; it would have perished. And, its death could be attributed to effects of assembly line methods on an organizational metacontingency that included recruiting and keeping a sufficient number of well “motivated” workers.

Absenteism, however, remains a chronic occurrence among all U.S. industries in spite of good wage levels. Absence rates in 1993 were highest, 6.2%, among service occupations and within the mining industry, 6.1%, even though miners earned the highest average wage of all workers, $14.66 per hour (Bureau of Labor Statistics, 1994). The Lincoln Electric Company, on the other hand, is reputed to have the highest paid factory workers in the world and the lowest absence rate. What distinguishes the Lincoln Electric Company culture from others is not that Lincoln’s tasks have been “enlarged” or “enriched” or that the factory is brighter and cleaner “looking” than others. The difference is the degree to which a contingency exists among quality and quantity of work output of every individual worker and that individual’s earnings. Individual earnings throughout the year and a share of a bonus pool from sales revenues divided among all workers at the end of the year depend relatively directly on the individual’s daily level of work output and quality (Handlin, 1992). The metacontingencies of the Lincoln Electric Company culture have, for many years, resulted in rising worker efficiency (more sales revenue per unit of labor cost paid) and rising incomes among workers, managers, and other members of the culture.

Rates of absenteeism among a culture’s members provide prima fascia evidence regarding effectiveness of its institutional practices as they relate to aggregate strength of contingencies that reinforce members for attending work each day. The idea that operant contingencies of reinforcement could tip the balance in favor of attendance over absence arose among OBM and
Industrial/Organizational psychology researchers and practitioners in the late 1960s and early 1970s (Petlock, 1978). Even if one cannot change all the contingencies in a work setting in ways that transform the setting from one dominated by aversive contingencies to more positively reinforcing contingencies, one can target or pinpoint (Daniels, 1989) some specific behaviors. Attendance is one such behavior. Managers can arrange for positive consequences to depend on arriving to work on time. An important example of how this sort of intervention can be achieved appears in published results of a study by Pedalino and Gamboa (1974). The remainder of this paper will focus on this example. Data in that article and additional data kindly provided by Victor Gamboa (personal communications) form a data set from which relatively detailed analyses of absence rates and costs will be developed.

**A SKETCH OF THE ORIGINAL STUDY**

Pedalino and Gamboa (1974) credited Skinner (see Conversation with Skinner, 1973) with suggesting how operant conditioning terms and concepts could be used to develop contingencies that would make attendance at work more “positively reinforcing.” Within an ABA reversal design they introduced a poker card game based incentive lottery among 215 assembly line operators earning an average $4.86 per hour or $39 per day (in the early 1970s), paid weekly. Within groups ranging from 14 to 26 in number, each worker arriving on time each day drew a card from a poker deck. Those workers holding a five-card hand at the end of each week participated in a lottery in which the worker with the best poker hand at the end of the week within each group was awarded a $20 cash prize. (The expected value of winning among members of each group was about $1.4 (Mawhinney, 1975.) The game was played every week for six weeks and every other week for the next ten weeks of the 16 week long intervention. Data for 32 weeks before and 22 weeks after the intervention provided pre and post intervention baselines. Only data from the intervention phase were presented graphically in the published article (Pedalino & Gamboa, 1974) even though the two A phases of the ABA data were available as were data for the AB phases of four comparison groups of the same organizational culture. More pertinent to the subject of this article, no benefit/cost data were provided in the article they published.

**ESTABLISHING OPERATIONS**

Establishing operations are experiences of an individual that change the individual in ways that make otherwise neutral antecedents of three-term
contingencies function as discriminative stimuli and otherwise neutral consequences function as reinforcers (Michael, 1993). My work on this reanalysis of the Pedalino and Gamboa data set arose from an establishing operation. It occurred when a reputable applied behavior analyst, during my presentation concerning effects of data analytic methods on analysts' responses to data, asked a question something like the following: "Why be concerned with small intervention effects like those produced by Pedalino and Gamboa (1972)? What you are talking about is a small absence rate, maybe three or four people absent, while fully 96 to 97 people out of 100 are attending each day." The data that prompted that question appear in Figure 1.

The size of the intervention effect appears small in this graphical representation as it would if it occurred within an SPC X-Bar Chart. The size of the effect would appear even smaller if it was plotted within one of Og Lindsley's standard celeration charts (Lindsley, 1997). The data as they would appear in an SPC chart with sigma limits derived from the baseline of N = 32 data points appear in Figure 2. The same data in logs similar to celeration charts appear in Figure 3.

The data appear different to the eye when plotted as cumulative person days absent from work compared to cumulative absences that would occur using mean baseline absence rate. To create the cumulative absence data

FIGURE 1. Graph of time series data from t = 70 observations of absence rates the author obtained from personal correspondence with Victor Gamboa.
FIGURE 2. An SPC X- Bar control chart for ABA data with center line and control limits computed from baseline $A_1$ or $l = 1-32$ of Figure 1.

Baseline X-BAR Mean:3.01 Proc. sigma:615043 ($n=1$)

FIGURE 3. The same data as in Figures 1 and 2 graphed as simlogs.
Hypothetical Consequences of Cumulative Benefits

plotted in Figure 4, one simply multiplies the number of workers by days of the week (5 x 215) by weekly absence rates and then adds each week's accumulation upon the preceding week's accumulation. To construct the projection of cumulative absence rates based on the mean baseline rate the same procedure is followed but the weekly actual absence rates are replaced with the constant value of the baseline mean absence rate. When the baseline cumulative absences and its projection beyond the baseline are plotted in the same graph with the actual cumulative absence rates, the plots reveal a growing difference between the two cumulative absence plots throughout the intervention phase of the study. This difference in cumulative absences is readily apparent even to the unaided eye. And this occurs in spite of the fact the effect seems quantitatively small when stated as a 0.55% or one half of one percent reduction in absence rate (from 3.01% to 2.46%) during the intervention. In the case of Figure 4, the eye does not deceive. By the end of the intervention, the cumulative person days of absence projected from baseline absence rate is 1542 compared to the actual cumulative person days of absence of 1458 or a difference of 84 person days. Although the number 84 appears larger than the 0.55% difference depicted in Figure 1, this may or may not represent a practically significant effect in terms of the organization's metacontingency. As noted above, significance at this level of analysis is revealed by the ratio of benefits to costs of the intervention or a change in organizational practice and its economic consequences.

BENEFITS AND COSTS ANALYSIS

I estimated that the hourly cost of benefits would be $1.25 per hour or $10 per person day absent. This is a conservative estimate since by union/management contract, workers in this setting were entitled to six paid sick day absences per year. This daily cost per employee accrues whether the employee attends work or not. Thus, an invalid sick day taken would cost about $39 in wages and $10 in benefits. In addition, every absence would involve additional costs in terms of supervisory activities associated with documentation, rescheduling or reassigning workstations, and, perhaps, even providing for a back-up supply of workers. (Although not presented here, my computations of estimated costs of the Pedalino and Gamboa (1974) intervention suggested it was marginally cost effective and would have been highly cost effective if it were not for the floor effect described below.)

The absence rate for comparison group 2 was approximately 7.97% and the group size was N = 270 compared to the smaller experimental group, N = 215. Estimated cumulative costs of absences for comparison group 2, cumulative costs of absences for the comparison group less 0.55%, and the cumulative costs of absences for the experimental group appear in Figure 5. Sav-
ings from a 0.55% absence rate level reduction assuming a 48-week year would be $4,880 if the rate reduction that occurred in the experimental group was replicated in comparison group 2 for a full year. The two groups, experimental and comparison group 2, were involved in different work and differed in size. However, there was an apparently large PIP (Gilbert, 1978) for the comparison group compared to the experimental group. Since the rate of absence due to actual sickness among manufacturing workers is estimated to be 3.1% (BLS, 1994) and this equals the baseline level of absence rate of the experimental group, the experimental group was probably exhibiting an absence rate near its “natural floor” when the intervention occurred. The absence rate among members of the comparison group, on the other hand, was probably far from its “natural floor.”

The importance of such a small but reliable intervention effect is apparent if one assumes that the reason it was so small in the case of the experimental group was that results of the intervention for that group were limited by a floor effect. Suppose, for example, that instead of the cumulative costs for comparison group 2 depicted in Figure 5, that comparison group 2’s absence rate was identical to the experimental group for a 48-week year? The cumulative saving from this sort of hypothetical yoking would be observed in the difference between the cumulative costs for the comparison group in Figure 5
FIGURE 5. Cumulative weekly estimated costs of absence for control group 2 compared to the same data with a 0.55% reduction in weekly rates for comparison group 2 and cumulative weekly estimated costs of absence for experimental group. Computations based on data provided in personal correspondence with Victor Gamboa.

and cumulative costs for that group assuming its absence rate matched that of the experimental group's during intervention. The hypothetical result of this comparison is depicted in Figure 6. The hypothetical cost savings would amount to $45,710 for the year.

Evidently, other factors or systems (Mawhinney, 1992b) variables were responsible for the initially low absence rate in the experimental group. So an important question suggested by data such as those above is whether a small-size intervention effect will result in a much larger effect in the presence of a much larger PIP? If this assumption were found to be valid, then replicating the intervention in comparison group 2 would produce the hypothetical results depicted in Figure 6. Whether the hypothetical results will match reality, on the other hand, remains an empirical question. If that question is addressed and the answer is no, then attention would be directed to identifying the system variables in the experimental group responsible for its low absence rates during baseline and their introduction to the comparison group (Mawhinney, 1992b; Redmon & Mason, in press). If the answer is yes, this would imply that small effects resulting from interventions in systems near their floors (or ceilings) with respect to a dependent variable would underestimate the likely effects in other settings. That is, magnitude of intervention effects...
FIGURE 6. Cumulative estimated weekly cost savings for comparison group 2 if its weekly absence rates matched those of the experimental group. Computations based on data provided in personal correspondence with Victor Gamboa.

should be larger for interventions that occur in settings where dependent variable baselines are far from their floors (or ceilings).

CONCLUSION

Many researchers and practitioners are trained to evaluate efficacy of an intervention primarily in terms of its immediate effect-size (assuming the effect is reliable). This practice makes it unlikely they will consider the possibility that a larger effect-size would occur if the intervention producing it occurred under more propitious circumstances (e.g., in the presence of a large PIP). If this is what happens, in fact, they are apt to underestimate efficacy of interventions resulting in small immediate effects. There is reliable evidence that expert analysts tend to place great emphasis on effect-size when evaluating efficacy of intervention data (Furlong & Wampold, 1982). And, unless they attempt to make projections from current data into the future, conclusions about intervention effects will be restricted to those already observed.

An intervention's effect size observed under one set of conditions may or may not reflect the potential size of its effect under other conditions. Other things equal, conditions characterized by larger PIPs should be associated
with larger effect sizes for interventions that produce smaller effect sizes in the presence of smaller PIPs. Attention should be paid empirically evaluating intervention effect size for the same intervention in the context of larger and smaller PIPs. In addition, cumulative results as captured by benefit to cost ratios should be estimated.

The Pedalino and Gamboa (1974) study and its results will not be fully appreciated if evaluated in terms of immediate effect-size alone and without considering that the small effect was achieved within the context of an exceedingly small PIP. But, effects of a PIP will not be evident unless data from one or more comparison groups is examined as in the current analysis. However, it should go without saying that collecting more data concerning the context of an intervention, e.g., rates of accidents and documented illness that covary positively or negatively with OBM interventions, is a better practice than focusing on a single criterion (Streff, Kalsher & Geller, 1993; Poling, Smith & Braatz, 1993). More data sets and more diverse data sets provide an even more comprehensive picture of an organization's metacontingencies.

For example, if an intervention were associated with rising accident rates and falling absence rates and rising net costs, absence rate reduction efforts would clearly be a matter of optimization. That is, one can envision situations in which absence rate reduction efforts are counter-indicated. Ethical considerations suggest that any balance struck between absence rates and worker safety and health probably should favor worker health and safety. On the positive side of this vantage point is the possibility that a combination of interventions can be introduced so as to balance potentially conflicting effects of interventions. As food for thought, consider the intervention by Austin, Kessler, Riccobono, and Bailey (1996) in which higher performance rates of dangerous work were reinforced while safely performing at these rates was the target of a companion intervention. While work like this can confound relations among variables, from an ethical vantage point it deserves high marks. Results of the study suggest that performance, safety, and profitable operations are not necessarily incompatible objectives.

REFERENCES


Balcazar, F. E., Shupert, M. K., Daniels, A. C., Mawhinney, T. C., & Hopkins, B. L. (1989). An objective review and analysis of ten years of publication in the *Journal of Organizational Behavior Management, 10*(1), 7-38.


